Handbook on
Renewable Energy Financing
for Rural Colorado

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Unless otherwise stated, photographs were obtained from the National Renewable Energy Laboratory's on-line Photographic Information ExChange (PIX). Information about the photographers and specific locations can be found at http://www.nrel.gov/data/pix/.

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Abbreviations and Acronyms

B20	20% biodiesel fuel blend
B100	100% biodiesel fuel
BEF	Bonneville Environmental Foundation
CH4	Methane
CHP	Combined heat and power
CORE	Community Office for Resource Efficiency
CoSEIA	Colorado Solar Energy Industries Association
CSP	Concentrating Solar Power
CSP	Conservation Security Program
DMEA	Delta-Montrose Electrical Association
DOE	US Department of Energy
E10	10% ethanol fuel blend
EPACT	Energy Policy Act
HFRA	Healthy Forests Restoration Act
HVAC	Heating, Ventilation and Air Conditioning
IRS	Internal Revenue Service
kW	Kilowatt
kWh	Kilowatt hours
kWh/yr	Kilowatt hours per year
lbs	Pounds
LCOE	Levelized Cost of Energy
LLC	Limited Liability Corporation
MACRS	Modified Accelerated Recovery System
MW	Megawatts
MWh	Megawatt hours
NEPA	National Environmental Policy Act
NREL	National Renewable Energy Laboratory
OEMC	Office of Energy Management and Conservation
PPA	Power Purchase Agreement
psi	Pounds Per Square Inch
PTC	Production Tax Credit
PV	Photovoltaic
RCDG	Rural Cooperative Development Grant
REA	Rural Electric Association
REC	Renewable Energy Certificate
RES	Renewable Energy Standard
RPS	Renewable Portfolio Standard
RUS	Rural Utility Service
SBA	Small Business Administration
Tri-State	Tri-State Generation & Transmission
USDA	US Department of Agriculture
VAPG	Value Added Producer Grants
WAPA	Western Area Power Administration

Introduction

The Handbook on Renewable Energy Financing for Rural Colorado was sponsored by the US Department of Energy (DOE) and the Colorado Governor's Office of Energy Management and Conservation (OEMC). The Handbook is part of a larger project called the Industries of the Future program, which among other objectives, seeks to expand the use of renewable energy in the agricultural sector. Many farms and ranches in Colorado are located in areas rich in renewable energy resources. Depending on the circumstances, it may be possible to save money by deploying renewable energy technologies or even make a profit by selling energy to utilities.

Due to the broad nature of the topics covered, the Handbook is by no means a comprehensive resource. Rather, it provides information that can serve as starting point in deciding whether to pursue the development of a renewable energy project. The first chapter provides brief descriptions of commercially available technologies that have potential applications in rural environments. Chapter 2 discusses basic financing issues and explains how incentives and partnership structures can be used to make a project economically viable. Chapter 3 describes some of the policies and programs that provide financial incentives for project development. Chapter 4 contains case studies on projects that have been implemented on farms and ranches in Colorado and elsewhere. Chapter 5 includes a list of resources to consult for additional information on the topics covered in the Handbook. The last chapter provides a list of companies, primarily project developers and equipment providers, that are active in Colorado.[1]

[1] OEMC provides this information as a public service and does not endorse individuals, companies, services or products. To learn more about OEMC support for renewable energy and energy efficiency, please visit http://www.state.co.us/oemc.

1. Renewable Energy Technologies for Rural Colorado

In contrast to fossil fuels that were formed more than 300 million years ago, renewable energy comes from sources that are constantly replenished. For example, the power of resources such as the sun and the wind do not diminish over time. Renewable resources makes it possible to reduce our dependence on foreign oil, increase the security of our energy supply, mitigate environmental impacts, and provide economic development opportunities in rural areas.

There are many commercially proven renewable energy technologies which can help rural Coloradans reduce the amount of money spent on energy consumption and create additional revenues through the sale of power to the electricity grid. These technologies can be used on a small-scale to support operations on the farm or they can be large enough to provide power for an entire community. This section provides an overview of specific technologies appropriate for rural Colorado.

Biomass

Biomass is produced from organic wastes, which can be found in both rural and urban settings. Trees, crops, crop residues, and manure are biomass resources commonly found on farms and ranches. The type of biomass resource will dictate which technology is used to process the organic matter into energy or fuel. For additional information on biomass, please refer to http://www.coloradobiomass.org.

Anaerobic Digestion (Biogas)

Using a digester, manure can be converted into a gas to produce heat, steam or electricity. The byproducts of anaerobic digestion are digested solids (useful as a soil amendment) and methane (the primary component of biogas). The most common types of anaerobic digesters are lagoons or tanks, depending on the volume and the amount of solids in the manure. Every farmer's situation is different, but the size of the system is based on the number and type of animals, the amount of dilution water to be added and the desired retention time. On an annual basis, an average of 2,000 kilowatt hours (kWh) can be generated per cow, 100-300 kWh/year per pig and 4.6 kWh/year per chicken.[2]

Biogas obtained from anaerobic digestion can be used to replace natural gas, although equipment will need to be modified to accommodate the burn characteristics of biogas. Biogas is most typically used in an internal combustion engine/genset to produce electricity. Advanced technologies that can use biogas include microturbines, fuel cells and Stirling engines. Biogas can also be used to produce heat, hot water or steam.

In addition to generating power, anaerobic digestion has the added benefit of reducing disposal costs and pollution associated with animal waste. Capturing and using the methane helps to mitigate global warming, since methane is a potent greenhouse gas.

[2] http://www.easternct.edu/depts/sustainenergy/publication/reports/BIOMASS%20FINAL%20REPORT-Phase%201%20.pdf

According to USEPA, the payback period for digesters is about 3-7 years when the biogas is used on the farm.[3] A wealth of information can be found at USEPA's AgSTAR website, including screening for project opportunities, securing energy contracts, selecting consultants, obtaining financing, etc. See http://www.epa.gov/agstar/resources/handbook.html for more details or call the AgSTAR hotline at (800) 952-4782.

According to USEPA, there are five criteria for preliminary screening of project opportunities for installing an anaerobic digester at a dairy or swine feedlot:

- The livestock facility must confine at least 300 cows or 200 swine to be economically viable.
- Manure must be fed into the digester year-round to maintain methane-producing bacteria.
- The manure management strategy must be compatible with the digester technology.
- There should be a use for the energy recovered (either on-site or sold to the grid).
- There must be someone available to perform daily maintenance on the digester.

Liquid Fuels: Ethanol, Biodiesel and Bio-oil

The agricultural sector may be able to profit from the biofuels industry by providing inputs (crops, residues, vegetable oils and tallow) to processing facilities. Biomass can be converted into liquid fuels for transportation: biodiesel and ethanol. Biodiesel can be made from oil seed crops, including soybean, canola and mustard. Animal fats from the rendering process can also be used to make biodiesel. Ethanol can be produced from corn, barley or wheat through a fermentation and distillation process, similar to the method used in making beer. Ethanol can also be made from cellulosic biomass such as wheat straw, corn stover, and wood waste, although this technology is not commercial yet. Newly emerging technologies gasify solid biomass and then use catalysts to make alcohol fuels.

The biomass energy content of crops is as follows:[4]

- 1 bushel of soybeans (60 lbs) yields 11 lbs of soybean oil, which makes 1.5 gallons of biodiesel.
- 1 bushel of corn (56 lbs) yields about 2.5 gallons of ethanol
- 1 ton of corn stover yields 80-90 gallons of ethanol
- 1 ton of switchgrass yields 75-100 gallons of ethanol

Biodiesel can be used neat (100% biodiesel or B100) or blended with petroleum diesel. The most common blend is B20, which is 20% biodiesel and 80% petroleum diesel. It can be used in diesel engines or in boilers designed to use heating oils. Ethanol can be

[3] http://www.epa.gov/agstar

[4] Western Area Power Administration "Reliable Energy Solutions" brochure (3/05)

blended with gasoline to create E85, a mixture of 85% ethanol and 15% gasoline. E10, which has only 10% ethanol, is much more common. A blend must consist of at least 85% ethanol to be considered an alternative fuel.

Pyrolysis can be used to create bio-oil, which is a substitute for natural gas and heavy oil in heat and power applications. Bio-oil can be used in boilers, gas turbines and slow to medium speed diesel engines.

Photo courtesy of the National Renewable Energy Laboratory

Solid Biomass

Biomass can create both heat and power. The heat can be used directly for buildings and industrial processes, and it can be used to produce steam to generate electricity. Biomass can be converted to energy through several technologies, the most common of which is combustion. Stoker boilers and circulating fluidized beds are the most common combustion technologies, due to their relatively low costs. Wood waste is a common combustion material. Biomass can also be combined with other fuels, such as coal, in co-fired power plants.

Gasification and pyrolysis are emerging technologies for energy conversion. Biomass can be gasified with air to create “producer gas” or it can be gasified with oxygen to produce synthesis gas. Synthesis gas can be processed into ethanol, methanol, ammonia and diesel fuel or it can be used in electrical generation.

Wind

Colorado Green Wind Site. Photo courtesy of Craig Cox from the Interwest Energy Alliance.

Wind turbines are manufactured in a variety of sizes, and wind power projects can consist of a single turbine or a large group of wind turbines. Blades can be configured in horizontal or vertical positions, although the horizontal-axis wind turbines dominate the utility scale market. Turbines for farm use typically range in size from 400 watts to 40 kilowatts. The latest utility scale turbines generally have a capacity of at least 1.5 MW, and the industry trend has been to increase the size of each unit.

Farmers can lease their land to wind developers, use the turbines for the farm or become wind power generators and sell the electricity themselves. Utilities, investors and community entities (such as schools) also own wind turbines. Since turbines require only limited space to operate, it is possible to plant crops and allow livestock to graze around the base of the turbine. Large turbines generally require less than half an acre of land, including road access.

Royalties from leasing land typically range between $2,500 and $5,000 per turbine, depending on the size. Alternatively, payments may be $3,000-4,000 per megawatt of capacity or 2-4% of gross revenues.[5]

[5] http://www.windustry.com/opportunities/farmer.htm

Solar

Colorado has abundant solar resources, boasting more than 300 days of sunshine per year. There are also significant incentives which encourage the use of solar in Colorado. Most notably, the new Colorado Renewable Energy Standard (RES) requires that 4% of the participating utilities' renewable energy come from solar electric technologies, at least half of which must be located on-site at customer facilities.

Photovoltaics (PV)

Solar electric systems, also known as photovoltaic systems or PV systems, produce electricity when the sun hits semi-conductor silicon wafers in solar modules. Modules are combined to form arrays, which can be strategically positioned for a variety of applications.

Solar PV modules are long lasting and have low maintenance costs. Due to the high capital costs of installing these systems, solar PV is typically used in remote locations where connection to the grid is difficult or expensive. Some applications include powering pumps, lights and electric fences.

Photo courtesy of the National Renewable Energy Laboratory

Solar Water Pumps

In most locations, solar water pumps can be used year round, although the volumes of water produced will be highest on sunny days. Factors to be considered before installing a solar livestock watering system include:[6]

[6] From http://www.attra.org/attra-pub/PDF/solarlswater.pdf

- Distance from the power grid and the cost of a line extension ($10-30,000 per mile)
- Costs of alternative systems, including installation, operation and maintenance
- The uncertainty of future electricity prices
- Rising costs of propane, gasoline and diesel fuel
- Season of use – summer vs. winter

It is generally worth considering a solar pumping system when the distance from the utility lines is greater than one-half mile. Solar equipment is on the market that can power pumps and motors up to 650 horsepower.[7]

Although solar power systems have relatively high initial costs, operation and maintenance costs are low. Cost advantages are strongest in low-head and low-volume situations. Gas, propane or diesel generators may be cheaper when large volumes are required, depending on fuel costs. Mechanical windmills may have higher installation and maintenance costs than solar, but they may be more cost effective in areas where wind speed is above seven miles per hour.

A tracking structure can be added to the system for $400-800, and it may increase the output by more than 25 percent in the summer. The system can be mounted on a trailer to make it portable. A solar dealer can help determine the proper sizing and design for a solar pumping system. The dealer will want to know:[8]

- How much water is needed
- When the water is needed
- Whether the water source is a stream, pond, spring or well
- Water available in gallons per minute
- Well depth
- Distance the water will be pumped, elevation gain if any
- Water quality issues that may damage the pump
- Volume available in storage tanks and how the tanks are arranged

Solar Heat Collectors

Solar heat collectors can be used to dry crops and heat buildings. “Active” solar systems consist of heat collectors and fans to consistently warm the air. “Passive” solar systems refer to the architectural design of buildings; passive solar design maximizes the capture of natural daylight and minimizes the need for electricity.

[7] http://www.worldwater.com/pages/home.html

[8] From http://www.attra.org/attra-pub/PDF/solarlswater.pdf

Solar Water Heaters

This technology can be used for farming operations (such as pen cleaning), as well as heating water for the house. Solar collectors convert the sun's energy to heat the water, and an insulated storage tank keeps the water hot until it is ready for use.

Concentrating Solar Power

Parabolic troughs, power towers, and parabolic dish concentrators paired with Stirling or other heat engines, are all forms of concentrating solar power (CSP) technologies. Troughs and power towers are suitable for large-scale applications. Dish Stirling can operate on a small, modular scale of 1-25 kW.

Geothermal

Photo courtesy of the National Renewable Energy Laboratory

Geothermal energy is heat that is derived from the earth. Depending on the temperature of the resource, geothermal can be used to generate electricity (high temperature resource) or be used for direct use applications (low temperature resource). Examples of direct use applications include heating for buildings, greenhouses or aquaculture.

There are currently no deep-source, high temperature resources mapped in Colorado; particularly those capable of yielding large electrical generation output. However, OEMC is currently involved in a pre-feasibility study to locate Colorado's high temperature resource sites; which have apparently been well known by some geologists but have never been shown on the current geothermal maps of Colorado. The current Colorado geothermal map, which does not show these yet-to-be-mapped deep sources, is available on the Internet:
http://www.state.co.us/oemc/programs/renewable/geothermal/geothermal_map.pdf

Hydropower

Photo courtesy of the National Renewable Energy Laboratory

Hydropower creates energy when water flows from a higher level to a lower level. Turbines are turned by water pressure, which creates mechanical energy to drive a generator. A large dam or a small channel can be used in a hydroelectric power plant.

Hydropower requires no fuel and does not consume the water that flows through it. Low-impact hydro can be built using environmentally sensitive techniques that take the needs of marine life into account. Although hydropower is a very clean technology, the flow of water and resulting energy may vary with the seasons and snowmelt.

2. Project Feasibility and Financing

Assessing Feasibility

The developer of a potential renewable energy project must consider the following issues to determine whether the venture is worth pursuing:

- Resource assessments
- Technology analysis
- Economic analysis
- Siting studies
- Transmission interconnection studies (for power projects)
- Legal and regulatory considerations

Project developers and consulting firms can provide guidance in conducting the preliminary analysis. Feasibility studies require an investment, but it may be worth spending money in the beginning to avoid costly mistakes later. Funding may be available to pay for feasibility studies through various government agencies listed in this handbook.

Resource Assessment

An important first step is to conduct a resource assessment to determine how much "fuel" is available and how much power it can produce. Is there enough biomass or wind, for example, to justify the investment costs?

Technology Analysis

This step involves matching the appropriate technology to the energy use and the availability of resources. Other considerations include O&M concerns, number of laborers required to operate the equipment, the availability of vendor support, etc.

Economic Analysis

Are the revenues significant enough to justify the costs? Can the energy be sold at a high enough price to pay for the equipment and other expenses? A more detailed discussion is presented below.

Siting

The physical location of equipment can impact the efficiency of renewable energy generation. The location of wind towers is a key example, since wind speeds can be affected by tower height. Anaerobic digesters should be located to complement existing farm operations. There are specific considerations for every technology. Note that local policies and land use rules have an impact on siting, and farmers should contact their county planning department to determine if their land can be zoned for energy generation.

Transmission Interconnection Studies

An assessment needs to be done to determine whether the additional energy generated can be absorbed by the grid and where. Issues such as interconnection policies, costs and load need to be considered.

Legal and Regulatory Considerations

In addition to zoning, developers need to be able to obtain the necessary permits. In some cases, National Environmental Policy Act (NEPA) reviews or environmental impacts statements will be required.

All contracts should be reviewed by legal experts prior to signing. Everything from lease agreements with wind developers to Power Purchase Agreements with electric utilities should be discussed with an attorney. In most cases, lenders will require copies of all documentation prior to issuing a loan.

Illustrative Power Project Costs

Large-scale renewable energy projects can entail a significant investment, although, grants and other incentives can significantly lower costs and increase the likelihood of obtaining project financing. The table below provides a range of values for the capital costs of building a renewable energy facility. The levelized cost of energy (LCOE) takes into account the initial investment costs (capital cost), financing and operations & maintenance over the life of the equipment. Revenues will depend primarily on resource availability (number of kWh that can be generated) and the electricity rates in Power Purchase Agreements.

Illustrative Renewable Energy Costs[9]

	Wind	Solar Thermal	Solar PV	Biomass	Biogas	Geothermal	Hydro
Capital Cost, $/kW	$1,000-1,400	$2,700-4,000	$7,000-9,500	$2,000-3,450	$1,600-2,400	$2,500-3,500	$1,300-6,000
Levelized cost of energy per kWh	$.04-.06	$.11-.41	$.25-.50	$.06-.13	$.027-.058	$.037-$.059	$.024-$.165

Calculating Potential Revenues

Regardless of the type of renewable energy technology used, the revenue stream will be based on the kilowatt hours generated by the system. This number is the basis for calculating avoided costs (from the purchase of electricity) as well as possible sales revenues. In order to maximize sales to the grid, a project developer should consider

[9] McNeil Technologies, "Summary of Activities and Results of Strategic Value Analysis of Renewable Power Technologies," August 2005: 5-8.

implementing energy efficiency measures prior to developing a renewable energy source. This will enable a developer to consume less energy on-site and prevent potential energy revenues from literally going out the window. Information about energy efficiency and energy audits can be found in the chapter entitled "For Additional Information."

The percentage of operating time during which kilowatt hours are being produced by technology is known as the capacity factor. Knowing this value for a given resource will help in calculating potential revenues. The table below shows the average capacity factors for various renewable energy technologies.[10]

Capacity Factors for Renewable Energy Technologies

	Wind	Solar Thermal	Solar PV	Biomass	Biogas	Geothermal	Hydro
Capacity Factor	20-50%	20-90%	15-25%	25-85%	40-60%	40-90%	50-90%

For example, a 1.65 MW wind turbine with a capacity factor of 35% will produce 1.65*.35*8,760[11] = 5,059 MWh per year or 5,059,000 kWh per year.

Demonstrating Cash Flow – PPAs, RECs and Rebates

Power Purchase Agreements (PPAs) create a revenue stream based on the projected energy sales from the project. Lenders will evaluate the duration of the contract, the creditworthiness of the utility or developer and the penalties for breaching the contract. It is prudent to specify the ownership of the green power attributes in PPAs and capture the green power premium up front if possible. "Green power," another term for renewable energy, often sells at a higher price than traditional fossil fuel power due to various policies and incentives.

Markets for green power have been growing in recent years, with trading taking the form of either the renewable generation itself or renewable energy certificates (RECs) that are based on that power. RECs represent the non-electricity attributes -- particularly the environmental benefits -- of renewable energy generation. On the "voluntary market," RECs are sold to people and organizations with an interest in supporting the development of new renewable capacity. On the "compliance market," RECs are used as a means for utilities to comply with Renewable Portfolio Standards.

RECs are a highly flexible tool for financing, since they can be sold on the voluntary market to anyone in the country – not just entities connected to the local grid. It is worth noting, however, that prices for RECs on the voluntary market have been falling steadily since there is currently more supply than demand.

The Colorado RES has the potential to create new opportunities for renewable generation in rural areas. Depending on how the eligibility rules are developed, the renewable power

[10] Ibid, 16.

[11] 8,760 generating hours per year

or the RECs based on renewable power, may be sold to utilities to help them meet these new requirements. The fact that a multiplier of 1.25 is applied to every MWh of renewable electricity generated in Colorado may be an added incentive for utilities to buy green power from local farmers and ranchers. Since the rules were not yet finalized when this handbook was written, it is highly advisable to determine how RECs will be qualified for RES compliance prior to undertaking a project.

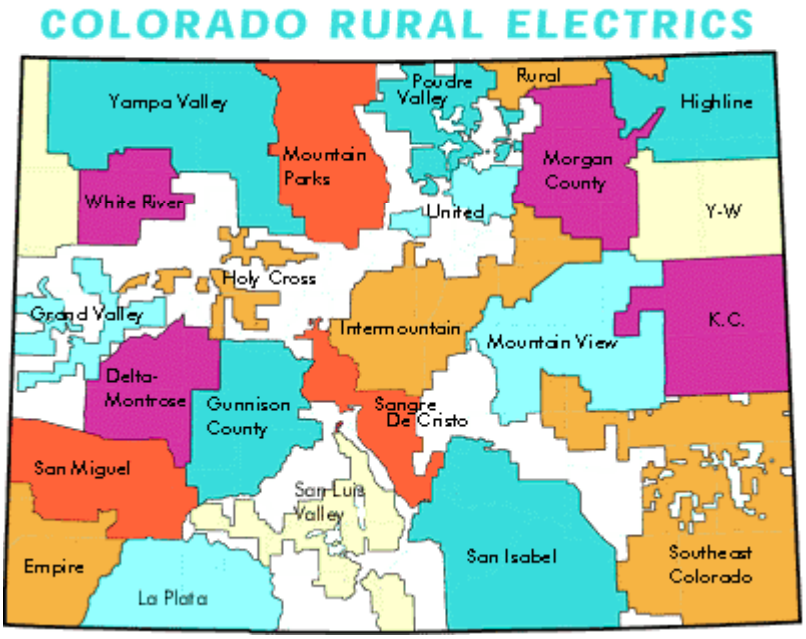
The Rural Electric Associations (REAs) currently affected by Amendment 37 include: Holy Cross, United Power, Mountain View, La Plata, Poudre Valley and Delta Montrose. These utilities may have an especially strong interest in working with project developers to supply renewable energy to their customers. Note that Intermountain opted out of compliance through a ratepayer vote, and other utilities may opt on in the future.

Selling the Power: The Utility Perspective

Since 1978, utilities in Colorado and around the U.S. have been required to buy power from non-utility generation projects (meaning projects owned by third parties, including both cogeneration and renewable resources) only if the cost of the power produced by the resource is less than or equal to the price that the utility would have paid to build or buy its own generation (so-called avoided costs). Sometimes, these resources are sought out by a utility under a "Request for Proposal" (RFP). RFPs may request energy from specific types of renewable energy technologies or they may consider all resources. In some cases, projects must be located within a specific utility's service territory or be able to deliver power to the service area.

There are 22 distribution cooperatives in Colorado as shown below.[12] Of these, all but four (Grand Valley, Holy Cross, Intermountain and Yampa Valley) are members of Tri-State Generation & Transmission Association (Tri-State). Thus, for ranchers or farmers considering a renewable energy project, it is likely that the power would be sold to Tri-State. Tri-State, based in the Denver, Colorado area, provides generation and transmission services and many related services to its distribution cooperatives throughout the state.

[12] http://www.coloradorea.org/index.cfm?id=142



Tri-State has indicated in recent discussions that potential developers of energy projects in the rural areas of Colorado should first speak with the local general manager of the distribution cooperative (those organizations shown in the map) regarding the type of project they are considering, the timing of the project, the size of the project, and other types of related parameters. If they wish to speak with personnel at Tri-State directly, they should contact either Mark McGahey, Member Services Manager or Dill Ramsey, Power System Planning Manager. The general phone number for Tri-State is 303-452-6111.

All renewable power projects, or conventional power projects for that matter, are not equally valuable as far as most utilities are concerned. Those that generate electricity continuously, particularly those whose electricity output is controllable (called dispatchable), are preferred over what are described as intermittent resources – those that generate at the whim of Mother Nature. Intermittent resources include solar and wind, if such resources are not backed up with gas-fired turbines or other controllable electricity generators.

Project developers are required to pay for the necessary transmission lines and interconnection facilities to connect to the local power company. For this reason, power projects that are reasonably close to existing power lines (in general, small lines are referred to as distribution and big lines are referred to as transmission) will be preferred over power projects that are located fairly far away from existing distribution and transmission. Wind projects will require power lines to be built from each individual wind turbine or wind farm to some central area for interconnection with the electric utility transmission/distribution grid.

Depending upon the size of the project, the developer may be required to pay for a detailed system study to insure that there is sufficient capacity to handle the added power.

If the project is deemed economically feasible by the developer and can be integrated into the local power network, Tri-State is willing to sign a long-term power purchase agreement (PPA) that spells out the term of the agreement and the amount they will pay for electricity from the project, among other conditions. Right now, most PPAs that would be signed between a developer and a rural electric cooperative in Colorado need to be negotiated on a case-by-case basis, with the terms and conditions decided between the utility and the developer.

Types of Financing

The question of how to recover costs and make a profit is determined by project financing. In order to make a project viable, flexibility may be required when making decisions about the project siting, configuration, financing and ownership structures. Outside expertise in finance, engineering and contract law can be helpful in making the best decisions.

There are two types of financing: debt and equity. Debt financing involves taking a loan or issuing a bond to provide capital which must be repaid. Equity financing entails sharing ownership and/or revenues with an investment partner or partners.

Types of equity partners include:[13]

- Strategic investors (such as utility-related companies)
- Institutional investors (banks, insurance companies) – usually for commercial developers
- Corporate investors (large companies) – to offset tax liabilities

Debt financing can be obtained from several sources:

- Regional agricultural lenders affiliated with the Farm Credit Administration
- Commercial banks, including foreign commercial banks
- Vendor financing. Technology manufacturers may offer low cost financing or structure payment terms to provide bridge financing during construction[14]
- Commercial finance companies – Most prefer large-scale investments, but GE Structured Finance will work with smaller projects
- Local banks – although they may be unfamiliar with the technology and project risks

Most utility-scale projects are structured with a mix of debt and equity, typically 40-70% debt, using non-recourse financing (meaning that the loan is secured by the project itself as opposed to some other type of collateral). Lenders to recent community-owned

[13] Venture capitalists and angel investors are not included, since they typically require a high Return on Investment.

[14] A solar trough system was installed at the jail in Jefferson County, CO through a limited partnership with Industrial Solar Technology, Inc.

projects have required pre-tax cash flow to be 10% greater than expenses plus debt service. They have also required a debt-service ratio of 1.25.[15]

When applying for a loan for a large-scale project, the following information is typically needed:[16]

- A resource assessment (for example, a comprehensive wind monitoring study conducted at the site)
- A project feasibility study (technical and economic evaluation) by a credible consultant
- Proven expertise in managing the type of project to be financed or an agreement with a qualified third party project manager
- Zoning and site permitting approval, including environmental impact studies
- Equipment performance data
- Equipment warranties and an operations and maintenance agreement
- A completed interconnection study
- A long-term power purchase agreement (at least 10 years, preferably 15) with a creditworthy utility that will purchase the electricity at specified prices
- Commitments for all required equity
- A business, financial and risk management plan for the project including complete pro-forma financial statements

Loan Guarantees

Some lenders may be unfamiliar with renewable energy technologies. A loan guarantee can reduce the risk for the lender and increase the potential for a project to be financed. The Small Business Administration (SBA) offers loan guarantees for solar thermal, photovoltaics, energy efficiency, biofuels, industrial co-generation, hydropower, and wind energy. See http://www.sba.gov/co/ for SBA offices in Colorado.

Maximizing Fiscal Incentives

The role of financial incentives (described in Chapter 2) can be significant. For example, the Production Tax Credit and favorable depreciation rules can represent over 60% of the total financial return of a wind project. The PTC can be worth as much as $47,000-55,000 per year per installed MW of wind generation and up to 40% of the installed project cost using a Net Present Value calculation. The table below illustrates the impact of the PTC on payback period.[17]

[15] Charles Kubert, Howard Learner, Jill Geiger and Rebecca Stamey-White, "Community Wind Financing: A Handbook by the Environmental Law & Policy Center," 2004: 10.

[16] Ibid.

[17] Ibid, 17.

Impact of Production Tax Credit on Hypothetical Community Wind Project Economics

Scenario	Net Present Value (10 years)	Internal Rate of Return (10 years)	Simply Payback (# of years)
Full PTC Utilization	$510,612	18%	2.8
50% PTC Utilization	$77,045	10%	5.0
No PTC	<$356,523>	-2%	10.5

Based on financial model developed by Cooperative Development Services for 3 MW project in Wisconsin. Assumes 1.8 cent/kWh PTC constant over 10 years, 40% equity/60% debt, 8% discount rate for NPV calculation.

Accelerated depreciation enables the project to be depreciated over 5 years instead of 20, which is the requirement for many conventional energy projects. This benefit can be used only if the corporation is actively involved in the project or has offsetting passive income.

If a farm operation is not structured in a way that enables it to take advantage of various incentives, it might be worth considering a partnership or ownership structure in order to make the project viable.

Types of Ownership Structures

Small-scale or community-based projects can face several barriers: lack of access to capital, limited economies of scale, and the inability to take advantage of tax breaks. Selecting the right ownership structure can help overcome these obstacles.

Municipal

Municipal utilities, such as the one in Lamar, Colorado, have installed wind turbines. As public entities, they have access to lower-cost public financing (such as issuing bonds) and lower financial return requirements (due to the fact that a city is unlikely to default on a loan). Municipal utilities also benefit by not being required to pay federal or state income taxes. Like other utilities, munis can sell green power at a premium to their customers or sell RECs. School districts in Iowa and Minnesota have been successful at raising revenue through this type of business structure over the past few years.

Rural Electric Cooperatives

Rural electric cooperatives have invested in renewable energy projects to supply green power to their members' customers. These projects can benefit from low financing costs through the USDA Rural Utilities Service and green power or RECs. Coops are not eligible for the Production Tax Credit. Another options is for coops to lease PV and wind systems to customers. Rural electric coops can be good partners or valuable sources of information.

Sole Ownership (LLC)

If the business or individual can produce the required equity, it is possible to be the sole owner of a utility-scale project. Individuals should establish one or more limited liability corporations (LLCs) in order to avoid personal financial liability for the project. The

Production Tax Credit (PTC) and accelerated depreciation benefits apply if the owner is actively involved in managing the project.

Local Investor Groups

Individuals can purchase shares in projects. The projects are formed as an LLC to shield against liability, but profits and losses flow through to investors. The PTC and project losses apply only to the extent that each passive investor has income to offset against these tax benefits. For more information about structuring this type of investor group, refer to page five of *Community Wind Financing: A Handbook by the Environmental Law & Policy Center*.[18]

LLC/C-Corporation Joint Ownership

Local investor groups can join forces with outside corporate investors. The local group does the pre-development work and markets the project to corporate investors who are interested in the tax shelters offered by the PTC and accelerated depreciation. Debt financing is obtained along with a commitment from the corporate investor to acquire an interest in the project when it begins operation. After the corporate investor has realized its financial return objectives, it may grant the local investors the right to purchase its interest at fair market value. At the end of 10 years, the cost of buying the interest in the project is significantly lower since depreciation has been taken on taxes over this period.

A variation on this model is for the local group to lease the project to the corporate investor, share revenues from the energy sales, and for the local group to receive royalties based on wind rights and a value assigned to the pre-development expenses. The local owners would have the option of purchasing the project at the end of the 10-year period. Note that investment projects may consist of several separate projects bundled together since investors generally seek a minimum project size. Moreover, royalties and other terms are negotiable.

Project Development

Assuming that the feasibility study and preliminary analyses have identified a viable opportunity, the developer should be prepared to start investing in the project itself. The next steps entail: initiating the interconnection process with the local utility; developing the plant layout and design; beginning the permitting application process; updating financial projections; initiating power purchase negotiations and contacting funding sources to obtain financing. In some cases, strategic partners will also be equity investors, which may expedite project implementation. The entire process – from conducting the resource assessment to the start-up of operations – may take two years or longer, depending on the scale and complexity of the project.

[18] Available on-line at http://www.elpc.org/energy/windhandbook2004.pdf

3. Policies and Regulations

Laws and regulations can create favorable conditions for implementing renewable energy projects. There are also many grant programs to support renewable energy and/or rural economic development. The following section highlights some of the major incentives available as of September 2005.

Major Federal Policies

Energy Policy Act of 2005

The final version of the energy bill was signed by the President on August 8, 2005. It included a wide range of tax breaks and incentives for traditional energy interests, as well as alternative energy sources. Some of the renewable energy provisions include:

- A two-year extension of the Production Tax Credit (described in this section)
- A two-year extension of excise and income tax incentives for biodiesel
- A mandate to increase ethanol consumption to 7.5 billion gallons by 2012
- The creation of Clean Renewable Energy Bonds (the federal government pays a tax credit to the bondholder in lieu of the issuer paying interest to the bondholder). $800 million has been authorized.
- A $20/green ton credit for using biomass to produce energy, heat or transmission fuels (Section 210)
- Tax credits for hybrid vehicle purchases
- Tax credits of 30% or up to $2,000 for the purchase of residential solar panels or hot water heating

Renewable Electricity Production Tax Credit

Under the new Energy Policy Act of 2005, the Production Tax Credit (PTC) was extended to cover facilities placed in service through the end of 2007. The duration of the PTC is 10 years. Hydropower and Indian coal were added as new qualifying resources. Other eligible resources include: wind, closed-loop biomass, open-loop biomass, geothermal energy, solar energy, small irrigation power (150 kW to 5 MW), landfill gas, municipal solid waste and refined coal. Taxpayers are allowed a credit of 1.5 ¢/kWh (adjusted annually for inflation or 1.9 ¢/kWh in 2005) for electricity generated from wind, solar, closed-loop biomass and geothermal projects under Section 45 of the Internal Revenue Code. Open-loop biomass, small irrigation, hydropower and municipal solid waste receive .9¢/kWh. For more information, see: http://www.dsireusa.org.

Business Energy Tax Credit

This provision was modified and extended under the Energy Policy Act of 2005. A 10% tax credit is available for businesses that invest in or purchase solar or geothermal property. Up to $25,000 per year is available, plus 25% of the total tax remaining after the credit is taken. Solar water heat, solar space heat, solar thermal electric, solar process heat, photovoltaics, and geothermal electric are eligible. Starting in 2006, the credit will also apply to fuel cells, microturbines and solar hybrid lighting and will increase to 30% for fuel cells and solar hybrid lighting (10% for microturbines). In 2008, the credit for solar energy property and solar hybrid lighting will revert to 10%. Passive solar and equipment used to generate steam for industrial or commercial purposes are not eligible. http://www.dsireusa.org/

Executive Order 13123 - Federal Green Power Purchasing Goal

Executive Order 13123 required federal agencies to increase their percentage of renewable energy use to 2.5% of total consumption by 2005. Individual agencies voluntarily chose to purchase renewable energy or Renewable Energy Certificates to support this goal. Based on its success, the goal was extended under the Energy Policy Act of 2005 to 5% in 2010-2012 and 7.5% in 2013 and thereafter.

Section 9006 of the 2002 Farm Bill

The Farm Security and Rural Investment Act of 2002 (Farm Bill) requires the US Department of Agriculture (USDA) to implement a program of loans, loan guarantees and grants to agricultural producers and rural businesses for renewable energy systems and energy efficiency. More details on these programs are provided under the “USDA Programs” section of this document.

The Healthy Forests Initiative

The Healthy Forests Initiative was developed by the Bush Administration in 2002 in order to:

- Significantly step up efforts to prevent the damage caused by catastrophic wildfires by reducing unnecessary regulatory obstacles that hinder active forest management;

- Work with Congress to expedite procedures for forest thinning and restoration projects; and fulfill the promise of the 1994 Northwest Forest Plan to ensure the sustainable forest management and appropriate timber production.[19]

Healthy Forests Restoration Act (HFRA) of 2003[20]

The Healthy Forests Initiative was introduced to reduce barriers to the timely removal of hazardous fuel and to expedite forest health improvement projects on federal lands. The Healthy Forests Restoration Act supports the Initiative by outlining various provisions for projects on lands that are at risk of wildfire or insect and disease epidemics.

Title II includes measures to promote biomass utilization and support research activities. Section 202 "Rural Revitalization Through Forestry" seeks to accelerate community-based enterprises and encourage the adoption of technologies that use biomass and small diameter material. This section authorizes $5 million for each fiscal year from 2004 through 2008. The Section 203 "Biomass Commercial Utilization Grant Program" authorizes grants to facilities that use biomass as a raw material to produce electric energy, sensible heat, transportation fuel, substitutes for petroleum-based products or wood-based products. As of July 2005, however, appropriations had not been made for these programs.

Small Diameter Utilization Program

The Forest Service, private forestry groups, non-profits, states and universities are cooperating under the Small Diameter Utilization Program. The objective is to provide information in areas such as technology transfer, logging systems, forest products and manufacturing, biomass and marketing.
http://www.fs.fed.us/fmsc/sdu/index.php

Federal Fiscal Incentives

Accelerated Depreciation

Solar, wind and geothermal property placed in serviced after 1986 can be depreciated using the Modified Accelerated Cost-Recovery System (MACRS). The property class for most renewable energy equipment is five years. A seven-year tax life applies to property used in the conversion of solid waste and biomass into a solid, liquid or gaseous fuel. See http://www/ors/gov for additional information.

Tax-Exempt Financing for Biomass

Assuming that the facility has more than 10% private business use, a biomass project can qualify for tax-exempt financing if it fits into one of two categories: 1) the project

[19] U.S. Office of the White House, *Healthy Forests Initiative,* http://www.whitehouse.gov/infocus/healthyforests/.

[20] http://capwiz.com/wwipo/webreturn/?url=http://thomas.loc.gov/cgi-bin/bdquery/z?d108:h.r.1904:

supplies gas or electricity to an area no larger than two contiguous counties or one city and a contiguous county; or 2) the facility is a solid waste disposal facility.[21]

Utility Rebates

Section 136 of the IRS Code states that energy conservation subsidies provided by public utilities – either directly or indirectly – are non-taxable. It is possible that rebates from utilities are also non-taxable. Although the IRS has not ruled definitively on this issue, it may be worth consulting a tax advisor:
See: http://www.irs.gov
Contact:
Information Specialist – IRS
1111 Constitution Ave., NW
Washington, DC 20224
Tel: (800) 829-1040

Tribal Programs

Tribal Energy Program Grant

The Department of Energy provides technical and financial assistance for feasibility studies in support of renewable energy installations on tribal lands. Cost share is available for project implementation. Assistance is also provided for developing and implementing energy policies.
http://www.eere.energy.gov/wip/program/tribalenergy.html

Native eDGE

This is an interagency initiative to facilitate sustainable economic development for American Indian and Alaska Native communities. The program web site at http://nativeedge.hud.gov lists federal programs available from 12 different agencies. A Call Center is also available at 1-877-807-9013 to provide basic information on resources available for economic growth.

Federal Ethanol and Biodiesel Incentives

Clean Air Act

The Clean Air Act of 1970 authorized the EPA to promulgate regulations regarding the quality of conventional fuels. In 1990, the Act was amended to include establishing air quality standards related to vehicle emissions. The EPA subsequently established the National Ambient Air Quality Standards covering carbon monoxide, nitrogen oxides, particulate matter, ozone and lead. Urban areas were required to use cleaner burning fuels if they did not meet the minimum clean air standards. This can be achieved by adding oxygen to gasoline, which improves combustion efficiency; ethanol contains 35% oxygen. Substituting regular fuel with ethanol results in a reduction of carbon monoxide, volatile organic compounds and nitrogen oxides.

[21] U.S. Department of Energy, Energy Efficiency & Renewable Energy, Biopower Program.

Budget Reconciliation Act of 1990

A 10-cent/gallon tax credit was established under the Budget Reconciliation Act of 1990 to encourage the development of new ethanol production facilities. Plants with an annual production capacity of 30 million gallons or less are eligible to deduct 10 cents/gallon from the first 15 million gallons produced annually. This small producer tax credit is scheduled to end December 31, 2007.

Energy Policy Act of 1992

In 1992, the Energy Policy Act (EPACT) required government and private fleets (having 20 or more vehicles in metropolitan areas with more than 250,000 people) to include alternative fuel vehicles in their fleets. The requirement ranges from 30% to 90% of fleet vehicles. The requirement may be met by using fuels containing at least 85% alcohol by volume. Other possibilities include: natural gas, propane, hydrogen, liquid fuels from coal, and electricity.

Section 179-A allows tax deductions for the purchase of a clean fuel vehicle or the conversion of an existing vehicle to clean fuel. Deductions are also available for clean-fuel refueling property. This incentive was extended under the Working Families Tax Relief Act of 2004. The deductions will be phased out by 2007, and property must be placed in service by 2005.

American Jobs Creation Act (Public Law 108-357)

Tax credits are available for ethanol and biodiesel blenders and retailers through 2010. This law is an extension of the federal excise tax exemption and Energy Tax Act of 1978. The credits are 51 cents per gallon of ethanol that is 190 proof or greater, $1.00 per gallon for agri-biodiesel and 50 cents per gallon on waste-grease biodiesel. Mixtures are credited at 0.5 cents per percentage point ethanol or agri-biodiesel. See http://www.irs.gov/publications/p378/ar01.html for more details.

Biobased Products and Bioenergy Initiative

Under this umbrella program, the Commodity Credit Corporation makes incentive payments available to encourage the production of fuel grade ethanol and biodiesel from farm crops; $100 million was approved for 2005 with a maximum payment of $5 million per producer. Payments are based on bioenergy production increases from eligible commodities. To qualify, companies must produce and sell ethanol or biodiesel commercially and be in good standing with the EPA.

Conservation Reserve Program

Under the Conservation Reserve Program, farmers are encouraged to adopt conservation practices on environmentally sensitive land. Farmers can harvest energy crops on part of the 34 million acres included in the program. The Commodity Credit Corporation provides rental payments and cost-share assistance for establishing conservation practices, such as planting crops (including energy crops) that will prevent soil erosion. http://www.fsa.usda.gov/dafp/cepd/default.htm

Biomass Research and Development Initiative

The Biomass Research and Development Initiative is a joint endeavor of several agencies, headed by DOE and USDA. The purpose of the initiative is to develop a comprehensive national strategy that includes 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 national and international markets."[22] The initiative was started under an Executive Order of the Clinton Administration in support of the goal of tripling U.S. use of biobased products and bio-energy by 2010.

US Department of Agriculture (USDA)

Rural Utility Service (RUS)

The RUS supports rural utilities in keeping their technology up to date and expanding rural infrastructure. RUS provides loans and loan guarantees to utilities for system improvements and the construction of on-grid and off-grid renewable systems. Additional information on loans and grants is available on the Internet.
http://www.usda.gov/rus/electric/loans.htm
http://www.usda.gov/rus/electric/hecgp/index.htm

Rural Business Programs

Note that there are a handful of programs that broadly support the development of rural businesses through the USDA Rural Business-Cooperative Service:

Loan guarantees are available under the Business and Industry Guaranteed Loan Program. The objective is to create employment in rural areas by expanding the lending capacity of commercial lenders. Up to 80% of a loan made by a commercial lender can be guaranteed, and the maximum loan size is $25 million.[23]

The Intermediary Relending Program provides financing to business facilities and community development projects through intermediaries. The intermediaries establish revolving loan funds for this purpose.[24]

The Rural Business Enterprise Grants program provides funds to public bodies, nonprofits, and Indian Tribal groups to finance small business enterprises in "urbanizing

[22] U.S. Office of the White House, *Executive Memorandum – Subject: Biobased Products and Bioenergy,* August 12, 1999, http://www.bioproducts-bioenergy.gov/about/ememo.asp.

[23] USDA Rural Business Cooperative Services, *Business & Industry Guaranteed Loans,* http://www.rurdev.usda.gov/rbs/busp/b&I_gar.htm.

[24] USDA Rural Business Cooperative Services, *Intermediary Relending Program,* http://www.rurdev.usda.gov/rbs/busp/irp.htm.

areas" outside cities with populations of over 50,000. Grant funds are not provided directly to the business.[25]

Rural Economic Development Loans can be provided at 0% interest to electric and telephone utilities. The utility must re-lend the money at 0% interest to a third-party for the purpose of job creation. Priority is given to areas with populations of less than 2,500 people.

Rural Economic Development Grants are available for rural economic development purposes. Grants are provided to electric and telephone utilities and are used to establish revolving funds. The utility must contribute 20% of the funding for each grant administered.[26]

The Rural Business Opportunity Grants program seeks to promote sustainable economic development in rural communities with exceptional needs. Grants cover the costs of economic planning, technical assistance for rural businesses, and training for rural entrepreneurs or economic development officials.[27]

USDA's Renewable Energy Systems and Energy Efficiency Improvements programs assist farmers, ranchers and rural small businesses in developing renewable energy systems and making energy efficiency improvements to their operations. The USDA provides funding by issuing a Notice of Funds Availability. Renewable energy systems can receive up to $500,000, but no more than 25% of the total project cost. Eligible technologies include: solar water heat, solar space heat, photovoltaics, wind, biomass, geothermal electric, geothermal heat pumps, hydrogen, anaerobic digestion, renewable fuels, fuel cells and energy efficiency. In September 2005, three $500,000 grants were awarded to Colorado wind projects.
http://www.rurdev.usda.gov/rd/farmbill/9006resources.html
http://www.dsireusa.org/documents/Incentives/US05F.htm
http://www.dsireusa.org/documents/Incentives/US05Fa.pdf

Value Added Producer Grants (VAPG)

VAPGs may be used to support value-added agricultural products and farm-based renewable energy. Support is available for planning activities (such as marketing and business plans) and for acquiring working capital. Eligible applicants are independent producers, farmer and rancher cooperatives, agricultural producer groups, and majority-controlled producer-based business ventures. Eligible technologies include: photovoltaics, wind, biomass, hydroelectric, anaerobic digestion, ethanol and biodiesel.
http://www.rurdev.usda.gov/rbs/coops/vadg.htm

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[25] USDA Rural Business Cooperative Services, *Rural Business Enterprise Grants,* http://www.rurdev.usda.gov/rbs/busp/rbeg.htm.

[26] USDA Rural Business Cooperative Services, *Rural Economic Development Grants,* http://www.rurdev.usda.gov/rbs/busp/redg.htm.

[27] USDA Rural Business Cooperative Services, *Rural Business Opportunity Grants,* http://www.rurdev.usda.gov/rbs/busp/rbog.htm.

Rural Cooperative Development Grant Program (RCDG)

Grants are available for the development of new cooperatives or improvement of existing cooperatives as part of USDA's mission to improve economic conditions in rural areas. Funding of up to $300,000 per cooperative is available, and recipients must contribute at least 25% of the total project funds. If a recipient is a 1994 Institution, the matching requirement is only 5% of total project costs.[28]
http://www.rurdev.usda.gov/rbs/coops/rcdg/rcdg.htm

The Conservation Security Program (CSP) Production Incentive

The program provides technical and financial assistance for conservation on tribal and private working lands. The renewable energy component allows payments of $2.50 per 100 kWh, up to $45,000 per year for a maximum period of 10 years. Eligible resources include solar thermal electric, photovoltaics, wind, geothermal electric and anaerobic digestion.

1890 and 1862 Land-Grant Institution Initiative

This program seeks to develop income-producing projects for underserved rural communities that are traditionally dependent on agriculture. Colorado State University is classified as an eligible 1890 institution. Funding can be used to:

- Sponsor business conferences and workshops;
- Finance rural businesses;
- Provide technical assistance to new and existing businesses, including cooperatives;
- Assist communities in leveraging other resources via state, local, private, and/or public funding;
- Assist businesses through the application process;
- Offer courses in business development;
- Provide computer labs where community members can have access to other rural economic development sources on the Internet;
- Establish business incubator services.

See http://www.rurdev.usda.gov/rbs/oa/1890.htm for more information.

Other Initiatives

25x'25

The vision statement of this initiative is as follows: "Agriculture will provide 25 percent of the total energy consumed in the United States by 2025 while continuing to produce abundant, safe and affordable food and fiber." The project is sponsored by the Energy Future Coalition, a non-partisan group seeking to accelerate the development and

[28] A definition and listing of 1994 Institutions can be found at http://www.csrees.usda.gov/about/offices/legis/edequity.html.

implementation of new energy solutions. More information can be found at www.energyfuturecoalition.org and www.agenergy.info.

Clean Cities Program

The Department of Energy Clean Cities Program fosters the development of a sustainable alternative fuels market through the public/private partnerships formed around the country. It includes initiatives such as: the purchase of alternative fuel vehicles; vehicle demonstrations; infrastructure development; the reduction of greenhouse gas emissions through increased use of renewable fuels and advanced vehicle technology; and the development of Clean Cities organizations.

US Small Business Administration (SBA)

504 Loan Program

The Certified Development Company can provide SBA loans covering up to 40% of the project cost or up to $1.3 million. A list of CDC offices in Colorado can be found at: http://www.sba.gov/co/cdcco.html

7(a) Loan Guarantee Program

The program guarantees up to 75% of loans made by the private sector. A fee of 3.5% is required for loans over $700,000 with an additional fee of 0.25% for the amount over $1 million. There is an annual maintenance fee of 0.36% of the amount guaranteed. For more details see: www.sba.gov/financing/sbaloan/7a.html.

Colorado Policies and Programs

Amendment 37 (Renewable Energy Standard)

The passage of the Amendment 37 ballot initiative requires the Public Utilities Commission to develop a Renewable Energy Standard (RES) for the state of Colorado. Utilities serving over 40,000 customers are required to generate or cause to be generated renewable energy in the following amounts: 3% of retail sales for the years 2007-2010; 6% of retail sales for the years 2011-2014; and 10% of retail sales in 2015 and beyond. At least 4% of the total renewable energy quota must be derived from solar electric generation technologies, half of which must be supplied by on-site customer facilities. The RES also has a provision of a $2.00 per watt rebate which is available for on-site solar installations, up to 100 KW.

Utilities can meet their obligations by increasing their generation of renewable energy, purchasing “green” (renewable) energy from another supplier or purchasing Renewable Energy Certificates (RECs). Implementation rules are currently under development. Information about using RECs and green power sales as sources of revenue can be found in the Project Financing chapter.

Cooperative and Municipal Utilities Interconnection Standards

There are no industry-wide net-metering rules (or corresponding interconnection procedures or standards) in Colorado, but standby and interconnection charges are specifically authorized for electric cooperatives in the state; customers must pay all costs for additional metering.

According to the Database for State Incentives for Renewable Energy, safety equipment includes a requirement for an external disconnect switch. Customer equipment must meet IEEE, UL and NEC requirements, and any other applicable regulations or standards. Cooperative utilities must approve every eligible interconnection.

Net Metering Rules

In order to implement the state's Renewable Energy Standard (RES), a net metering system will be required. For example, participating utilities are required to provide rebates for solar electric generation and must reimburse customers for excess generation.

Some utilities have already adopted net metering practices. Aspen Electric and Holy Cross Electric provide net metering and allow customers to get full retail credit for any excess generation supplied to the grid. Fort Collins Utilities is conducting a five-year pilot net metering program, giving customers full retail rates for their electricity generated (with a maximum capacity of 10 kW). After five years, other rates will apply. Gunnison County Electric Association will reimburse customers for net excess generation at $0.07593/kWh until the meter reads zero and then customers receive $0.035/kWh. Low interests loans up to $25,000 are available for PV and wind. Xcel Energy offers net metering for facilities under 10 kW, and net excess generation can be carried over to the next month of the customer's bill.

Line Extension and PV Cost Evaluation

Utilities in Colorado are required to provide a cost-benefit analysis to customers considering line extensions vs. stand alone PV systems in remote areas (if the ratio of power consumption to distance is less than or equal to 1,000). For example, if a customer lives 0.5 miles from the nearest power line and consumes less than 500 kWh per month, then the utility is required to assess the relative costs of extending the power lines and installing a PV power system on-site.
http://www.dsireusa.org

Renewable Energy Resource Loan

Low interest loans are available for wind, PV and other renewable energy systems installed in the Gunnison County Electric Association service area. Systems do not need to be connected to the grid, and up to $25,000 is available over 10 years of qualifying customers. For more information, see:
www.gcea.coop/consumerserv/renewable_energy.cfm

Wind Anemometer Loan Program

The Governor's Office of Energy Management and Conservation has seven anemometers, which can be used to measure the feasibility of wind energy. The anemometers are loaned out on an annual basis, depending on the likelihood of future wind energy utilization and existing statewide wind mapping information. The program provides the anemometer, a 20-meter wind tower, data logger, guidance on equipment installation, and assistance with data interpretation. For more information, see: www.state.co.us/oem.

Colorado House Bill 00-1257

Cities and counties can exempt certain pollution control and renewable energy equipment from sales tax through a refund, subject to funding availability. Applications must be submitted to the department of revenue by April 1 of the fiscal year following the purchase of the item. Details can be found at http://www.revenue.state.co.us/legis2000.html#Sales%20Tax.

Possible Future Incentives

Carbon Offsets

In many countries around the world, carbon dioxide is being traded as a commodity – just like bushels of corn or barrels of oil. Based on an upper limit of allowable emissions, countries and companies trade "allowances" and "emissions reductions" as a way to comply with regulations. A company with high emissions can buy "emissions reduction units" or make reductions within its own operations. In many cases, it will be less expensive to buy the allowances on the market or make pollution reductions at another company in exchange for the pollution offsets. In addition to reducing pollution, "sequestering" or trapping carbon can create tradable credits. For example, planting trees or using conservation practices in farming may qualify for credits.

Although the United States is not a participant in the international treaty that governs global emissions trading (the Kyoto Protocol), the concept of emissions trading originated in the US Environmental Protection Agency and many state and local governments in the US support emissions trading as a compliance tool. The Chicago Climate Exchange has a voluntary trading program for companies and organizations that want to gain experience with trading or are making reductions on a voluntary basis. In California and several states in the Northeast, emissions registries are being developed which will support trading. More than 150 cities have made commitments to combat global warming, and it is likely that many will embrace the concept of carbon credits as a tool for reaching their environmental goals. It is likely that new opportunities will appear for farmers and ranchers to get credit for the development of projects that reduce greenhouse gases.

4. Illustrative Projects

This section describes how renewable energy technologies have been utilized in agricultural settings -- including information about costs, benefits and lessons learned (when available).

Anaerobic Digestion

There are roughly 100 anaerobic digesters in use or under construction in the United States. Digesters can provide an additional economic source and reduce the environmental problems associated with large-scale animal operations. In 2000, there were over 500 commercial hog farms in Colorado with over 840,000 animals. More than 1.4 million tons of manure were generated every year, leading to significant environmental issues. If all of this manure were converted into power, 5.5 MW of electricity could be generated on an annual basis.

The Colorado Swine Partners hog farm near Lamar, Colorado uses an anaerobic digester to convert hog waste into methane which is used as a fuel to power farm operations. A combined heat and power (CHP) system, using an 80 kW Caterpillar engine, uses the methane generated by the digester. The system provides 50% of the farm's peak electricity needs. The heat from the engine is recovered to maintain the digester's optimal operating temperature of 102ºF.[29] Based on the initial success with the CHP system, the farm added a microturbine generator to the system.

The project involved several sponsors and partners and sought to demonstrate the energy, economic and environmental benefits of using an anaerobic digester. The project was paid for by Colorado Swine Partners, supported by a $30,000 grant from the Environmental Protection Agency for the technical design work. The Department of Energy provided funding through the Colorado Governor's Office of Energy Management and Conservation to evaluate the results and benefits of the project.

[29] http://www.state.co.us/oemc/programs/agriculture/hog_wastes/case_study.pdf

Anaerobic Digester at Colorado Swine Partners – Photo by McNeil Technologies

The system operates as follows:

- Manure falls through slatted floors and is stored in pull-plug pits.
- Sewer lines connect the pits to a concrete manure holding tank.
- The effluent is pumped into the digester – a 500,000 gallon heated concrete tank.
- The effluent is mixed for 30 minutes per day using two pumps.
- Hot water from the cogeneration engine circulates through pipes to maintain the optimum temperature for methane production, 100ºF.
- Methane is piped underground to the engine's intake manifold to produce electricity.

The cost of the system was approximately $375,000. Other lagoons which could have been used to bring the plant into environmental compliance cost approximately $300,000; the implication is that for an additional $75,000, the hog farm was able to generate electricity. Project costs from 2000, unadjusted for inflation, are listed below.

Anaerobic Digester Costs

Item	Cost ($)	%
Site preparation	13,848	3.7
Digester tank construction	125,000	33.4
Engine/generator purchase	67,012	17.9
Engine building construction	12,500	3.3
Plumbing (pipe, fittings, valves)	17,510	4.7
Electrical	17,566	4.7
Special equipment (pumps, valves, meters)	58,003	15.5
Engineering	48,943	13.1
Labor	8,881	2.4
Miscellaneous	4,760	1.3
TOTAL	**374,023**	**100**

Reciprocating Engine – photo by McNeil Technologies

The digester enabled the farm to reduce energy costs by approximately $1,800 per month (to only $1,400 per month); the facility's average use was 43,233 kWh at a cost of $3,200 per month (at a rate of $.042/kWh). The power is not currently sold to the grid due to the fact that it all used on-site. However, a net metering agreement was established with Tri-State and the system is connected to the power lines via Southeast Colorado Power

Association. If Colorado Swine Partners sold excess energy to the grid, it would receive 1.5 cents/kWh.

Photo from North Carolina State University

Since every project is unique, the following project review table from USEPA AgSTAR is included by way of comparison.[30] The savings for Colorado Swine Partners (formerly Colorado Pork) is based on a $0.07/kWh electricity rate, which is higher than the $0.042/kWh rate used by the OEMC sponsored report. Nevertheless, the table is valuable for comparing different sizes and types of projects.

[30] http://www.waste2profits.com/Articles/articles2.htm

AgStar Digester Projects

Location	Year Installed	Animal Production	Volatile Solids (gal/day)	Manure Collection Type	Biogas Use	Installed Cost ($)	Est. Annual Benefit (type of benefit)*	CH4 Reduction Mt CE/Yr
Complete Mix Digesters								
Apex Fork, Rio, IL	1998	8,600 finisher pigs	5,780	Flush	Boiler & Flare	152,300	$0 (O)	1,191
Swine USA Thayer, IO	1999	5,000 sow farrow-wean	6,000	Pull plug	Electricity	576,000	$46,000 (O, E)	959
Colorado Pork Lamar, CO	1999	5,000 sow farrow-wean	6,200	Pull plug	Electricity	368,000	$34,800 (O, E)	1,013
Plug Flow Dairy Digesters								
Craven Farms Clovendale, OR	1997	650 cows	10,227	Scrape	Electricity	253,000	$55,400 (P, E, F)	1,129
AA Dairy Candor, NY	1998	550 cows	10,787	Scrape	Electricity	240,300	$38,000 (E, F, O, M)	1,129
Haubenschild Dairy Princeton, MN	1999	480 cows	10,700	Scrape	Electricity	295,800	$43,400 (E, H, M, O)	992
Covered Lagoon Digesters								
Martin Farms South Boston, VA	1993 (1997)	600 sows Farrow-50 lb	1,233	Flash/pull plug	Electricity & flare	95,000	$5,000 (O, E, H)	397
Barham Farms Zebulon, NC	1997	4000 sows Farrow-wean	4,537	Pull plug	Electricity & heat	289,000	$37,000	1,158
Boland Farms Williamsburg, IA	1998	3,000 pig nursery	581	Pull plug	Flare	20,000	$0 (O, R)	Not metered
Cal Poly Diary San Luis Obispo, CA	1998	200 cows	2,688	Flush	Flare	150,000	$7,500 (O, E)	149

* source of benefit: Monetary benefits – E=electricty, H=heat, F=digested fiber sales. Non-monetary benefits: 0=odor control, N=nutrient reduction, M=improved material handling, P=pathogen reduction, R=Rainfall exclusion

In addition to the direct monetary benefits, the use of methane has significant environmental benefits since this gas contributes to global warming when it is emitted into the atmosphere. The use of the manure also means that the farm can use a smaller lagoon, which cuts down on potential water pollution and reduces construction costs. Less water is needed to process the hog waste, and the digester enables the farm to meet odor control regulations under Amendment 14. Odor control, mineralization of organic nitrogen, weed seed destruction, pathogen and toxin reduction and improved manure handling are other benefits demonstrated by digestion systems.

Wind

Wray School District

A 1.65 MW Vestas wind turbine will be installed at a local school in Wray, Colorado thanks to the diligent efforts of community members over a period of three years. The turbine will meet all of the school's energy needs and supply roughly 25% of the city's power through an arrangement with Tri-State Generation & Transmission (Tri-State), Western Area Power Administration (WAPA) and YW Electric. In addition to selling power, the project will also sell RECs.

The $1.8 million in project costs were covered through a variety of sources:

- Feasibility study funding from the Rocky Mountain Farmers Union
- $200,000 in seed capital from the Eva and Ralph Bowman family
- A matching contribution of $200,000 from the Kitzmiller-Bales Foundation
- $200,000 in support from 21 citizens in the school district
- An Energy Impact Fund grant of $350,000 from the Department of Local Affairs
- A synthetic lease with a private company (likely to be John Deere)

The project will save the school district approximately $70,000 per year in energy costs, and it will generate $180,000 in energy sales. It is unclear how much revenue will be generated by selling the RECs. As part of the Power Purchase Agreement (PPA), 10% of the RECs will be given to Tri-State as compensation for modifying the existing PPA. A new contract between YW Electric, WAPA and Tri-State requires the city to use the power from the wind turbine. The power is purchased at the rate of $0.035/kWh for the first 10 years of operation and at 40% of current retail prices for the remainder of the project life, which is projected to be an additional 15 years. The private company will lease the equipment and claim the project's depreciation and Production Tax Credit; the school district will receive the energy revenues.

It is worth noting that the nature of the project changed substantially from the initial project concept. The school district had originally intended to install a 660 kW turbine, but those plans changed when it learned it could get three times the power for only twice the cost. The location of the turbine also changed from the Highline Cooperative's service territory to YW Electric's service territory, which is where the school is physically located. If there is a lesson to be learned from this project, it is that perseverance and flexibility are critical.

Solar

Solar Water Pumping

Most rural cooperatives serve small loads in remote locations. Distributed generation resources, such as PV, offer an opportunity to reduce costs by avoiding expensive investments in line upgrades or increases in substation capacity. This was demonstrated by K.C. Electric in Hugo, Colorado, which lost 600 utility poles due to ice and snow. Rather than rebuild power lines at a cost of $10,000 per mile, PV arrays were installed. A more recent study by Sandia showed average line replacement costs to be $12,000 in flat

areas and up to $60,000 per mile in rugged mountain terrain.[31] K.C. Electric found that the PV solar water pumps worked effectively, and the coop decided to consider PV in areas where line reconstruction was necessary.[32]

A cost effective example of PV technology is solar water pumps. These systems can be installed in less than a day, and some systems are even portable. The lifetime costs of operation are lower than windmill water pumps, although the initial costs are comparable. Solar water pumps are also cost effective compared to generator systems, due to lower maintenance costs. To compensate for cloudy days, water can simply be stored in a large tank or several smaller tanks. A battery can also be installed to supply energy to the pump on demand. Tracking systems can be installed to follow the movement of the sun and increase the amount of electricity generated. Tracking devices add considerably to the costs of the system and may not be needed; tanks may fill in the morning and last through the next day.

In Montana, a system pumps nearly four gallons of water per minute. It has two, 1,200-gallon storage basins which act as "batteries" and a tracking device. The 240-watt unit provides enough water for 75 pairs of cows and calves (each pair drinks about 25 gallons of water per day). Another rancher in Montana calculated that he could pump 1,000 gallons of water for $1.85 with his system.[33] System sizes are usually in the range of 100-200 watts, 300-400 watts and 800-1,200 watts.

Geothermal

Geothermal Direct Use for Aquaculture

Aquaculture and low-temperature geothermal resources represent an attractive match for renewable resource development. In Colorado, there are at least three geothermal aquaculture facilities, all located in the San Luis Valley. Nationally, there are over 50 geothermal aquaculture operations, widely dispersed throughout several western states. The combination of expanding markets coupled with ample supplies of low-cost warm water that provides an ideal growing environment allows for year-round production.

Colorado Gators is located in Mosca, Colorado in the heart of the San Luis Valley. Geothermal fluids provide warm water for growing Rocky Mountain White Tilapia® as well as over 400 alligators, crocodiles and caiman (see Figure 2). The business was initially focused on growing fingerling tilapia for eventual grow-out at other facilities and subsequent sale to consumers. In 1987 alligators were added to eat the waste left over from raising and making the fish marketable. Presently the farm produces over 2 million fingerlings per year and operates a full-time visitor center to view the alligators and assorted reptiles in several on-site greenhouses.

[31] http://www.usda.gov/rus/electric/engineering/sem2002/skinner.htm

[32] http://www.usda.gov/rus/electric/engineering/2000/doe.htm

[33] http://www.usda.gov/rus/electric/engineering/sem2002/skinner.htm

Figure 1. Alligators at Colorado Gator Farm, Mosca, Colorado
Source: Seth Chapin

Colorado Gators is able to conduct aquaculture in an unlikely area for either warm water fish or reptiles. At an elevation of 7,550 feet, and ringed by the magnificent Sangre de Cristo Range, air temperatures regularly fall to well below zero. Warm water, approximately 87ºF, is supplied by a 2,050 foot deep, 14 inch diameter irrigation well. Originally the well sustained artesian flow in excess of 800 gallons per minute. With draught and increasing utilization of the underlying aquifer by adjoining farms, the artesian flow diminished to the point where the owners installed a 40 horsepower variable speed pump to ensure adequate flow year-round. The pump is set at about 40 feet. While the well is permitted for over 2,000 gallons per minute (gpm), current requirements are for approximately 400 gpm.

Warm water is circulated in a number of raceways that provide a living environment for the fish and reptiles (see Figure 2). The overall system does not recycle water; rather the spent fluids are disposed of because the water quality is lower than the supply quality. A disposal well was considered but rejected due to the cost. The preferred disposal method is a 25-acre constructed wetland. The owners placed over 25 acres of land in the Conservation Reserve Program for 10 years. USDA assistance was provided in the design and construction of the wetlands. The wetlands cost approximately $200,000 and the cost was split at a 50:50 ratio with USDA.

Figure 2. Satellite photograph, Colorado Gators, Mosca, Colorado

The owner of Colorado Gators, Mr. Irwin Young, is a passionate advocate for conserving natural resources. He points out that although the temperature of his resource is not high, it is perfect for his application. Relative to natural gas, he estimates his energy cost savings with the geothermal system at over $300,000/year. Perhaps more importantly, he notes that he would not be in business without the plentiful geothermal resource base. On the downside, Mr. Young notes that the upfront capital cost of renewable energy technologies is difficult to finance because of long payback periods.

Geothermal Heat Pumps

The Delta-Montrose Electrical Association (DMEA) offers innovative technology solutions to its electric customers, including the Co-Z GeoExchange. The device works by using a compressor to circulate fluid (water and anti-freeze) through underground pipes. The technology is based on the fact that the earth's temperature is a constant 58F. In the winter, a pump pulls the heat into the home; in the summer, the air flow is reversed. The resulting temperature in the house is a consistent 70F year-round. The cooperative offers the technology to customers for a fixed price of $100 per month. DMEA estimates that an average house can save about $1,600 per year on heating and cooling (assuming a 2,000 square foot home uses $2,645 to heat with propane). On a source fuel basis, geothermal heat pumps are 48% more efficient than the best natural gas furnaces and 75% more efficient than oil furnaces. DMEA's income from the GeoExchange systems is reinvested to develop new technologies, such as fuel cells. For more information, see www.dmea.com or call 970-249-4572.

Hydropower

The majority of renewable energy production in the US comes from hydropower – nearly 98%.[34] Hydropower can be located wherever there is access to a stream and the possibility of laying a pipe from a higher to lower elevation.

Given that Aspen Skiing Company already had two components of a hydropower system in place as part of its snowmaking operations -- a pipe and pond (reservoir) – a microhydro plant at Snowmass was a logical addition to the resort's renewable energy commitment.

Using 4,103 feet of pipe, the project was able to achieve a flow rate of 1,100 gallons per minute, creating 323 psi of pressure on a Pelton turbine. The mechanical energy of the turbine was converted to energy by a generator, supplying 250,000 kWh per year to the grid.

The Snowmass Hydroelectric project was built for only $155,000, of which $55,000 was provided in the form of grants from project supporters. Project partners included:

- Governor's Office of Energy Management and Conservation (OEMC)
- StEPP Foundation
- Town of Snowmass
- Community Office for Resource Efficiency (CORE)
- Holy Cross Energy
- Aspen Renewable Energy Mitigation Program Fund
- Canyon Industries The Ruth Brown Foundation

The payback period for the project is estimated at seven years, based on energy sales to Holy Cross Energy at an average rate of $0.06/kWh. Without the existing snowmaking infrastructure, the project would have cost an additional $2 million.

[34] http://www.wvic.com/hydro-facts.htm

5. For Additional Information

General Information on Renewable Energy

The Colorado Governor's Office of Energy Management and Conservation (OEMC)
Renewable energy programs in Colorado – 303-866-2100 or 800-632-6662
http://www.state.co.us/oemc/programs/renewable/index.htm

US Department of Energy (DOE) – 1-877-337-3463
http://www.eren.doe.gov

DOE Green Power Program – 1-877-337-3463
http://www.eere.energy.gov/greenpower/

National Renewable Energy Laboratory – 303-275-3000
http://www.nrel.gov

Renewable Energy Atlas of the West – 415-979-0343
Provides maps which should the availability of different renewable energy resources in Colorado:
http://www.energyatlas.org/PDFs/atlas_state_CO.pdf

National Sustainable Agriculture Information Service – renewable energy applications for farms – 800-346-9140
http://www.attra.ncat.org/energy.html

Coloradans for Renewable Energy – 303-573-3871, ext. 308
http://www.coenergy.info

Public Renewables Partnership – 415-561-2100 or 510-891-0446
http://www.repartners.org/

Biomass

Includes information about technologies, applications financing and policies for biomass in the state of Colorado. Contact the Colorado Governor's Office of Energy Management and Conservation – 303-866-2100 or 800-632-6662
http://www.coloradobiomass.org

Regional Biomass Energy Program – 202-586-2325
http://www.eere.energy.gov/biomass

National Biomass Coordination Office – 202-586-7766
http://www.bioproducts-bioenergy.gov

EPA AgStar program for anaerobic digesters. Provides expertise for developing projects

using livestock waste:
http://www.epa.gov/agstar
1-800-952-4782

"Methane Generation from Livestock Waste"
Don D. Jones, John C. Nye, and Alvin C. Dale
Purdue University
Cooperative Extension Service
West Lafayette, IN 47907
1-800-398-4636
Purdue University worksheet to calculate the economics of an anaerobic digestion system (prices need to be updated to reflect current electricity rates):
http://www.agcom.purdue.edu/AgCom/Pubs/AE/AE-105.html

Agricultural Utilization Research Institute helps evaluate the benefits of an on-farm digester and provides at checklist to determine if a digester is a viable option.
507-835-8990
http://www.auri.org/research/digester/digester.htm

Manurenet lists projects and technical experts in the US and other countries:
No phone number available
http://res2.agr.ca/initiatives/manurenet/en/man_digesters.html

National Sustainable Agriculture Information Service site about making biodiesel:
1-800-346-9140
http://www.attra.org/attra-pub/PDF/biodiesel.pdf

National Corn Growers Association – 636-733-9004
http://www.ncga.com/

Blue Sun Biodiesel – 970-221-0500
Colorado-based biodiesel manufacturer
http://www.gobluesun.com/

National Ethanol Vehicle Coalition – 877-485-8595
http://www.e85fuel.com/legislation/legislative.php

Wind

Windustry website. Supports locally owned and community based wind projects throughout the US. It operates the Wind Farmers Network:
800-946-3640
http://www.windfarmersnetwork.org/.
http://www.windustry.com/community/default.htm

American Wind Energy Association – 202-383-2500

http://www.awea.org/

The US Department of Energy Wind Powering American Initiative:
206-553-7841 (Western Regional Office)
http://www.eere.energy.gov/windandhydro/windpoweringamerica/

US Department of Energy Wind Information:
206-553-7841 (Western Regional Office)
http://www.eere.energy.gov/windandhydro/

Small Wind Electric Systems: A Colorado Consumers Guide (DOE Publication)
303-275-4838
http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/small_wind/small_wind_co.pdf

ELPC Community Wind Financing Handbook. Explains the options for structuring and financing community-based wind projects.
Environmental Law & Policy Center, 312-673-6500
http://www.elpc.org/energy/windhandbook2004.pdf

National Wind Coordinating Committee – 1-888-764-WIND
Supports the development of commercial markets for wind power
http://www.nationalwind.org

Solar

The Borrowers Guide to Financing Solar Energy Systems
Copies available from the National Technical Information Service – 1-800-553-6847
http://www.nrel.gov/docs/fy99osti/26242.pdf

Photovoltaic Systems for Farmers and Ranchers – 303-275-3000
http://www.nrel.gov/clean_energy/farmer_pv.html

Solar Electric Power Association – 303-857-0898
http://www.solarelectricpower.org/

Solar Energy Industries Association – 202-628-7745
Trade association for suppliers of solar equipment, architects, consultants and others.
http://www.seia.org/

American Solar Energy Society – 303-443-3130
http://www.ases.org/

Solar water pumping design considerations, system selection, cost and economics:
800-553-6847
http://www.sandia.gov/pv/lib.htm

Solar-Powered Livestock Watering Systems
National Sustainable Agriculture Information Service
800-346-9140
http://www.attra-pub/solar/swater.html

Case studies on solar pumping in Montana:
800-275-6228
http://www.montanagreenpower.org

Geothermal

Geothermal Energy Association – advocates policies to encourage geothermal development and utilization – 202-454-5261
http://www.geo-energy.org

Geothermal Heat Pump Consortium – 202-558-7175
http://www.geoexchange.org/

Department of Energy information on geothermal energy – 877-337-3463
http://www.eere.energy.gov/RE/geothermal.html

Geothermal Direct Use Applications: Financing Development
Bob Lawrence & Associates, Inc. – 703-836-3654
http://www.geothermal-biz.com/Battocletti_090204.pdf

Hydropower

National Renewable Energy Laboratory – 303-275-3000
Information on hydropower for farmers and ranchers
http://www.nrel.gov/clean_energy/farmer_hydroelectric.html

National Hydropower Association – 202-682-1700
http://www.hydro.org

International Small Hydro Atlas – No telephone contact
http://www.small-hydro.com/index.cfm?fuseaction=welcome.whatis

Hydropower Resource Assessment for Colorado
Idaho National Energy Laboratory
208-526-0111
http://hydropower.id.doe.gov/resourceassessment/pdfs/states/co.pdf

Energy Efficiency

American Council for an Energy Efficiency Economy – 202-429-8873
Publications about energy efficiency and agriculture are available.
http://www.aceee.org/progpage.htm

Community Office for Resource Efficiency (CORE) – 970-544-9808

Promotes renewable energy, energy efficiency and green building
http://www.aspencore.org/

Colorado Governor's Office of Energy Management and Conservation – 303-894-2383
Sponsors programs to promote energy efficiency and renewable energy
http://www.state.co.us/oemc/

US Department of Energy, Central Regional Office – 303-275-4826
Offers publications and programs on energy efficiency and renewable energy
http://www.eere.energy.gov/EE/industry.html

ColoradoENERGY.org
Contact R.L. Martin & Associates – 712-848-3297 or 970-219-2605
http://www.coloradoenergy.org/tips/default.htm

Relevant Organizations

Small Business Administration - 303-844-2607
http://www.sba.gov/co/

StEPP Foundation – 303-277-0932
Provides grants for renewable energy projects:
http://www.steppfoundation.org/rfp/rfp.htm

Colorado Office of Economic Development & International Trade.
303-892-3840
Information on loan funds and technical assistance for community and economic development in Colorado:
http://www.state.co.us/oed/finance/funds.cfm

Intermountain Harvesting Clean Energy Network.
Contact Colorado Working Landscapes at 303-283-3524
The Network is being developed as a partnership between the Colorado Farm Bureau, Rocky Mountain Farmers Union, Environment Colorado and Colorado Working Landscapes. It will support rural communities in CO, NM, AZ, NV, UT, WY and KS.
http://workinglandscapes.com/CREF.htm

Harvesting Clean Energy
Contact Climate Solutions at 360-352-1763
http://www.harvestcleanenergy.org/hce.html

Colorado Working Landscapes - 303-283-3524
Works to conserve land, sustain agriculture and enhance landowner values while recognizing public benefits
http://www.workinglandscapes.com/

Council of Energy Resource Tribes - 303-282-7576

Provides technical information related to the management of tribal resources
http://www.certredearth.com/content.php?page=aboutCERT&title=About%20CERT

Rocky Mountain Farmers Union – 303-752-5800
Grassroots farm and ranch association
http://www.rmfu.org/

Colorado Farm Bureau – 303-749-7500
http://www.colofb.com/

Western Area Power Administration – 720-962-7000
http://www.wapa.gov/

Western Governors' Association – 303-623-9378
Has working groups that deal with energy issues
http://www.westgov.org/

REC Brokers Active in Colorado

3 Phases Energy Services
Sells Green-e certified RECs, offers green pricing and suggests technology solutions to customers (PV, solar, efficient HVAC)
Partners with western utilities to offer solar, wind and biomass
Offices in San Francisco, Los Angeles and Portland.

Utility Partnership & Green Certificates Division
Presidio of San Francisco
6 Funston Ave.
San Francisco, CA 94123

Phone: 866.476.9378 (toll-free)
Fax: 415.680.1561
http://www.3phases.com

Bonneville Environmental Foundation (BEF)
Located in Washington state, BEF is a non-profit organization that markets green power to both the public and private sectors. BEF developed a green tag product in 2000 to support renewable energy development in areas where alternative energy is not available. Revenues from green tag sales are reinvested into new project development. It offers both BEF Green Tags and Environmentally Preferred Power (EPP). BEF Green Tags are RECs generated from sources in the Northwest and Alberta, Canada. EPP is green power sold to public utilities in the Pacific Northwest.[35] EPP is a blend of new and existing wind and low-impact hydro. In 2003, the new content was 60%. Proceeds from Green Tag sales are re-invested in new renewable projects through a grant-making process.

[35] Idaho, Montana, Nevada, Oregon, Washington and Wyoming. http://www.b-e-f.org/about/renewable.shtm

Angus Duncan - *President and CEO*
Bryce Smith - *Renewable Energy Project Manager*
Bonneville Environmental Foundation
133 SW 2nd Avenue, Suite 410
Portland, OR 97204
503-248-1905
Toll-free: 866-BEF-TAGS (233-8247)
info@b-e-f.org
www.b-e-f.org

Community Energy
Offers NewWindEnergy RECs.
Mona Newton
Colorado Marketing Director
Mona.Newton@NewWindEnergy.com
303-666-5307
708 Grant Ave.
Louisville, CO 80027
www.CommunityEnergy.biz

EAD Environmental
Markets RECs and implements green power campaigns (public education)
EAD Environmental, LLC
100 William Street, Suite 2005
New York, NY 10038
Phone: 1.866.323.4733 Fax: 212.232.5353

Mainstay Energy
Aggregates RECs from small scale renewables, sells RECs and finances projects. Works with wind, solar PV, biomass, geothermal and low-impact hydro producers.
161 E. Chicago Ave., Suite 41B
Chicago, IL 60611-2624
877-473-3682 (tel.), 312-896-1515 (fax)
http://www.mainstayenergy.com/

NativeEnergy
Purchases help finance new wind farms and methane projects. The company also provides consulting services to procure green energy supplies, develop and manage green pricing programs, develop and negotiate green tag and power purchase agreements, and design green energy marketing and sales programs.
823 Ferry Road
P.O. Box 539
Charlotte, VT 05445
800.924.6826
E-mail: info@nativeenergy.com

http://www.nativeenergy.com/

PPM Energy
Offers Green-e certified wind products. Develops wind power.
1125 NW Couch Street
Suite 700
Portland, OR 97209
503-796-7000
http://www.ppmenergy.com/wwd.html#re

Renewable Choice Energy
Markets wind RECs.
1-877-810-8670
http://www.renewablechoice.com/m/

Sterling Planet
Develops green power marketing and renewable energy development programs for utilities, non-profits, businesses, colleges and governments. Sells RECs derived from new generation -- wind, biomass and solar.
3295 River Exchange Drive, Suite 300
Norcross, GA 30092
877-457-2306
http://www.sterlingplanet.com/

6. Technology Providers and Project Developers

Biomass

McNeil Technologies
Scott Haase
143 Union Boulevard, #900
Lakewood, CO 80228
303-273-0071
http://www.mcneiltech.com
Provides analytical expertise to assess renewable energy resource potential (biomass, wind, solar, geothermal). Services include: technical and economic feasibility studies for renewable power plants and thermal applications, market assessments, development of green power marketing programs, workshop and conference management and the development of communication and outreach programs.

Chiptec
48 Helen Avenue
South Burlington, VT 05403
800-244-4146
http://www.chiptec.com
Provides equipment for converting biomass waste into energy.

Community Power Corporation
8420 S. Continental Divide Road, #100
Littleton, CO 80127
303-933-3135
http://www.gocpc.com
Develops, commercializes and markets renewable energy products, including biomass conversion technologies.

Delta Dynamics, LLC
1420 18th Street
Denver, CO 80202
303-298-7241
http://www.deltadynamicsenergy.com
Constructs small-scale biomass power plants and installs systems to improve energy efficiency

Blue Sun Biodiesel
344 E. Foothills Pkwy., Suite 3E
Fort Collins, CO 80525
970-221-0500
http://www.gobluesun.com
Develops and produces oilseed crops. Manufactures and sells biodiesel.

Wind

Distributed Generation, Inc. (Disgen)
Dale Osborn
200 Union Blvd., #304
Lakewood, CO 80228
Tel: 303-531-5223
Fax: 303-531-5527
dosborn@disgenonline.com
www.disgenonline.com

EnXco
North Palm Springs, CA
www.enxco.com
Developer of Peetz wind farm

AES SeaWest Wind Power
858-268-7909
www.seawestwindpower.com

American Wind Energy Association (AWEA)
1101 14th Street, 12th floor
Washington, DC 20005
202-383-2500
List of small turbine equipment providers:
http://www.awea.org/faq/smsyslst.html

List of AWEA members:
http://web.memberclicks.com/mc/directory/viewallmembers.do?masthead=true

GE Wind Energy
http://www.gepower.com/businesses/ge_wind_energy/en/index.htm
No telephone contact provided.

PPM Energy, Inc.
1125 NW Couch Street, Suite 700
Portland, OR 97209
503-796-7000
http://www.ppmenergy.com/

Vestas USA
111 SW Columbia Street, #480
Portland, OR 97201
503-327-2000
http://www.vestas.com

Solar

There are numerous solar thermal and solar electric equipment representatives and installers in Colorado. The Colorado Solar Energy Industries Association (CoSEIA) maintains a list on its website at http://www.coseia.org/Directory.html. CoSEIA can be contacted at 303-333-7342 or 1-866-633-9764. The mailing address is P.O. Box 18191, Boulder, CO 80308-1191.

Geothermal

Geo-Heat Center
3201 Campus Drive
Klamath Falls, OR 97601
541-885-1750
http://geoheat.oit.edu/index.htm
The Geo-Heat Center provides technical assistance in geothermal resource development.

Millennium Energy
Joe Bourg
26596 Columbine Glen Ave.
Golden, CO 80401
303-526-2972
http://www.millennium-energy.net
Provides consulting services in renewable energy project development.

EMC Engineers, Inc.
Sandy Busby, Director of Marketing and Sales
143 Union Boulevard, #350
Lakewood, CO 80228
303-974-1210
http://www.emcengineers.com
Designs geoexchange systems and conducts economic feasibility studies

For additional Geoexchange system providers, see:
http://www.geoexchange.org/documents/qualified_2003.htm or contact the Geothermal Heat Pump Consortium at 202-508-5509.

The International Ground Source Heat Pump Association also provides accreditation and listings. 405-744-5175

For a list of installers in Colorado, refer to:
http://www.igshpa.okstate.edu/directory/dresult.asp

GeoExchange designers in Colorado are listed at:
http://www.igshpa.okstate.edu/directory/dresult.asp

Hydropower

National Hydropower Association
1 Massachusetts Avenue, #850
Washington, DC 20001
202-682-1700
List of equipment and service providers
http://www.hydro.org/directory/Services.asp?t1=index.asp&n1=Hydro+Directory

ALSTOM Power Inc.
860-285-3462
http://www.alstom.com
A leading manufacturer and provider of hydro turbines, generators, and related equipment.