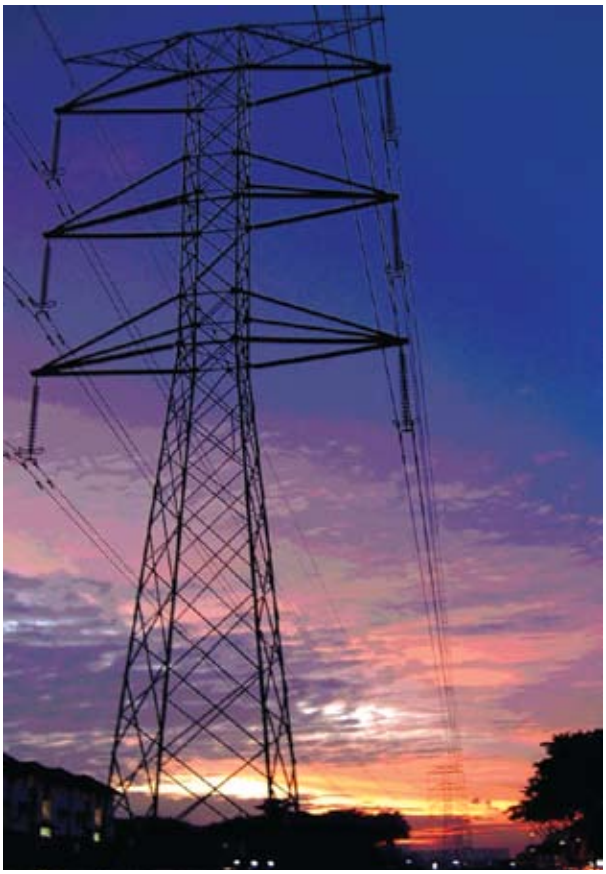
Chapter 8: Net-Metering and Government Programs

As some of the world's most important environmental stewards, farmers have a long tradition of protecting the land, air, and water they use to grow food for their communities. Investing in renewable energy is one way that farmers can continue this tradition. Renewable energy refers to non-fossil fuel sources of energy. Fossil fuels (coal, oil, and gas) are not renewable because they take millions of years to form and there are limited amounts of each stored in the earth. Wind and solar are both considered renewable energy sources because humans will never exhaust the supply.

Investing in renewable energy and reducing reliance on fossil fuels is also a way for farmers to join in the fight against global climate change. In fact, coupled with cost-effective energy efficiency measures and homegrown biomass, renewable energy has the potential to make many farms carbon neutral.

Finally, renewable energy is not just a benefit to farmers. It also impacts national and international energy security. With over 60 percent of U.S. energy coming from foreign sources, we are increasingly dependent on the political whims of OPEC[269] and other oil and gas producing countries.[270] The time is ripe to shift the energy balance. With the right policies and investments, farmers can begin to replace Middle Eastern oil with renewable domestic energy sources.



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Net Metering: A Way Forward for Renewable Energy

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.[271] This simple bi-directional meter opens up a whole new opportunity for customers with their own renewable energy systems. Net metering allows users to sell extra energy back to the utility for use by other customers connected to the grid. By selling electricity back to the grid, farmers who install renewable energy systems are able to do more than simply replace dirty, expensive fossil fuel powered electricity: They are able to turn excess energy into dollars.

The mechanics of the bi-directional meter are straightforward. The meter spins forward when your farm is consuming electricity from the grid, and spins backwards when your farm has excess electricity from its renewable energy system.[272] At the end of each billing period, the utility charges you only the "net" amount of energy you consumed. If you put more electricity into the grid than you took out, you pay nothing and the

balance is carried over to the next billing period. Net metering systems vary, but in some states the utility will pay you directly for excess energy delivered back into the grid.

The importance of net metering is its ability to act as a storage system for renewable energy. One of the challenges with electricity is the inability to store it in large quantities. While the wind can turn a turbine at any hour of the day or night, we typically consume most of our energy only at a few peak times during the day. Without net metering, all of the excess electricity produced by renewable energy systems at off-peak times is wasted. With net metering, that excess electricity is sold to the grid, and offsets the cost of the electricity consumed at peak times. The "net" result can be significant savings.

Unfortunately, net metering is not available in every state, and even where it is available, it may come with significant limitations. For more information on the particulars of net metering in your state, see *Freeing the Grid: How Effective State Net Metering Laws Can Revolutionize U.S. Energy Policy*.[273]

Government Initiatives: Policies that Support Renewable Energy

Net metering goes a long way toward easing the financial hurdle of the upfront costs associated with installation of a renewable energy system. There are also other ways that farmers can save money. The federal government and many states administer programs that support investment in renewable energy systems. The benefits of renewable energy production reach well beyond the farm. Regional and national benefits include improving public health due to reduced pollution, easing the burden on electric power grids, combating global climate change, and reducing dependence on foreign oil. With all of these benefits, state and federal governments are eager to promote renewable energy production on farms, as well as in homes and businesses. It is a wise investment of government money and a big help for you and your farm.

The government programs offered cover a wide range of tax incentives, grants, loans, and rebates. One federal program that is available to any U.S. farmer is the Renewable Energy Systems and Energy Efficiency Improvements Program (also known as the Section 9006 Program).[274] This program offers farmers grants for 25 percent of eligible renewable energy system investment costs up to $500,000. The program also offers guaranteed 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.[275]

Another important, and often overlooked, source of revenue for farm-powered renewable energy systems is renewable portfolio standards (RPS) and tradable renewable energy credits (RECs). Twenty-three states and the District of Columbia have implemented renewable portfolio standards,[276] which require that a certain percentage of the electricity sold by utilities in the state come from renewable energy sources. In some of these states, the requirement can be satisfied by the purchase of RECs from qualifying renewable energy producers, even if the utility doesn't directly purchase the corresponding electricity. This means that farmers who install renewable energy systems may produce valuable RECs that can be sold to electric utilities. Each state's system is different, with some requiring that the renewable energy be produced in-state and others allowing purchases from out-of-state sources. Regardless of the specifics, every RPS program creates strong incentives for renewable energy production that can be turned into real money for farmers.

The REC market is not limited to electric utilities. Many businesses and non-profit organizations purchase RECs from renewable energy producers to offset emissions of the greenhouse gases that cause climate change.[277] Right now these offsets are done on a voluntary basis, but with growing concern over global climate change, a national cap-and-trade system for greenhouse gases could be implemented in the near future.[278] When such legislation is passed, utilities will be looking for the cheapest way to offset greenhouse gas emissions and the market for RECs will explode. Farm-powered renewable energy will become even more valuable. With RECs adding a second source of revenue in addition to the energy itself, renewable power systems can be a great investment for forward thinking farms.

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269. OPEC is the Organization of the Petroleum Exporting Countries, consisting of Algeria, Angola, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates (UAE), and Venezuela. See, http://www.opec.org/aboutus/.
270. Strengthening National Energy Security, available at: http://www.fueleconomy.gov/feg/oildep.shtml.
271. Network for New Energy Choices, *Freeing the Grid: How Effective State Net Metering Laws Can Revolutionize U.S. Energy Policy*, Report No. 01-06, Nov. 2006, available at: http://www.newenergychoices.org/uploads/netMetering.pdf.
272. Id.
273. Id.
274. The Secretary of Agriculture's final rule implementing the Section 9006 program is published at 7 C.F.R. § 4280 (2006).
275. See, Renewable Energy and Energy Efficiency, available at: http://www.rurdev.usda.gov/rbs/farmbill/index.html.
276. For more information, see, http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm.
277. For example, companies like TerraPass Inc. sell emission offsets for vehicles and air travel, investing the proceeds into renewable energy projects through the purchase of RECs. See, http://www.terrapass.com.
278. For a list of recent Senate bills proposing carbon cap-and-trade systems, see, http://www.pewclimate.org/docUploads/Cap-and-trade%20bills%20110th_Feb5.pdf.

Chapter 9: Renewable Energy: Wind

Anyone who has been outside in a strong storm is familiar with the power of the wind. For centuries, farmers harnessed this power using windmills to grind grain and pump water.[279] In a similar fashion, wind turbines turn wind into valuable electricity that powers pumps, motors, and equipment, as well as provides light and heat for barns and homes. When combined with net metering, a wind turbine may reduce expensive electricity bills, or, if the turbine is installed on a site for optimum efficiency, it may actually turn a profit. Along with other means for achieving energy efficiency such as, biomass, solar and methane, etc., wind may help small and medium farms become completely energy independent.

Turbine Type	Power Rating (kW)	Blade Diameter (ft)	Tower Height (ft)
SWWP AIR-X	0.4	3.8′	60′
Bergey XL 1	1.0	8′	80′
SWWP Storm	1.8	12′	40′
SWWP Wh. 500	3	15′	80′
Bergey Excel	7.5	22′	80′
FL 30	30	43′	120′
NW100/19	100	63′	115′
V27 (225 kW)	225	89′	110′
V47 (e.g. Hull, Mass)	660	154′	164′
GE 1.5SL	1,500	253′	197′

Common Types of Turbines with Corresponding Power Ratings and Sizes

In addition to proper siting of the turbine itself, one of the main factors for efficient wind power generation is the turbine's blade size. Typically, the larger the turbine's blade diameter, the more electricity it may generate (qualified by the nature of the winds in your area—the largest turbines are best suited for high wind areas, for example). The maximum amount of power produced by a turbine is called the turbine's "rating."[280] The higher the power rating, measured in kW, the more electricity a wind turbine potentially produces. 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 the whole farm a larger commercial size turbine may be necessary.

"Micro-wind" turbines attach to roof tops or 30 to 60 foot towers.[281] However, turbines placed on roofs are often less efficient and may produce excess noise and vibration. Commercial size turbines may require you to work with a developer to install the 200 to 250 foot towers.[282] These can produce up to several megawatts of electricity, but keep in mind that with increasing size and power outputs, comes increasing start-up costs. Also, all turbines require repair over their lifespans, so it is important to factor in maintenance and service costs into your calculations. We strongly recommend that you consult a wind expert, financial advisor, and your lawyer before installing larger scale wind turbines.

For those with a technical, "do-it-yourself" inclination, Scoraig Wind Electric, run by Hugh Piggot, offers publications, courses, and general information about building your own wind turbines.[283] Home built and installed turbines are generally less expensive than purchasing manufactured turbines. Keep in mind, however, you will still need to hire a certified electrician to connect your system to a power inverter and then to the grid according to local utility interconnection standards.[284]

Regulatory Issues

There are several regulatory issues that need to be addressed if you are considering installing a wind turbine. First, many towns require a siting permit, and some have height or location restrictions.[285] Be sure to check with your local town council or

Burmeister Farm, Central Kansas: An AWEA Success Story

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 our reliance on fossil fuels and their negative environmental impacts—greenhouse gases, acid rain and 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.

For more examples of successful wind installations on farms see the American Wind Energy Association's website at http://www.awea.org/smallwind/success_stories.htm.

select board to understand the requirements. It is also a good policy to talk to your neighbors about your plan before you start construction. If the wind turbine will be visible from their property, it is common courtesy to raise the issue and find out if a wind farm will cause any debate. Plus, it is a great opportunity to spread the word on the big benefits of renewable energy on farms.

For larger commercial scale wind turbines or for those individuals interested in net-metering, you may need special certification.[286] Each state has different standards and requirements for connecting to the electricity grid.

Who Should Install Wind Systems On Your Farm?

The first element required for the installation of a wind turbine is a windy location. To get a rough idea of whether or not your property contains the proper wind speeds you can refer to the National Renewable Energy Lab's wind atlas maps.[287] If the maps suggest good wind resources, you may want to collect data on your farm for up to a full year. Many wind development firms will do this for you, or you can participate in an anemometer (a wind speed measurement device) loan program. Check with your local colleges, public utility companies, and Natural Resources Conservation Service (NRCS) or USDA office for programs near you.

If you have good wind on your farm, the next step is to find a suitable location for your turbine(s). A general rule of thumb for siting turbines is that the distance from an obstruction, like a house or barn, must be 20 times the height of that obstruction. For instance, if you have a barn that is 50 feet high, the wind turbine should be 1,000 feet from the barn for the best results. In addition, the turbine should be twice as tall as the structure. So for the same 50 feet tall barn, the wind turbine should be 100 feet tall.

Small scale wind turbines may need to be secured with guy wires, which will require additional space. If you are considering multiple turbines, they should be placed five rotor diameters apart to ensure enough room for maintenance, wildlife movement, and to reduce interference between the turbines.[288] All turbines should be located in areas with minimal obstructions, such as buildings, trees, and hills. The most desirable site for turbines is on a hilltop or ridgeline with a flat surface. Also, potentially environmentally sensitive locations should be taken into account. For instance, bird and bat migratory pathways are not good locations for turbines.[289]

Finally, it is important to keep in mind the cost of installing a wind turbine. According to the American Wind Energy Association, the installation of a micro-turbine producing about 10 kW of electricity costs approximately $32,000. Generally costs can range from $20,000 to $60,000.[290] The cost is related to many things such as size, tower type, permitting fees, service agreements, installation, equipment, and maintenance. Fortunately, the federal government and many states offer strong incentives for wind turbine installation, including grants, low or no interest loans, and tax benefits.

Commercial Wind Farms: Leasing Your Property

Some farmers with appropriate wind resources and space may want to consider leasing their land to a large wind developer. This can be a very lucrative arrangement in which a developer leases a plot of your land (typically with right of way access), and builds, owns, and operates one or more large commercial size turbines on your property.[291] Your farm may not receive any electricity from this turbine, but instead you will receive considerable lease income. Plus, by leasing your land, you support wind energy on a larger scale benefiting many other citizens. Most lease agreements pay the farmer a fixed percentage of

the revenues produced by the wind turbine, but other arrangements may be possible.[292] If a developer approaches you, make sure to speak with your lawyer before signing any contracts.

279. Robert Righter, Wind Energy In America: A History 15 (1996).
280. J.F. Manwell et al, Wind Energy Explained 60 John Wiley & Sons Ltd (2004).
281. United States Department of Energy Office of Energy Efficiency and Renewable Energy, *How Wind Turbines Work*, available at: http://www1.eere.energy.gov/windandhydro/wind_how.html.
282. Id.
283. See Scoraig Wind Electric, available at http://www.scoraigwind.com/ (noting this website is a good source of information for building your own turbine).
284. Vermont Agency of Agricultural, Farm Energy Handbook: A Guide to Renewable Energy Opportunities at 29 (2007), available at: http://www.vermontagriculture.com/news/energyHandbookJan23.html.
285. Vermont Agency of Agricultural, Farm Energy Handbook: A Guide to Renewable Energy Opportunities at 30 (2007), available at: http://www.vermontagriculture.com/news/energyHandbookJan23.html.
286. Kathy Belyue, *Frequently Asked Questions About Net-Metering*, American Wind Energy Association, available at: http://www.awea.org/pubs/factsheets/netmetfin_fs.PDF (last visited Nov. 5, 2007).
287. National Renewable Energy Lab *Wind Energy Resource Atlas of the United States*, available at: http://rredc.nrel.gov/wind/pubs/atlas/maps.html; United States Department of Energy State wind resource maps available at: http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_maps.asp.
288. United States Department of Energy, *Wind Powering America: Clean Energy for the 21st Century*, 3 (2001), available at: http://www.eere.energy.gov/windandhydro/windpoweringamerica/.
289. American Wind Energy Association, *Save the Loon with Wind Energy: Comparative Impacts of Wind and Other Energy Sources on Wildlife*, 2 (2001), available at: http://www.awea.org/pubs/factsheets/wildlife.pdf .
290. Vermont Agency of Agricultural, Farm Energy Handbook: A Guide to Renewable Energy Opportunities, 29 (2007), available at: http://www.vermontagriculture.com/news/energyHandbookJan23.html.
291. United States Department of Energy, *Wind Energy for Rural Economic Development*, 4 (2004), available at: http://www.nrel.gov/docs/fy04osti/33590.pdf.
292. Id.

Chapter 10: Renewable Energy: Solar

Every farmer knows the power and importance of the sun. It keeps our planet warm and it is a key ingredient in growing crops and feed. Most people are familiar with using the sun's energy for heat—greenhouses trap the sun's energy to warm plants in cold times, allowing production year-round even in northern climates. But the sun's energy does more than provide heat. Solar panels, also known as PV cells, convert sunlight into valuable electricity. The most efficient solar cells convert about fifteen percent of direct sunlight into energy.[293] Historically, this electricity heated and provided light to buildings and produced hot water. Presently, farms utilize solar panels to power electric fences, water pumps, irrigation systems, and much more. The most commonly installed solar panels mount on roof tops or are free standing, angled cells placed on small towers.[294]

There are two main ways to configure a solar energy system: stand-alone or grid connected. Stand-alone systems simply provide electricity when the sun is shining. The more sun, the more electricity the system will produce. Since the sun doesn't shine 24 hours a day, however, stand-alone systems are more flexible when coupled with batteries to store energy. Systems with batteries are often more expensive but they supply a reliable source of power, regardless of weather conditions or time of day.[295] Grid-connected systems, on the other hand, use net-metering to sell power to the public utilities when the solar cells produce more than the farm needs. Farmers may use those sales to offset the electricity the farm consumes at night or on very cloudy days.

Unlike the installation of other forms of renewable energy generators, such as wind turbines, there are very few local regulations that must be considered. However, there may be local ordinances regarding rooftop structures or reflected light, so make sure to contact your local zoning commission before installing solar panels. You may also want to check on the property tax implications of adding a solar energy system. Many states exempt renewable energy systems from property taxes, but that is not something you want to leave up to chance.

Who Should Install Photovoltaic Cells On Your Farm?

Those farms located in regions with moderate to full sunlight are best suited for solar panel installation. To get a rough idea of whether or not your property contains the proper amount of sunlight, please refer to the National Renewable Energy Lab's solar days maps.[296] Another way to verify the amount of sunlight your farm receives, is to examine local weather reports or the Farmer's Almanac to determine the average annual days of sun in your area. You will also want to find the best location on your farm for the solar panels. South facing sunny exposures are usually the best bet.

Given the expensive up front costs associated with solar power systems, an incremental installation is often easiest to manage. Fortunately, there are several state and federal incentive programs to alleviate the costs and encourage solar resource development. These include the USDA Farm Bill Grant Program, Residential Federal tax credit and Business Federal tax credit.[297]

How Do I Go About Installing Solar?

The first step is to decide what you will power with your solar system. If you can afford it, a larger system could power your whole farm or provide the electricity for your home and some farm buildings. Smaller systems could be used to power many remote applications such as electric fences and automated water/feed distribution systems. The more power kW of electricity required, the more PV cells you will need.[298] The particular plan used for your system will dictate the number, placement, and configuration of your PV cells.

With an increased size and number of cells there is obviously an increased cost. Small remote systems, which provide a simple light source, may cost around $500. However, a grid-connected system that powers an entire building or home

Farm & Granary, Wawarsing, NY: An NYSERDA Success Story

With a sizable grant from New York's Energy $mart program, Michael Siegel and Barbara Caldwell were able to install 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, but the state incentive chipped in $16,800 (almost 50 percent!), making it a good long-term investment for the farm and the environment. The New York State Energy Research and Development Authority (NYSERDA) also helped arrange for qualified technicians to install the system.

may cost close to $25,000.[299] The higher cost is offset by major energy savings, reducing electricity consumption by fifty percent or more.

Once you have settled on a system size, you should contact your local zoning commission to find out if any permits are required or if any ordinances restrict installation. Next, you should contact your local public utility to further explore net metering options. Public utilities may also be able to suggest retailers and licensed electricians to install the solar panels. Finally, you should consult with the installation company to determine what size, placement, and type of solar panels are right for your farm. [300]

Example of Estimated Costs from a Vermont Solar Dealer*

Solar Electric Systems	1800 Watt Output	2520 Watt Output	3600 Watt Output
Number of Panels	10	14	20
Area – Sq. Feet	161	225	322
Avg. Monthly Output (kWh)	174	244	348
Price Before Rebates	$17,979	$22,925	$32,411
VT State Rebate ($1.75/ watt)	($3,150)	($4,410)	($6,300)
Cost After State Rebate	$14,829	$18,515	$26,111
Federal Tax Credit	($2,000)	($2,000)	($2,000)
Total Cost after Federal Tax Credit	$12, 829	$16,515	$24,111

* Prices will vary depending on region and dealer.

Combining Wind and Solar

You may have heard nay-sayers complain that renewable energy like wind and solar are unreliable because they only work when the sun shines or the wind blows. It is true that wind and solar power systems do not produce the same amount of electricity at all times. However, it is important to note that wind and solar systems can be used in combination. In fact, they are complementary systems.[301] Usually, wind speeds are the highest in the winter months, producing more electricity.[302] This means that in the calmer summer months, you may have less of your farm's energy needs met by wind turbines. Photovoltaic cells, on the other hand, produce more energy in the sunniest months, which are usually in the summer. Adding solar to wind can compensate for the lack of energy produced by the wind turbines on lazy summer days. Farms with both systems often have consistent amounts of energy to use and can put more energy back into the grid.

293. *US Department of Energy, Solar Technologies Program Photovoltaics*, available at: http://www1.eere.energy.gov/solar/photovoltaics.html.
294. Id.
295. Vermont Agency of Agricultural, Farm Energy Handbook: A Guide to Renewable Energy Opportunities, 37 (2007), available at: http://www.vermontagriculture.com/news/energyHandbookJan23.html.
296. National Renewable Energy Lab, Dynamic Maps, GIS Data, and Analysis Tools, available at: http://www.nrel.gov/gis/solar.html.
297. United States Department of Energy, Office of Energy Efficiency and Renewable Energy, *Solar America Initiative: Photovoltaic R&D Taxonomy and Future Funding Opportunities*, 5 (2007).
298. Vermont Agency of Agricultural, Farm Energy Handbook: A Guide to Renewable Energy Opportunities, 38 (2007), available at: http://www.vermontagriculture.com/news/energyHandbookJan23.html.
299. Id.
300. Id.
301. Virinder Singh, Center for Renewable Energy and Sustainable Thechnology Renewable Energy Policy Project, Blending Wind and Solar into Diesel Generator Market 8 (2001).
302. J.F. Manwell et al, Wind Energy Explained 27 John Wiley & Sons Ltd (2004).