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# Linking Distributed Electricity Production from Alternative Energy Sources to the Traditional Generation and Transmission System

Prepared for the United States Department of Agriculture

***The positions expressed in this study do not necessarily reflect the official positions of USDA or the Administration.**

# Linking Distributed Electricity Production From Alternative Energy Sources to the Traditional Generation and Transmission System

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## Executive Summary

On-farm generation of energy holds much promise as a means of contributing to the rural renaissance in America. Markets for renewable energy resources—including wind, biomass and solar—are growing rapidly as a result of technological advances, favorable policy developments at the state and federal level, such as renewable portfolio standards, and growing investor interest in "green" energy.

This paper examines business models that could provide greater opportunity for rural America to capture a larger portion of the value created by renewable energy projects. The findings are as follows:

- Currently, the primary renewable energy business model currently in place is for individual farmers to lease land to developers. This model, while low-risk, misses opportunities for greater value capture through multi-participant land/resource aggregation models.
- The greatest opportunity for profit comes from capital and resource pooling arrangements similar to those used in ethanol plant development. However, significant development of or provision of access to expertise in power plant development, power purchase agreements, financial mechanisms to maximize tax incentives and other power development complexities must occur for this to be successful on a widespread basis.
- Finally, to maximize profit opportunities, rural residents must have real-time access to "best practices" both in the policy and business model that can help them reduce operating risk and costs.

USDA can and should take a series of actions to help farmers and other rural residents realize the potential that renewable resources provide them. Specifically USDA should consider:

- Creating high-profile outreach tools and processes that help inform rural constituents on renewable energy market and policy developments on a regular basis, and create a means of capturing and transferring favorable market and regulatory developments into rural communities with significant renewable energy potential.
- Providing assistance to overcome the technical barriers to utility-scale renewable energy generation by establishing new mechanisms through which farmers or rural communities could gain access to nationally recognized technical and legal experts on partnership formation, power purchase and interconnection contracts and negotiation, and other complex matters that often dictate the success of renewable projects.
- Creating new mechanisms to increase demand for renewable power owned by rural entities through the creation of "green" labels.
- Examining why rural communities have under-utilized available funding sources and designing options to make investment in renewable energy more profitable.

## Introduction

Rural energy production holds much promise as a means of supporting our national energy needs and contributing to the rural renaissance in America. While on-farm consumption of electricity constitutes about 1% of the electricity consumption of America,[1] the rural electricity cooperatives that USDA supports deliver 10% of the nation's electricity.[2] A high percentage of the U.S. estimated wind and solar capacity and virtually of all of the biomass-derived electricity generation capacity is located either in rural areas or within the service territories of rural electric cooperatives. The EIA projects that renewable sources will account for about 10% of the country's total electric demand in 2015, compared with 8.1% in 2005. Nationwide, the growing demand for electricity and renewable energy specifically can contribute significantly to the economic development of rural America.

However, as renewable energy markets develop, the predominant business model is large-scale (primarily wind) development by non-local entities, including investor-owned utilities and private energy companies. These projects, while bringing economic benefits to the community, return the majority of the profits to outside entities. Capturing the value inherent in renewable energy production requires major shifts in the way in which farmers and other rural residents think about and act upon these opportunities. It also requires USDA to take a strong role in helping to develop the institutional and technical capacity required to take advantage of these opportunities.

The focus of this paper is on business models that sell power to the electric grid while maximizing the value captured and retained by the local community. These models can be employed by rural communities to "capture" profitable opportunities for developing and operating utility-scale renewable energy projects (including wind, solar, biomass, and waste-to-energy projects). However, significant and complex obstacles stand in the way of development of these resources. This paper is intended to examine not only the potential for various renewable resources, but also how USDA can assist rural communities to overcome the barriers that stand in the way to develop them and provide greater opportunities for Rural America to capture a greater share of the value of renewable energy resources.

To do this, the report is organized along several different lines of inquiry:

- Section I examines renewable energy market characteristics by resource type, including the size, location, and volume of current renewable energy production.
- Section II looks at the various barriers that stand in the way of further development of renewable energy resources in America that prevent full use of these resources by rural Americans.
- Section III examines a variety of business model options that can be applied to better enable on-farm generation. A discussion of the federal and state policies that either encourage or discourage on-farm generation is also addressed.
- Finally, Section IV provides a series of recommendations for policy and program options that could result in greater capture of renewable energy benefits by local rural communities.

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[1] Farm Foundation, "Agriculture as a Producer and Consumer of Energy", Arlington, VA, 2004
[2] Dorr, Thomas C., Congressional testimony, June 29, 2006

The analysis in this paper is predicated on several underlying principles:

- Unlocking the economic potential for renewables requires analysis of where the value lies in the renewable supply chain and tapping into it.
- Realizing this value requires sufficient scale at a local level, which in turn, informs the choice of a business model by the local communities.
- USDA has at its disposal a set of resources that are almost unique in the federal government: namely, the vast array of extension service offices and rural cooperative entities that can serve as credible and reliable distribution mechanisms for financial assistance, technical information, trainings and other materials developed centrally by the USDA.
- The first step in shifting the business of the rural communities is the dissemination of technical, business, and policy information in a manner that is comprehensible to America's rural entrepreneurs. Government support of this movement must be appropriate and timely to ensure a market-based solution to both our energy and rural renaissance goals.

The key findings are as follows.

- Affordable transmission remains the greatest obstacle to the development of rural renewable energy projects overall. However, given the complexity and the number of state and federal jurisdictional issues involved, the ability of USDA to impact these issues in the short and medium term may be limited.
- However, there are emerging policy solutions at the state and federal level that could substantially "tilt" the playing field toward renewable energy development. These include provisions of the Energy Policy Act of 2005 calling on the federal government to create new transmission "corridors" in renewable resource-rich areas, to state regulatory developments that could make transmission access more transparent and affordable for renewable energy projects. USDA can and should play a significant role in helping analyze and publicize these developments to ensure that rural communities are able to capitalize on them to the greatest degree possible.
- The greatest opportunities for "capture" of renewable energy value arises from the ability of rural communities to aggregate their resources, either in the form of land lease rights or capital formation to develop new projects at the rural level. However, success in these endeavors also involves the acquisition of a sophisticated understanding of the various technical and contracting mechanisms that govern power production, including site selection, project operation and power purchase agreement negotiation. These are skills that are difficult to develop on a community-by-community basis. USDA can play a significant role in helping to provide this expertise to rural communities.
- There is no current mechanism for differentiating renewable energy generated and owned by rural communities. For that reason, some examination of marketing and outreach mechanisms that could spur greater demand for rurally-owned renewable energy should be considered for adoption by USDA.
- Finally, from examination of current use of federal incentives and loan guarantees for renewable energy projects, USDA may wish to analyze whether these programs could be used to more effectively facilitate rural ownership of renewable energy assets.

Based on these findings, we recommend the following actions by USDA:

### *USDA Should Facilitate the Capture and Transfer of "Best Practices"*

Given the pace of change in the renewable marketplace, new policies and business models emerge on an almost daily basis that fundamentally alter the feasibility of rurally owned and operated renewable energy. It is critical that rural communities and farmers have easy access to information and analysis of these developments in a manner that allows prospective developers to understand the impact on them more clearly and provides an opportunity to take advantage of them.

By providing rural Americans with easy access to such information, USDA would facilitate a more rapid transition to creative new best practices and allow for rural Americans to increase their profitability by using and adopting cutting edge policies and business models. However, without access to real-time information and analysis of these policies, this is unlikely to occur.

Actions that USDA could take to facilitate this information sharing and transfer could include: creating a website dedicated to communicating developments of interest in renewable energy to rural constituents; creating and delivering tutorials on topics of particular interest to rural communities; developing and delivering in-depth training on important renewable energy topics; developing on-line resources to help rural constituents better understand how their particular location rates in terms of potential for various renewable energy development.

### *USDA Should Provide Access to Technical Expertise for Rural Constituents*

On-farm energy generation will entail a number of technical decisions, ranging from the deciding on the appropriate energy source, technology, and size; to project related decisions involving siting and connecting to the grid; to business challenges such as the aggregation of financing and finding and negotiating a power purchase agreement. Development of the complex agreements and contractual obligations required to negotiate large scale power projects requires considerable expertise. In most cases, tackling all of these issues requires outside expertise or counsel, which is often time consuming and expensive.

USDA can help rural constituents overcome this barrier by establishing a program through which it would provide rural cooperatives and individual farmers access to experts on the various aspects of renewable project development, including negotiating power purchase and transmission access agreements, accessing capital, and establishing partnership agreements. These experts would be pre-screened by USDA to determine their level of expertise and experience in the renewable energy field.

### *USDA Should Generate Greater Demand for Renewable Energy Through "Green" Branding*

To assist in developing a local market for on-farm energy products, tools could be developed to create additional demand for rurally-derived renewable power. The government has used similar branding campaigns to build consumer awareness and markets for environmentally friendly products to great success, most notably with the ENERGY STAR Program. The federal government could assist rural developers to create green market branding campaigns to help the public connect the benefits of rural based renewable generation to those regions and to their own lives.

***USDA Should Examine Options to Increase the Attractiveness and Use of Financial Incentives for Renewable Energy Projects***

The Federal Production Tax Credit (PTC), with its relatively short authorization periods and lapses resulting from delays in reauthorization, has had the effect of creating boom and busts periods in the industry. To avoid such cycles in the future, the federal government should develop guidelines for a consistent, integrated set of financial incentives targeted specifically at renewables and on-farm generation, including making the PTC, CREB and REPI long-standing and consistent. Reforming the PTC to allow it to be applied against ordinary income instead of passive income would significantly increase rural ownership opportunities.

# I. Renewable Energy Markets

### *Renewable Resource Analysis*

Renewable energy represents only 9 percent of the nation's electricity production; roughly 75 percent of this production comes from conventional hydropower.[3] However, in recent years, federal and state regulatory demands for greater renewable energy production have grown significantly. Due to a variety of economic and environmental barriers, development of large scale hydroelectric production facilities has almost stopped. As a consequence, solar, wind and biomass energy are currently the fastest growing renewable energy segments. This growth in solar and wind is aided by technology improvements which have significantly reduced their cost, assisted by regulatory incentives, such as renewable portfolio standards and production tax credits.

To understand the full value of renewables to rural communities, it is important to understand the current market drivers and economics for each resource. The following section provides more detail on the market conditions for each resource.

### *Impact Potential for Alternative Energy Resources*

| Resource | Technology | Impact Potential |
|---|---|---|
| Biomass – Energy crops | Gasification or direction combustion | High |
| Biomass – Agricultural waste, forest residue | Gasification or direct combustion | Medium |
| Biomass – Manure | Anaerobic digester (gasification) or direct combustion | Medium |
| Biomass – Municipal Solid Waste | Anaerobic digester, landfill | Low for rural |
| Wind | High- and low-speed turbines | High |
| Solar | Solar Thermal and Photovoltaic | Low early, high ultimately |

## Wind

U.S. wind energy installations now exceed 10,000 megawatts (MW) of generating capacity and should generate an estimated 25 billion kWh in 2006. Since reaching the 2,000 MW benchmark in 1999, domestic wind power capacity has grown fivefold (approximately 29% average annual growth), and more wind power (3,000 MW) is forecasted to be installed in 2006 alone than existed in the entire installed base in the year 2000 (2,500 MW).

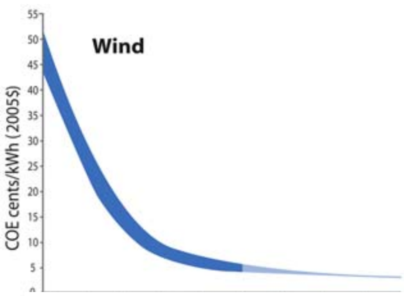
The American Wind Energy Association expects the U.S. to exceed 15,000 MW of installed capacity by the end of 2007 and, potentially in excess of 25,000 MW installed by the end of 2010. Texas recently surpassed California as the leading producer of wind-power in the United States. Both states each have greater than 2,300 MW of installed capacity, which makes up half of the installed capacity in the U.S., putting Texas and California ahead of Iowa, Minnesota, and

[3] Energy Information Administration, *2006 Energy Power Annual*; figures are for 2005 production

Oklahoma, the next highest states in installed capacity. The overall wind energy ***potential*** of the U.S. is estimated at 10,777 Gigawatt-hours per year—more than twice the electricity generated in the U.S. today[4]. The 10,000 MW of wind power installed in the U.S. today can potentially provide $20 million - $40 million in lease payments to landowners and provide long-term jobs to about 2,500 people in the U.S.

In the United States, the cost of wind power has fallen almost 90% over the past 20 years, from almost $0.50/kWh in 1980 to $.04-.06/kWh today. There is potential for wind prices to fall even further with some estimates suggesting that prices could dip to $.03 kWh for on-shore wind and $.05 kWh for off-shore wind by 2012. Some forecasts project that even without subsidies wind energy will be competitive with fossil fuels by the year 2010. These forecasts are based on expected improvements in wind production from larger wind farms and increased average turbine size, coupled with lower costs of capital and updated technologies on attractive sites.[5]

**Figure 1:**
**Levelized cost of energy in constant 2005$**




Today:
- Cost 4-6¢/kWh (unsubsidized)

Potential:
- 3¢/kWh (onshore) by 2012
- 5¢/kWh (offshore) by 2012

Typically, wind developments in rural America have taken one of two forms:

- Distributed generation wind projects, typically single or sometimes in serving multiple large consumer-investors used primarily to offset electricity purchases.
- Utility scale wind projects with 10 or more large turbines interconnected and secured by the sale of energy to a utility or coop through a power purchase agreement. This scale of project is primarily owned by utilities or large corporate entities, but there is increasing growth in community wind projects with some degree of local ownership and control.

While excellent potential exists for the further expansion of wind power in the United States, there are transmission, intermittency and peak production issues that present a challenge for grid-connected enterprises. These barriers and some emerging solutions will be discussed in more detail in Section II of this paper.

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[4] Source: Pacific Northwest Laboratory
[5] NREL, AWEA, GE Wind, ACORE

## Solar

Solar technologies have become increasingly more efficient over the years, and today photovoltaic (PV) and concentrating solar power (CSP) systems are considered the most mature and reliable technologies for medium to large scale utility production. Because solar power is generally available coincident to utility peak power usage patterns, electricity generated by solar is more valuable than wind energy, which generally is highest in off-peak hours.

## Concentrating Solar Power

Concentrating solar power systems produce electric power by converting the sun's energy into high-temperature heat using various mirror configurations. The plants consist of two parts: one that collects solar energy and converts it to heat, and another that converts heat energy to electricity. These technologies use only direct-beam sunlight, rather than diffuse solar radiation; therefore, making the southwestern U.S. a prime area for development opportunities. Concentrating solar power technologies currently offer the lowest-cost solar electricity for large-scale power generation (10 megawatt-electric and above). According to the Arizona Corporation Commission, CSP facilities that generate about 250MW provide the greatest cost efficiencies, with current technologies costing about $2–$3 per watt able to produce power at approximately 9¢–12¢ per kWh. New, innovative hybrid systems that combine large concentrating solar power plants with conventional natural gas combined cycle or coal plants can reduce costs to $1.5 per watt and drive the cost of solar power to below 8¢ per kWh[6]. Table 2, below, illustrates a few of the large-scale CSP projects that are currently in production or construction in the United States.

***Table 2: Large Scale CSP Projects in the U.S.***

| Capacity | Location | Utility |
|---|---|---|
| 64 MW | Eldorado Valley, near Boulder City, Nevada | Nevada Power/ Sierra Pacific Power Company |
| 300 MW | Calexico, California, Imperial County (proposed) | San Diego Gas & Electric |
| 500 MW | Victorville, CA (near LA) (proposed) | Edison International (NYSE:EIX) subsidiary Southern California Edison and Stirling Energy Systems |

## Solar Photovoltaics

Photovoltaic (PV) systems use solar photovoltaic arrays or solar cells to create electricity. Photovoltaics turn sunlight directly into DC electricity, which is then inverted into AC power. Maintenance consists of keeping panels clean and maintaining batteries. PV is used primarily off-grid; in the areas where PV is grid-tied, it is sized primarily to offset a portion of the electricity load. PV systems are limited by their storage capacity, but are most cost effective when connected to the grid to provide peak hour supplemental coverage. Photovoltaics are expensive ($0.18-0.30/kwh) which makes them uncompetitive with utility-scale power plants. However, installation

[6] Sandia National Laboratories (http://www.energylan.sandia.gov/sunlab/overview.htm#cost).

of large scale PV systems is feasible with the right economic incentives such as those offered in Europe (and recently in New Jersey). As Table 3 (below) demonstrates, there currently are several utility-scale PV projects in operation in the southwestern United States, which has some of the best solar potential in the world.

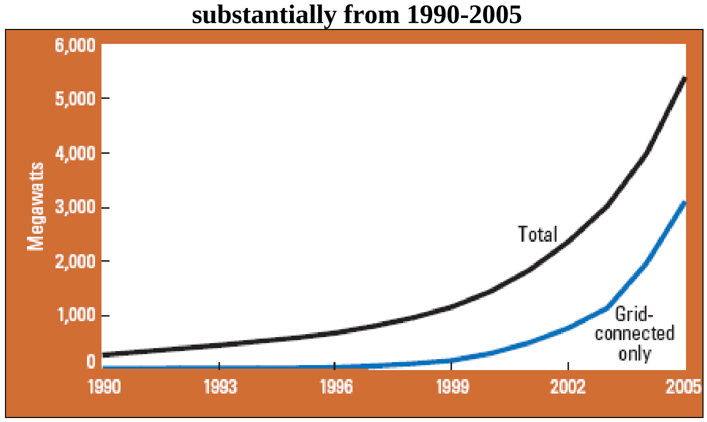
***Table 3: Large Scale PV Projects in the U.S.***

| Capacity | Location | Utility |
|---|---|---|
| 2 MW | Rancho Seco, California | Sacramento Municipal Utility District |
| 150 MW | Kramer Junction, CA | Part of the Solar Energy Generating System |
| 160 MW | Harper Lake, CA | Part of the Solar Energy Generating System |

The PV industry is projected to grow from an $11.2 billion business in 2005 to a $51.1 billion business by 2015.[7] Numerous companies entered the public equities markets in 2005, more than doubling the activity from 2004. In addition, private venture capital funds contributed more than $150M to a number of multiple next-generation solar technology companies, including U.S. based Nanosolar.

The industry however is investigating the potential of thin film technology, which uses an order of magnitude less silicon compared to wafer-based solar cells, thereby leading to a significant drop in manufacturing cost. Additionally, two longer-term technological advances, thin-film organics and nanotechnology, have the potential to dramatically reduce the cost of photovoltaics.

**Figure 2: Solar PV existing world capacity has increased substantially from 1990-2005**




*Source: NREL and BAH Analysis*

## Biomass

Biomass refers to any plant derived organic matter available on a renewable basis, including dedicated energy crops and trees, agricultural food and feed crops, agricultural crop and wood wastes and residues, animal wastes, and municipal wastes.[8] In 2005, the USDA and the U.S. DOE published a comprehensive biomass report, referred to as the "Billion Ton Study," which evaluates the size of the biomass resource. The report suggested that the current amount of rural biomass has an energy potential of 2,200 trillion BTU (TBtu) from wood and 2,800 TBtu from agriculture. The annual energy potential in miscellaneous waste, which excludes industrial waste and hazardous waste, was projected at 2,500 TBtu, including 540 TBtu from animal manure and 18 TBtu from dairy and swine manure methane recovery.

In 2003, biomass contributed nearly 2.9 quadrillion BTU to the nations energy supply (nearly 3%); making biomass the single largest renewable resource in the U.S.[9] Much of today's biomass-derived generation is provided by CHP facilities located at forest product industry sites.[10]

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[7] Clean Energy Trends Report by Clean Edge
[8] U.S. Department of Energy: Energy Efficiency and Renewable Energy (http://www.eere.energy.gov/RE/biomass.html)
[9] DOE/GO-102995-2135: "Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply", DOE April 2005, ORNL

Biomass can be used to generate electricity by burning it directly, co-firing with coal, gasifying it, or converting it into a fuel oil. Biomass can substitute up to 15% of the total energy input of a fossil burner with minimal modifications, and little to no loss in operating efficiency. The highest concentration of biomass boilers are used in the forest products industry and fired by pulping liquors and wood residues, due to the fact that they have significant biomass resources available on-site as by-products from their industrial processes.

Feedstock characteristics are a limiting factor for biomass use for power generation. Wood contains 50 percent moisture and must either be dried prior to being used as fuel (at some cost), or fired in special boilers designed to accommodate this high moisture content. Similarly, recently harvested biomass is wet, so up to half of the transportation cost (based on tonnage) is for water that has no fuel value.

The Public Service of New Hampshire recently brought on-line one of the nation's largest projects, the Northern Wood Power Project.[11] This $75 million project replaced a 50 MW coal boiler with a high-tech 50 MW wood-burning boiler. This project offsets the need to burn more than 130,000 tons of coal annually with the substitution of 400,000 tons of wood collected from the surrounding region. The high moisture content of the wood required the use of a state-of-the-art fluidized bed combustion system to improve the efficiency and combustion characteristics of the wood boiler.

As the example above illustrates, the significant feedstock requirements of a biomass boiler can serves as a limiting factor for sizing the technology; generally the rule of thumb is that biomass projects must be sized based on the amount of biomass that can be economically collected within a 50 to 100 mile radius. If a biomass power plant is built without contracting a long-term feedstock purchase agreement the resulting high demand for local biomass can create a seller's market where feedstock cost could significantly impact plant economics.[12]

Biomass can be found almost everywhere, but a large percentage of the biomass is concentrated in rural communities. The upper Midwest has not only the greatest levels of biomass, but the most ethanol plants and plant development activity as well. Much of the area between Michigan and Louisiana has high biomass levels, as does much of the West coast, the Carolinas, and Maine. Trends in biomass energy development are overwhelmingly towards transportation fuels, and there has generally been more activity in biogas and waste-to-energy than in creating power plants dedicated to wood or crop residues. The power plants that do rely on wood more often than not co-fire the biomass with coal. Over the long term, gasification is the technology that holds the greatest potential for mobilizing the direct use of biomass for power, but technology advances are still needed to reduce the cost of gasification systems.

## Biorefineries with Power Co-production

[10] U.S. Department of Energy: Energy Efficiency and Renewable Energy, (http://www.eere.energy.gov/RE/bio_biopower.html).
[11] Public Service of New Hampshire (www.psnh.com/nwpp)
[12] "WTE Biomass Power Plant in Central Wisconsin; Final Report on Grant No. 89029", Ragland, Ostlie, Berg, November 2000

As cellulosic biomass technology develops and demonstration projects evolve into commercial ones, biorefineries could be dispersed throughout rural America to produce transportation fuel, high value chemicals, and power. According to a 2002 study by NREL:

> *The major co-product of ethanol production from cellulose is lignin, which is produced in large quantities. For example, the four 550 bone dry ton (bdt) per day ethanol plant configurations considered in this study convert 180,000 bdt per year of biomass into 9.3 - 13.6 million gallons of ethanol, and 98,500 - 126,500 dry tons of lignin[13]. The lignin co-product is enough fuel to produce 14 - 18 MW of electricity in an efficient standalone power plant, or more than enough to supply all of the steam and electrical needs of the ethanol production operation, and still produce a surplus of 5 - 10 MW of electricity.*[14]

Such a model would mean that every biorefinery would also be a power plant, at a scale capable of exporting power to the transmission grid.

In terms of investment behavior in transition to this new model, by siting pilot cellulosic production technology projects onto existing ethanol biorefineries, demonstrations of these new technologies can be performed while minimizing necessary capital investment. They would also gain the technical expertise necessary to expand their businesses once they develop these new cellulosic ethanol production methods.

Selecting the location of the next generation of biorefineries may be dominated primarily by feedstock location issues, since transportation of biomass which is not very energy dense can become prohibitive as distance to the plant increases. A secondary consideration will be proximity to existing plants to utilize the biorefineries primary products, and the associated infrastructure for their export, such as transportation fuel pipelines, trucking for chemical products, and distribution and transmission lines for power.

There are multiple models to co-locate biorefining and power generation. One is to co-locate the cellulosic ethanol biorefinery with an existing power plant. Currently, about 28% of a grain ethanol plant's operating cost is for energy, so this would clearly benefit the biorefineries cost of energy. This would assist in co-locating power generation with existing power transmission infrastructure, and the existence of green credits to existing plants might make it useful in the near term, but likely has limited utility as a growth model given the energy density of biomass and associated costs and best land use planning.

These technologies have been demonstrated on a pre-commercial scale, but there is significant room for improvement in the cost and scale of these technologies, so that they might be more economic in this application. For example, cellulosic ethanol technology has the potential to mobilize a much greater proportion of the energy in woody or starchy plants, and that process can yield substantial amounts of lignin which can be used for biomass based power generation.

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[13] This amount of lignin appears to be approximately half to two-thirds of the biomass input, which if correct is higher than the 10 to 30% range most other studies use.

[14] "Bioethanol Co-Location Study", NREL/SR-510-33000, G. Morris, November 2002

## Waste-to-energy

The primary waste-to-energy opportunity for the rural sector is the capture and use of biogas emissions by dairy and hog farmers. Biogas, which contains approximately 60% methane and 40% carbon dioxide, is produced by the anaerobic digestion of waste. The methane content of biogas varies from 55% to 80%, with the average energy content of pure methane at 896-1069 Btu/standard cubic feet (scf), while natural gas has an average heating value about 10% higher than pure methane. The liquid flush manure collection systems used in dairy and hog farming facilitate the capture of the methane exhausted during the decomposition process.

The on-farm business model for Anaerobic Digestion (AD) in the U.S. is primarily distributed cogeneration to power and heat the farm itself. There are a few regional or centralized digesters which transfer manure from multiple farms to an off-farm digester operated by a third party. Typically this approach requires manure to be collected fresh with very little process water from farms located within about 5 miles of the processing location.15

In addition to electricity, the solid waste from the digestion process can be dried to produce stall bedding or commercial grade fertilizer, and hence can be valued at its price on the open market.16 Other benefits include waste heat, cleaner water, odor reduction and a cleaner environment. Such benefits further add to the value of AD beyond the value of its salable products, thereby "making digesters economically feasible even at less generous rate structures."17 The reduction of odors alone may ease pressures on large livestock operations, making such operations more acceptable to permitting agencies and local residents, which in turn may allow for even further expansion of operations where benefits may still arise from economies of scale.18

Manure digestion technology, however, is still in its infancy so early adopters face a significant amount of risk by entering into this business. Digester technology also displays significant economies of scale with respect to farm size. This is due to installation costs that are fixed with respect to the size of the operation. Hence, larger farms will gain more of a competitive edge through the use of digesters than will small farms.19 For this reason, there are currently no functioning digesters on U.S. farms with less than 400 cows.20

State and federal policies and incentives already exist for drive adoption of on-farm renewable energy technologies. Farmers interested in demonstrating a cost-effective technology for converting manure into biogas and generating electricity, for example, may be eligible for a Renewable Energy Technology Research and Development Grant of up to $50,000. Other incentives available through the state's renewable energy program include technical feasibility study grants; business and marketing grants; cash-back rewards for installing renewable energy technologies; and an equipment grant for non-profit organizations.21

15 EPA Methane-to-Markets Partnership
[16] Mehta, A., The Economics and Feasibility of Electricity Generation using Manure Digesters on Small and Mid-size Dairy Farms, Dept. of Ag. and Applied Economics Energy Analysis and Policy Program, Univ. of Wisconsin-Madison, Madison, WI, Jan 2002. , page 3.
[17] Ibid.
[18] Mehta, page 19.
[19] Mehta, page 18.
[20] Mehta, page 14.
[21] "Farmers Need to Check Out Funding for Renewable Energy Ventures, Says DATCP Secretary", Wisconsin 2002. 15 November 2006 www.focusonenergy.com.

Other levers, however, may also be used to drive adoption of on-farm renewable energy systems. Local environmental regulations and other policies governing land use and waste disposal, for instance, are key drivers for adoption of AD systems.22 Stringent policies in these areas could effectively drive the rapid adoption of AD systems by large livestock operations. Any taxes or limits on carbon emissions could spur the development of AD systems, as methane is 20 times as potent as carbon dioxide in its global warming potential.

## Landfill Gas

Municipal solid waste (MSW) naturally produces landfill gas (LFG) through anaerobic digestion, up to 432,000 scf/day of LFG per million tons MSW can be produced. With landfills becoming more costly and landfill volumes continuing to shrink, the economics of alternative disposal methods are becoming more attractive. There are currently 600 candidate landfills in the U.S. with a total LFG generation potential of 725 million scf/day (about 15,000 MMBtu/hour).23 Many landfills generate revenues through the sale of electricity or process heat. Onondaga County Resource Recovery Agency in North Syracuse, NY, generates in excess of $11,000,000 annually through the sale of waste-derived electricity sold to Niagara Mohawk for $0.06 per kWh24. Although the scale and size of rural landfills may limit the possibilities, this is a resource worth consideration in local communities.

Biomass and MSW can also be converted to pyrolysis oil (bio-oil). Pyrolysis involves the conversion of biomass to gas, liquid, and char through rapid heating and quenching in the absence of oxygen. Pyrolysis oil has the benefit of quadrupling the energy density of raw biomass and MSW, allowing more cost-effective transport. However, the high expense of this technology is currently cost-prohibitive for its use as a material densification option.

[22] Lusk, page 2-3.
[23] U.S. EPA, Landfill Methane Outreach Program (LMOP), "An Overview of Landfill Gas Energy in the U.S.", April 2006 PowerPoint
[24] OCRRA 2001 Budget Summary, "Major Assumptions for Budget Year 2001", (http://www.ocrra.org/2001budget.htm)

## II. Renewable Energy Barriers

### Challenges in Integrating Renewable Power into Regional Transmission Grids

As noted in Section I, renewable resources are often widely dispersed and located far from demand centers. The transmission system was built largely on a utility-by-utility basis to transport power from large central power stations to load centers. In most cases, the power plants were located within the utility service territory, with adjunct capabilities to sell power "off grid" to neighboring utilities or transmission-only utilities. The transportation of large quantities of remotely-generated, small scale and intermittent power supplies across long distances was not anticipated during the original construction of these systems, nor was this scenario anticipated in the development of state and federal regulatory pricing schemes.

Further, the very nature of the regulated monopoly power generation business is highly complex and in itself a barrier to development of rurally owned and operated, utility-scale renewable resources on a widespread basis. Utility system operators must balance electrical demand with appropriate generation sources on a real-time basis. Most system operators rely on "dispatchable" resources that can respond quickly to changes in demand. The challenge with renewable resources - particularly wind and solar - is that while they can provide valuable resources during times of high demand, they are not controllable resources that can be used to meet peak loads and are often remotely located from the source of the demand. As a result, renewable energy producers are often faced with complex and often risky power purchase agreements that may contain penalties for failure to deliver during peak energy user periods.

The challenge of incorporating intermittent resources into the utility system is currently being addressed in several ways. To the extent there are operational challenges, such methods as the increased use of cycling fossil plants, pumped hydroelectric facilities, price responsive demand-reducing programs, and distributed generation at load centers can be used. In addition, advances in forecasting wind availability, for example, is a key opportunity to facilitate higher penetration of wind resources on a system. If forecasting abilities improve then less spinning reserve will be required and standby charges can be reduced. Many integration and interconnection advances- e.g., controllable distributed generation, advanced storage technologies and other smart grid tools - could be further investigated and improved by more nationally-funded research. Achieving broader interconnection to the regional grid can offset the intermittent nature of a resource and alleviate operational obstacles to integration.

The problems resulting from the lack of investment in transmission in the U.S. has been documented in many recent studies. The challenges facing transmission system planners include:

- Lack of comprehensive regional planning
- Complex cost allocation rules for transmission investment
- Inadequate financial incentives for transmission development
- New capacity siting challenges
- Uncertainties over when and how costs are recoverable in wholesale and retail rates

These issues can become more challenging when transmission upgrades are needed to move renewable power from a wind-rich state into another state that has an RPS requirement or green market opportunities.[25] Expanding the "interstate highway" transmission backbone, including the extension of such a backbone system into areas that have significant wind energy potential would greatly reduce renewable energy costs as developers would only be responsible for the connection to a preexisting transmission backbone.[26] Federal and state regional models for development of such transmission corridors should be monitored by USDA and communicated broadly to the rural community.

The growing constraints on transmission lines can severely impact renewable energy development in particular. The nation's transmission grid was built to move electric power from large fossil power plants to population centers, the particular challenges facing smaller scale renewable energy include[27]:

- Transmission lines may be either inaccessible or of insufficient capacity to move surplus wind-generated electricity to distant population centers (demand centers)
- Transmission pricing mechanisms may disfavor moving electricity across long distances due to distance-based charges or according to the number of utility territories crossed
- Scheduling accuracy, penalties for ancillary services and first to connect prioritization put renewable energy at a disadvantage
- High infrastructure costs for the initial hook-up to the power grid discourage entry, economies of scale are necessary
- New entrants may see access to the transmission power grid limited in favor of traditional customers during periods of heavy congestion
- Wind plant operators are often penalized for deviations in electricity delivery to a transmission line that result from the variability in available wind speed
- Mismatch of wind power with peak load conditions. In most onshore locations, wind blows strongest during the night and during the winter. However, electricity demand is strongest during the day and the summer.

These transmission issues are explained in a 2005 California Public Utility Commission investigation:

> *While the costs of network upgrades and gen-ties should be accounted for when comparing resource options, the current approach, which assigns the costs of these facilities to the renewable generators, is problematic for renewable generators for a number of reasons…Since renewable projects may be small relative to the size of the resource potential of the area in which they are located, the transmission facilities that are necessary to interconnect a given project to the grid are likely to be smaller that the optimally sized facility that will ultimately be needed to develop the region's potential. However, without a mechanism in place by which the first developer can recover additional costs beyond those necessary to ensure deliverability of its own generation from subsequent developers, it is unlikely that any developer will be willing to fund the*

[25] September 2006 National Grid report (Transmission and Wind Energy: Capturing the Prevailing Winds for the Benefit of Customers)
[26] Section 368 of the Energy Policy Act gives FERC the authority to designate energy corridors (including electric transmission) on federal land in the 11 Western States.
[27] Schnepf, R., Congressional Research Service (CRS) , "*Wind Power Impacts on Electric Power System Operating Costs: Summary and Perspective On, Year to Date*", March 28-31, 2004 & Texas Wind Coalition.

*additional transmission capacity necessary to fully exploit a region's renewable potential.*[28]

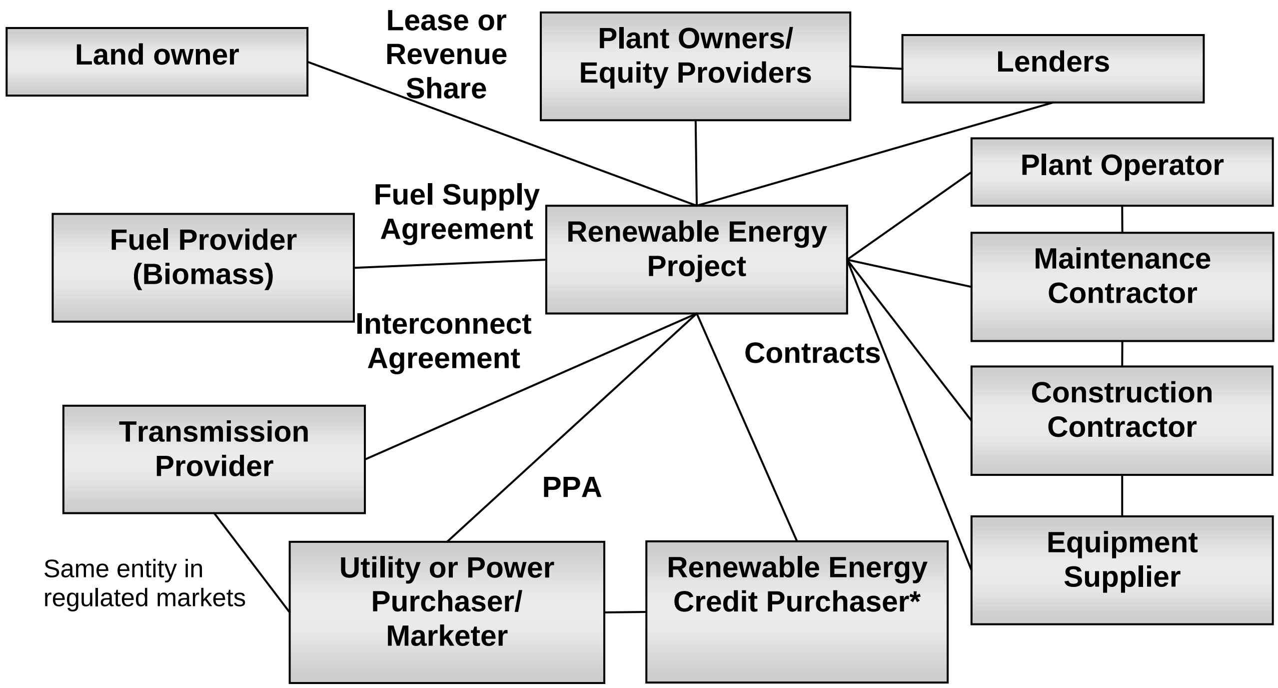
Finding new mechanisms to support investment in transmission for clustered renewable resources could greatly enhance their economic viability. In many electricity markets the determination of who must pay for transmission upgrades and gen-ties is uncertain. In most cases, renewable energy power plants can be built faster than transmission lines, but without guaranteed access to existing transmission lines renewable plants are difficult to finance. Texas has been a leader in renewable energy development in the U.S., and has recently acted to overcome this problem by establishing Competitive Renewable Energy Zones (CREZs). Transmission lines serving a CREZ have expedited approval and reduce the risk that the utility that builds the transmission line might not be able to recover its costs. The CREZ also reduce the development risks for renewables by establishing transmission rights for renewables and tying financial commitments by renewable developers to the transmission licensing process.[29] In addition, a number of efforts are underway by the American Wind Energy Association, FERC and IEEE to address interconnection issues with wind.

## Complexities of the Independent Power Producer Business Model

Rural landowners are able to increase their share in the value from renewable energy development by collective bargaining and/or negotiating revenue-sharing arrangements with project developers. However, in the current market, the highest returns (and the associated highest risk) are obtained by project ownership. Rural communities can maximize their value capture by managing or "owning" as much of the value chain as possible, including plant financing, equipment selection, management of permitting and construction, plant operation, and selling the power and associated environmental credits. This is the Independent Power Producer model, which involves coordinating the numerous entities shown below in Figure 3.

Figure 3: Entities Involved in Utility-scale Renewable Energy Independent Power Production

[28] CPUC OII 05-09-005, September 8, 2005, pp. 3-6.
[29] Public Utility Commission of Texas. Scope of Competition in Electric Markets in Texas. January 2007




* Unless unbundled, power purchaser will own REC
Source: BAH analysis

## Financing

Sources of funds for power plants include equity, debt, guaranteed loans, secured and unsecured loans. Equity in a project is subordinate to debt in case of default and therefore carries a higher risk and demands a higher return. Due to the high capital costs and low margins in traditional power production, debt to equity ratios as high as 80:20 are common, though most wind projects are funded by 40-60% debt.

In highly leveraged deals, the cost of debt can make or break the economics of the project. A Lawrence Berkeley National Laboratory study estimated that a typical 50-MW wind plant, which would deliver power at just under 5 cents/kWh if financed by a wind developer, could generate at 3.5 cents/kWh--a nearly 30% reduction--if an investor-owned utility (IOU) owned and financed the facility with a lower interest rate of 7.5% compared to 9.5% for a developer30. Government loan guarantees could similarly lower the debt interest rates for wind developers to IOU levels, drive down power production costs and increase potential returns.

Investor-owned power plants in deregulated markets are typically financed by project finance arrangements, also called special purpose entities, non (or limited) recourse, and off-balance sheet financing. In these arrangements, the project is an independent entity, and the lenders only recourse is to the project, not the parent company or other participant's assets.

[30] In "Alternative Windpower Ownership Structures: Financing Terms and Project Costs," Ryan Wiser and Edward Kahn of LBL

The optimal financial structure for a renewable power plant depends heavily on the tax regulations and subsidies available. Because renewable energy power plants have high capital costs but low operating costs, they are at a tax disadvantage when competing with fossil fuels, which can deduct fuel expenses from operating income.

This tax disadvantage is partially offset by allowing renewable energy investments accelerated depreciation[31] through the Modified Accelerated Cost Recovery System (MACRS). However, the development of renewable energy has been most powerfully driven by individual state policies and the Production Tax Credit (PTC)[32], which can increase a power plant's return by $20-30/MWh. Overall, tax subsidies pay for 60-70% of the capital costs[33]and the ability to maximize the benefit of this tax credit drives the ownership structure. Independent power producers or cooperatives with low tax payments commonly partner with investors or corporations that have a high marginal tax rate and need tax deductions in order to take full advantage of the PTC and the MACRS. These ownership models are discussed in Section III.

Renewable energy power plants face significant additional hurdles to obtaining financing including:

- Low margins and high capital costs (nature of the investment means that costs must be amortized over a long period of time, increasing all other risks)
- Low operating costs (creating tax disadvantages vs. fossil fuel generation)
- Technology risk premiums (unproven technologies such as biomass gasification, cellulosic ethanol and new advanced wind turbines)
- Market risk premiums (uncertainty of resource availability and continued policy support)
- Reduced capacity payments ability to sell into the spot market (due to intermittency of resource or unreliability of plant operation)

In addition, in deregulated markets, which are characterized by short-term energy sales and price volatility, financing for capital-intensive renewable energy projects becomes expensive and difficult to obtain. Because of these hurdles, a renewable energy project will normally be unable to obtain financing without a tentative Power Purchase Agreement with one or more buyers of the plant's electricity.

## Power Plant Development and Operation

Development of the power plant includes:

- Engineering (including engineering & economic feasibility studies, project design, air quality and site permitting requirements, etc.)
- Equipment Procurement
- Construction and Project Management

[31] Section 168: Modified Accelerated Cost Recovery System (MACRS) with 5-year, 200 percent (i.e., double) declining-balance depreciation. A typical rule of thumb is that 90% of the total costs of a wind project qualify for 5-year MACRS depreciation, with much of the remaining 10% depreciated over 15 years (Bollinger 2006).

[32] Currently at 1.9 cents per kWh

[33] Chadbourne and Parke, LLP. Renewable Energy Update, Project Finance Newswire. Sep. 2006. (Based on the Net Present Value of the plant)

- Project Commissioning

During the construction phase, the construction contractor should 'wrap' the construction risk, but the project developer takes the risk of project completion, and therefore needs to provide insurance and credit security for shortfall or failure to deliver. In at least one case, the project developer has failed to complete the project and declared bankruptcy and the construction contractor put a lien on the landowner's property. [34] In this case the landowner was fortunately able to raise the capital to complete the project and avoid the legal costs.

Wind power plants are the simplest plants to maintain and operate, whereas biomass power plants involve substantial feedstock supply and technological risks. The operational activities of a biomass power plant such as material harvesting, collecting, transporting, and some aspects of fuel processing may reside in the agricultural skill set, while other processing and operations related to the combustion or gasification of fuel, the turbine, the generation and transformation of high voltage power are much more specialized.

Wind turbines have specialized maintenance needs, but with no combustion component, the operation needs are greatly simplified. Solar photovoltaics, apart from some unusual electrical or storm related damage possibilities, are virtually maintenance free and well-suited to self-sufficiency scale projects.

The niche skills required to estimate, finance, develop, build, operate and maintain wind, solar or biomass power plants are complex. Clearly, there are significant obstacles from believing one has a substantial amount of consistent renewable resources, to developing a site or entering into the power provider business. There are also many opportunities for the USDA to take an active role in promulgating the knowledge and best practices necessary to enter these markets, and empowering and encouraging rural entrepreneurs with the access to financing and the proper tool set to succeed in leveraging their resources to add value to their communities.

## Power Purchase Agreements

Highly leveraged power projects are nearly always secured by long-term Power Purchase Agreements (PPAs). Plants that do not have PPAs but which sell power on the wholesale market are called 'merchant plants.' Financing and developing merchant plants was common in the late 1990s but many became uncompetitive when natural gas prices rose and today there is little investment without a PPA. A PPA is a contract governing the generation and sale of electricity, between the power plant owner and the electricity customer(s). [35] The basic information contained in a Power Purchase Agreement generally includes the purchase and sale of contracted capacity and energy (and possibly RECs) in addition to guarantees of performance, penalties, payments, force majeure, default and early termination.

[34] Sieve Wind Farm, Lincoln County, Minnesota, Wind Energy Easement and Lease Agreements, WINDUSTRY

[35] The website [http://www.mnpower.com/distributed_generation/] has some State examples and contract templates for PPA's, Energy Service Agreements, Interconnection Agreements, and similar distributed generation power project contracts.

The renewable power business is maturing, but power markets are inherently complex and establishing and negotiating power purchase agreements requires significant expertise. The agreements themselves can take several months to finalize. However, if the landowner can secure a tentative PPA with a cooperative, utility or other power marketer or power broker[36], they may obtain many times the return they would receive from selling the development rights before these relationships are established.

## Recognizing and Capturing Additional Sources of Revenue

Power plant revenues include capacity payments (normally low for wind plants due to the inability to guarantee generation and hence add capacity to the grid), electricity payments and more recently, environmental benefits payments. Environmental benefits payments include the growing markets for Renewable Energy Credits, or RECs.

The Renewable Energy Credits that currently produce the most value for power producers are Compliance Renewable Energy Credits, which are generated in States that have Renewable Portfolio Standards (RPS) requiring retail providers of power to purchase a certain percentage of their power from renewables. To meet this requirement, they can either own renewable electricity generation or buy credits or electricity from a renewable generator within the allowed area (the included areas vary and are determined by each State RPS). This "credit trading" system has been used effectively by the federal Clean Air Act to require utilities to reduce pollutant emissions.

RPS are "market-friendly," because they impose the fewest regulatory burdens on the market and reward the lowest cost producers of qualified renewable energy. They are currently in place in over 20 states, although their degree of aggressiveness in meeting their goals and penalties for non-compliance vary substantially. Outside of Connecticut and Massachusetts, prices for RECs to date have been low, on the order of $2-5/MWh. Massachusetts, by comparison, has had the highest priced RECs in the nation to date, up to $53/MWh. Most RPS regulations are recent and gradually increase over time, by approximately 1% per year, so the prices of RECs should rise as the market states increase their RPS standards and more states implement RPS.

Other sources or revenue include Voluntary RECs, or ‘green tags’, from Green Power marketers. There are many private sector organizations and utilities that purchase RECs from renewable energy producers on behalf of their customers as a means to support renewable energy.

An emerging source of revenue could be carbon emission reduction credits which might result from the nascent carbon cap and trade systems. Some U.S. farmers are currently receiving payments of up to $5 per ton for carbon offsets purchased on the Chicago Climate Exchange (CCX). While this CCX is a voluntary, prototype exchange, the value and amount of carbon offset funding available for alternative energy or carbon capture projects is anticipated to grow. The Northeastern US under the Regional Greenhouse Gas Emissions and California are in the process of instituting carbon emissions regulations and many power industry executives expect that the U.S. will have carbon limits or taxation schemes established within five years.

[36] Power brokers may not own any assets but trade power and realize profits on the margins in deregulated markets.

# III. Business Models for Rural Renewable Development

Capital investors who finance a power plant bear the risk and potentially receive the largest return. To the extent that members of the rural community can increase their capital participation in renewable energy projects, there is opportunity to capture value on the projects. Empowering local residents to become capital investors within a time period that can create room to keep outside investors from coming in and beating them to the project is a crucial element to ensuring that value remains in the rural economy.

However, some parts of the renewable energy value chain are more difficult for a member of the rural community to participate and compete in than others. The renewable power business is maturing and profit margins for the various segments of the value chain are in flux. In short, any examination of business models must start with an examination of where the greatest opportunities to profit lie in the renewable energy value chain.

## The Renewable Energy Value Chain

The value chain can be broken down into five basic components: capital development, technological components (such as wind turbine or solar panels, or their components), plant development, plant operations, and the power business itself. Below the relationship is represented graphically:

| | Capital Development | Component Manufacturing | Project Development | Plant Operation | Power Marketing |
|---|---|---|---|---|---|
| Opportunity For Rural Participation | Significant: Critical to participate in & move up the value chain | Small | Medium; depends on ability to develop specific skill sets | Small to medium depending on resource (e.g., biomass vs. wind) and ability to develop specific skill set | Small to medium, depending on the market conditions (varies by state and location) |
| Rural Market Power | Tailored incentives, capital aggregation leveraging of site dev. rights | No real opportunity to leverage site for equipment, need to aggregate with other developers to obtain market power | Leverage site/capital to be involved in deal or site development | On-site location reducing costs, leverage site/capital | Leverage site/capital to develop PPA or REC sales deals |
| Challenges to Rural Participation | Large corps, banks and taxed firms have competitive advantage | Site and operations mostly unrelated to machine market | Competition from outside experts in market, time to develop skills | Depending on resource, hard to be competitive in specialized skill sets | Potential performance risk if ongoing responsibility for delivering power |
| Types of Risk Involved | All: Technical and Market | Technology, component performance | Technology, Project, Construction, Supplier | Technology, Project performance | Market, Transmission Access, Price, Technology, Performance |

The largest themes that emerge from this value chain analysis include:

- Due to high demand, manufacturing of renewable energy components, such as PV panels and wind turbines are currently highly profitable. However, there is little opportunity for rural members to participate in the development of the components themselves or to team effectively with component providers.

- Opportunities for greater value capture remain in other parts of the value chain, including conducting pre-feasibility studies, developing project sites, negotiating and executing power purchase agreements, but these elements require highly specialized skills.
- Securing financing from local or rural sources is an important part of the solution to maximize rural value and keep wealth creation local/rural.

This analysis drives the discussion of discrete business models along the value chain which rural members can work toward or which policy makers can promote. However, the underlying construct in all business models is that there are several ways to increase the profitability of all renewable energy developments:

- Reduce non-systemic risk through acquisition of greater levels of sophistication.
- Reduce project costs by various means, including risk pooling, more transparent knowledge transfer among project developers, reducing the cost of marketing renewable energy resources and other mechanisms
- Ensuring that rural participants in the renewable energy markets capture greater value through mechanisms intended to aggregate the power of their greatest asset, which is the land and the crops grown on that land.

## Business Models

The best ownership model for land owner or entrepreneurial entrance into the power production business depends on the availability of capital, tolerance of risk, and chosen management structure. We will discuss these models in increasing order of difficulty, complexity and profitability.

### *Lease Models*

Leasing—whereby the individual landowner signs a lease right with a developer allowing use of their land in return for a lease payment—is the simplest and most prevalent model for renewable energy development in the rural U.S.

### *Leasing development rights individually*

Traditionally, land owners have chosen to capture additional revenues through leasing land to wind developers. This is the most simple and common form of rural power production development in the current investment climate. There is normally a fee paid for the option of development in order for the developer to invest the time and funding to conduct feasibility studies and project plans. The actual lease agreement may include payment per turbine (commonly $2000-$5000) and payment for the acres needed to construct roads and site the towers. Some landowners are now negotiating royalty payments of 2-4% of the plant's revenues. Revenue sharing (rather than profit sharing) insulates the landowner from some market risk and cost increases but not necessarily from performance risk so landowners must carefully negotiate the terms of these deals. There may be an option to purchase the wind farm after 10 years in the lease agreement.

*Leasing development rights collectively*

Individual landowner's ability to negotiate with developers and equipment providers can be limited by wind resource availability and access to transmission and distribution resources. Landowners that successfully join together to conduct pre-feasibility studies and perhaps even secure tentative Power Purchase Agreements, can greatly enhance their market power when selling their development rights, receiving as much as 10 times the value, according to a Constellation Energy wind developer.

Examples of collective wind leasing deals include:

- Trimont Wind Farm, MN. The owners carried out prefeasibility studies and responded to a request for proposal from Great River Energy, a rural generation cooperative. After securing the PPA, they then sold the development rights to PPM Energy.
- Cherry Valley Wind Farm, NY: According to John Fila, "The key here was the group. Dealing as individuals puts landowners at a severe disadvantage and allows the developer to control the process. Once organized, we felt in total control throughout the process armed with the knowledge that we were the ones positioned to say "take it or leave it" knowing that 4 or 5 other developers where waiting and anxious to jump in and negotiate the right to develop our wind park."[37]

*Distributed generation projects*

The construction and operation of energy generation for on-farm demand can be financed and managed by several alternative organizational forms of business. When local capital is insufficient or unavailable, franchising and leasing are options that may be used to partner with an energy service company (ESCO) or power equipment manufacturer. Leasing requires less capital up-front and allows farmers or small and medium sized business owners to borrow the renewable energy systems, payback the capital costs over time and capture the tax credits if they have sufficient passive tax liability.

The on-site wind generation model has challenging economics, because sites with both a large demand load and very good wind resources are rare, intermittency means generators continue to pay demand/standby charges, and most net-metering laws have upper limits below the size of even one utility scale wind turbine. Group net-metering might allow load aggregation to overcome some of the above problems. Net metering regulations are rapidly changing in a variety of jurisdictions and rural residents should be prepared to take advantage of these changes and potentially advocate for similar changes in their state or local jurisdictions.

While these business models bring benefits to the local community through increased revenues, maintenance jobs and initial capital investment; the capture of even greater value and wealth creation potential is possible. Local ownership allows communities to develop and control assets to capture more of the value chain in power production, which increases the likelihood that the benefits remain local, and capital is reinvested in the communities that created the wealth.

[37] Wind Energy Easements and Leases: Compensation Packages Published September 2005. Windustry's Wind Easement Work Group.

*Rural Electric Cooperatives*

Electricity co-ops consist of groups of customers who pay membership fees, which combined with low-interest loans are used to purchase equipment used to supply electricity to the members. The members are also charged for the electricity to pay operating expenses, provide a basis for future expansion, and repay the loans. Distribution cooperatives deliver electricity to the consumer, while generation and transmission cooperatives (G&T's) generate and transmit electricity to their member distribution co-ops. There are 864 distribution co-ops, and 66 G&T cooperatives (about 7%). These non-taxable entities are a common form of business organization, incorporated under the laws of the states in which they operate and owned and operated by the people they serve. Because cooperatives are non-taxable, they suffer from the same tax disadvantages as small owners. However, they may enter into Syndicated or Flip structures as described below in order to maintain ownership of renewable power but indirectly capture the tax benefits.

The DOE managed Renewable Energy Production Incentive (REPI) is designed to subsidize entities that do not qualify for the Production Tax Credit (PTC) or Accelerated Depreciation (MACRS) including: cooperatives, tribal governments, municipal utilities, and state/local. It is: 1.5 cents per kWh. Unfortunately it must be funded every year which large capital intensive renewable energy investments[38].

In addition, the Energy Policy Act of 2005 authorized Clean Renewable Energy Bonds (CREB's) in attempt to address the loss of the Production Tax Credit for state and local governments and municipal and cooperative utilities. A CREB is a tax credit bond that offers cooperatives the equivalent of an interest-free loan for financing qualified energy projects for a limited term. It does this by providing a tax credit to the bondholder in lieu of the Issuer paying interest to the bondholder. The CREB program is available for two years, beginning January 1, 2006, and is subject to a cap of $800 million to be shared between electric cooperative and government projects, with the electric cooperatives receiving at least $300 million of that total.

While CREBS create an incentive comparable to the PTC, the CREB subsidy amounts to approximately 1.4 cents/kwh on a typical project[39] which is significantly less than the tax benefits of the PTC of 1.9 cents/kwh and the MACRS depreciation tax benefits described in Section II. Furthermore, the CREB program must be authorized annually by Congress which reduces its ability to drive investment in renewable generation. Lastly, the CREB program was extremely oversubscribed in its first year. Of the $800 million available in 2006 there were 786 applicants from 40 states seeking a total of $2.5 billion in bond authorization (three times what was available). $2 billion of the bond requests came from governmental entities[40] and Co-ops sought $554 million but received only $300 million, which went to support 33 solar facilities, 13 wind projects, 13 landfill gas facilities, 12 open-loop biomass facilities, six hydro projects and one refined coal production facility (exceeding their $300 million set-aside)[41].

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[38] Tier I includes: solar, wind, geothermal, or closed-loop (dedicated energy crops) biomass technologies to generate electricity. Tier II includes: open-loop biomass technologies, such as landfill methane gas, biomass digester gas, and plant waste material that is fired (either 100% biomass or co-fired with another fuel)
[39] Windustry Conference Proceedings.
[40] IRS report, Environmental Law and Policy Center.
[41] Cunningham, Todd. Electric Cooperative Today December 1, 2006 edition.

## *Traditional and New Generation Cooperatives*

Traditional cooperatives are commodity clearinghouses and cost sharing organizations for farmers' products. Traditional agricultural supply and marketing cooperatives are not a business model that is well suited to large scale renewable energy projects, however they may use various forms of distributed generation to reduce energy costs.

New Generation Cooperatives (NGC's) developed in order to build capital intensive facilities such as ethanol plants have allowed farmers to move up the value chain. NGC's allow rural communities to overcome some of the capital barriers to renewable energy businesses while maintaining local benefits and control. NGC's are generally only open to farmers and require set equity contributions from their members. Memberships are closed, and exiting through selling of a farmer's equity stake is difficult. Members typically are required to sell a minimum amount of raw material to the cooperative (e.g. to power the ethanol plant). NGC's differ from corporate structures in that rather than assign voting rights based on number of shares, a strictly democratic form of organization with one vote per member is the norm. In these cooperatives, outside investment is not generally allowed under state tax rules, but debt can be raised. However, some state regulations are changing, allowing outside investment by non-producing members in NGC's. These changes should be encouraged as they facilitate access to local capital and encourage broad community participation in funding local ventures. If regulations do not allow non-producer investment, in many cases a subsidiary Limited Liability Company (LLC) is formed to raise capital. LLC's facilitate entrepreneurship through their tax flexibility and simplified regulations while still allowing for outside investment. LLC's can be joint ventures between co-ops, in which co-op executives sit on LLC boards, which can give co-ops flexibility while retaining rural ownership and local control. Importantly, cooperative organizations are familiar to rural residents, perform critical roles in product marketing, and their broad community support could help attain the political support for site permitting and support for infrastructure improvements. However, cooperatives may still have structural and operational limitations which include lower tolerance for risk, lower access to capital, restrictive ownership transfer rules, institutional resistance to consolidation, and the inability to capture tax incentives.

NGC's today are primarily ethanol plants[42] but the business model can be applied to biomass, cogeneration or community wind distributed generation projects. The cogeneration option may be particularly appealing to existing NGC owned ethanol facilities. In this case, the cooperative would be providing electricity to the biorefinery operation in addition to the more traditional farm electrical needs and export to the local electrical grid. The NGC cooperative would be well positioned to address feedstock and other issues associated with the production of the biofuels, selling the biofuels products through the traditional fuel marketing entities.

Example: Mid-Missouri Energy Cooperative
"In 2002, a group of 11 farmers near Malta Bend banded together to help change that. During six weeks in early 2003, they made 82 scouting visits in a 150-mile radius, looking for farmers willing to invest in an ethanol plant. Three times a day they made their Power Point pitches in church basements and town halls, even an abandoned train depot where they shivered in the bitter Midwest winter. They drew audiences as large as 150 people and as small as 2….In 2005, Mid-

[42] Waner, Jennifer, New Generation Cooperatives and The Future of Agriculture: An Introduction, Illinois Institute for Rural Affairs

Missouri plant made a profit of $6.6 million on the farmers' original investment of $22 million. Farmers who invested the minimum of $20,000 received dividends of about $6,000 each[43]"

### *LLCs*

The Limited Liability Corporation (LLC) structure is the most common business in the U.S., which isolates the business from the assets of its owners. The limitation to this model for community owned renewable energy is the difficulty in obtaining the PTC benefits. In this shared ownership structure, owners are passive, so unless they have substantial passive income from other sources (outside the project) they can not use the PTC to reduce their tax burden and improve the project economics. In addition, LLC's face securities regulation restrictions which vary based on state, which can make it more difficult to raise capital. Advertising or general solicitations are prohibited and there are limits on the number of investors and size of their investment. To circumvent these restrictions, projects are often broken into multiple LLCs[44].

### *'Flip' Models*

Partnership-Flip or Syndicate structures allow a firm to capture tax incentives, and then transfer ownership after the tax benefits have expired (10 years for the PTC and 5 years for the MACRS) to local investors (or a rural electricity cooperative). Under these models the local investor group normally conducts pre-development analysis and markets the project to potential tax-motivated corporations or large investors. The local group forms one or multiple LLCs and obtains construction and debt financing together with a commitment from the corporate investor to acquire an interest in the project at commercial operation. The corporate investor owns the project for tax purposes from construction completion through 10 years, and after the PTC expires the local investors or rural cooperative takes over the project. Because of the sophisticated tax structuring involved and state law variations, legal and accounting costs in these transactions can be significant.

The Minnesota and Wisconsin models are described in "A Comparative Analysis of Community Wind Power Development Options in Oregon"[45] and were designed to match tax benefit to tax liability to accelerate community wind projects. In the 'Minnesota-style flip structure', the income and tax benefits are attributed according to proportion of ownership so the ownership is structured to be 99% corporate, while the local owner owns only 1% but receives other compensation for developing and/or operating the plant. This model can be used by land or Rural Electric Cooperatives. The 'Wisconsin model'[46] has a higher initial local investment and the local funding is provided by debt. The corporate partner contributes 30% equity to a project, and borrows 20% of the capital from the local investment group (typically an LLC which sells shares to pool local resources) and borrows 50% on the open market. The tax motivated firm gains all the income for the first 10 years, as well as accelerated depreciation. After ten years, the local group buys out the corporate firm's investment. These models can be used by Rural Electric Cooperatives to indirectly obtain the PTC that makes most wind projects economical. The deal structure normally

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[43] Barrionuevo, A., As Investors Covet Ethanol Plant, Farmers Resist. NY Times. Nov 2, 2006.
[44] Kubert, C. Community Wind Financing. Environmental Law and Policy Center.
[45] Mark Bolinger, Ryan Wiser, Tom Wind, Dan Juhl, and Robert Grace. A Comparative Analysis of Community Wind Power Development Options in Oregon. Prepared for the Energy Trust of Oregon. July 2004
[46] Cooperative Development Services of Madison, Wisconsin, released a report titled *Wisconsin Community Based Windpower Project Business Plan.* 2003,

involves the cooperative prepaying for power which allocates default risk away from the tax equity, allowing lower cost for equity capital, while the co-op can place liens on the plant to secure power delivery. The project owner/operator must also guarantees that the PTC's will be delivered to the corporate investor[47]. An example of this structure is provided below.

The areas in which community wind schemes are succeeding are in states with strong incentives to support local ownership, either through state production tax incentives that are less restrictive than the Federal PTC or grants and other subsidies. These include: Minnesota, Wisconsin, Iowa and Illinois. There has also been some community wind development in the Northeast, lead by Massachusetts and including New York, and recently in the West coast states of Washington, Oregon, California, and Idaho.

Example: Locally-Owned Wind Farm in Greene County, Iowa. The ownership structure is based on the Minnesota LLC Flip model. The ownership flips sometime after 10 years from the investor to the local owner. The taxable investor provides majority of capital. Local owners have received USDA Section 9006 grants averaging about $230,000 each. The LLC is borrowing $250,000 from a state revolving loan fund at zero percent interest. The LLC will borrow some money from commercial banks. Local owners will have modest down payment.

Example of Rural Cooperative Flip model in Roosevelt, WA[48]:
White Creek Wind I, LLC is a projected 98.9 MW wind power project on 11,000 acres in southern Washington. It will cost approximately $150 million and is secured by 20 year contracts with 4 public power utilities which will pre-pay a substantial portion of their power at commencement of operations. There is a 10 year exit option following the expiration of the PTC. The debt price, on a risk-adjusted basis, is comparable to other structured tax credit equity investments.

### *Project Lease*

In the Project Lease model the landowners own the project, so they are responsible for putting together the deal and contracting with a project operator, but they then lease the wind rights and assign a portion of the PPA to an equity investor who captures the tax benefits[49]. These structures are increasingly used for solar energy production because of the federal solar investment tax credit.

### *Anaerobic Digestion Models*

Another illustration of how varieties of business models can be used flexibly to balance the risk-reward trade-off for the rural resident can be seen in the variety of models used to finance and operate anaerobic digester projects. These include[50]:

**Farm Ownership**, under which the farm owns all equipment and runs all operations. The farm pays all up front costs and assumes all risk, but also reaps all financial benefits from operations.

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[47] Meridian Clean Fuels, LLC. Structured Tax Equity for Public Power Utilities. Presentation to Community Wind Energy 2006
[48] Ibid.
[49] Cooperative Development Services of Madison, Wisconsin, released a report titled *Wisconsin Community Based Windpower Project Business Plan.* 2003,
[50] Joseph M. Kramer, "Agricultural Biogas Casebook – 2004 Update". September 2004: pages 17-18. Midwest Rural Energy Council. 17 November 2006 < http://www.mrec.org/pubs/25145.pdf>.

**Farm-Utility Partnership**, under which the farm owns the digester and the local utility owns and maintains the generation equipment. This limits some of the up front costs and risk to the farm and also taps into the utility's electricity generation expertise, but potential earnings for the farm are also reduced and the farm loses operational control over the generators. The utilities incentive may be to meet state renewable energy standards or green power requirements.

**Farm-Utility-Private Business Partnership**, under which a private business installs and maintains the anaerobic digester, while the local utility buys, installs and maintains the generating equipment. The farm owns the digester without having to pay any out of pocket expense, but instead uses the sale of electricity to service the debt.

**Multiple Farm Partnership**, under which the central digester operation that is fed manure from several local farms, with the electricity and other monetized outputs being shared by all participants. This model allows smaller farms to achieve the benefit from AD systems by achieving the economies of scale needed in AD operations.

**Shared Maintenance,** under which several farms share maintenance services instead of equipment. Each farm still bears the up front cost of installation and the risk of operation, but reaps all of the benefits and is able to reduce the cost of operating and maintaining the AD system.

**Farm-Industrial Partnership**, under which the AD outputs are used to support a nearby industrial facility. An intriguing option is to co-locate AD systems near ethanol facilities, thereby bringing synergies and economic benefit to both agricultural and livestock farms in a given area.

## IV. Recommendations

The previous sections demonstrate that the renewable market is growing rapidly, as is the policy "infrastructure" supporting it. In turn, this rapid growth spawns a complex power development market in which the risk and reward balance is constantly shifting throughout the value chain. Given the high level of public and private sector interest and investment in renewable energy, there is no reason to believe that the complexity of the markets and the rapidity of the policy and business driver changes will abate in the foreseeable future.

This complexity inherently works in favor of large-scale or highly specialized entities that possess the resources and expertise to quickly identify and exploit opportunities in the renewable energy value chain. However, new business models are emerging that provide opportunities for rural Americans to participate much more fully in the growth of the renewables market. These models can illuminate ways in which rural constituents can increase the value they capture while minimizing the non-systemic risks involved in the complex process of bringing a project to market. However, these models and policy developments will remain "underutilized" unless there are mechanisms for capturing this information and providing it to rural Americans in a methodical and on-going basis.

The recommendations in this section are based largely on several underlying principles:

- USDA is unlikely to become an active advocate for major policy shifts in some of the most complex barriers to renewable energy, such as reformulation of transmission access policy at the federal or state level.
- USDA has at its disposal a set of resources that are almost unique in the federal government: namely, the vast array of extension service offices and rural cooperative entities that can serve as credible and reliable distribution mechanisms for financial assistance, technical information, trainings and other materials developed centrally by the USDA.
- USDA can play an active and productive role in helping convene critical market stakeholders to examine barriers to development of renewables and/or the strengths and weaknesses of various policy mechanisms that currently exist in the market.
- The government can play a role in working to create greater demand for renewable energy owned and produced by rural Americans.

Given these underlying principles, the recommendations that follow advocate a stronger role for USDA in several areas:

- Illuminating new policy developments and the opportunities they provide to rural communities and farmers.
- Providing assistance to overcome the technical barriers to utility-scale renewable energy generation.
- Creating greater demand for renewable power owned by rural entities.
- Examining why rural communities have not accessed available funding sources and designing options to make investment in renewable energy more profitable.

We will discuss specific opportunities in each of these areas in further detail, below.

**USDA Should Facilitate the Capture and Transfer of Best Practices**

Given the pace of change in the renewable "marketplace," new policies and business models emerge on an almost daily basis that fundamentally alter the feasibility of rurally owned and operated renewable energy. Some examples include:

- California's recent announcement of a carbon cap and trade system in advance of a federally mandated market.
- Federal efforts to designate national transmission corridors under Section 1221 of the Energy Policy Act of 2005.
- Nearly continuous developments at the state and local level to develop renewable portfolio standards, tax exemptions/credits, transmission access rules and pricing mechanisms, and project siting regulations.
- New business models emerging from the private power development markets.

Each of these developments impacts the viability of projects within specific geographic locations. As such, it is critical that rural communities and farmers have easy access to information and analysis of these developments in a manner that allows prospective developers to understand the impact on them more clearly and provides an opportunity to take advantage of them.

It is also important that rural communities and individuals have the power to understand how other states and jurisdictions are helping to promote the development of renewable power, particularly by smaller-scale and/or non-utility producers. These policies can and should be examined and dissected by other states and localities and considered for adoption to help spur the development of on-farm renewable power.

However, because there is no central location and clearinghouse for this information that would allow USDA's constituents the opportunity to find this information in real time, many of the exciting new ideas and innovations that are taking place at the local and state level go unnoticed. By providing rural Americans with easy access to such information, USDA would facilitate a more rapid transition to creative new best practices and allow for rural Americans to increase their profitability by using and adopting "cutting edge" policies and business models. However, without access to real-time information and analysis of these policies, this is unlikely to occur.

Actions that USDA could take to facilitate this information sharing and transfer could include:

- Creating a dedicated website that provides on-going news and analysis of renewable energy developments at the state and local level. This website would also provide examples of how individual farms or communities were able to successfully use new or emerging regulatory mechanisms to establish a successful project.
- Creating and delivering tutorials on topics of particular interest to rural communities (i.e., what is a renewable portfolio standard and how can they differ from state to state?). These could be provided on-line and/or made available through USDA extension services and cooperatives.

- Developing and delivering in-depth training on important renewable energy topics. For example, training could be developed on the required steps to determine the feasibility of wind resources on a particular site. These trainings could be delivered through the USDA extension services offices or by rural coops.
- Developing on-line resources to help rural constituents better understand how their particular location rates in terms of potential for renewable energy development. For example, by typing in a zip code or rural county location, the individual could receive information on the wind, solar and/or biomass potential for their location based on information taken from federal government sources. This information could then link to additional resources on how to better understand the technologies and regulations governing development of those resources. The on-line resources might include a forum for landowners to establish connections with other landowners in their community. These partnerships help to increase rural owner's purchasing power in negotiations with developers and equipment suppliers. An example of how the federal government has previously undertaken such an effort through the Federal Government's AgStar Program can be found in the box on the right.

> The AgStar Program has an online model for determining whether a farm would benefit from a biogas power plant. However, much more information is needed on regional transmission availability, interconnection fees and power billing. A flexible, free, on-line model could be built that would incorporate the local policy and technical issues and allow farmers to more easily conduct pre-feasibility studies for their renewable energy generation potential.

**USDA Should Provide Access to Technical Expertise for Rural Constituents**

On-farm energy generation will entail a number of technical decisions, ranging from deciding on the appropriate energy source, technology, and size; to project related decisions involving siting and connecting to the grid; to business challenges such as the aggregation of financing and finding and negotiating a power purchase agreement. Development of the complex agreements and contractual obligations required to negotiate large scale power projects requires considerable sophistication and expertise. Finally, negotiating state and federal hurdles necessary to obtain benefits can be complicated and time consuming.

In most cases, tackling all of these issues requires outside expertise or counsel; yet gaining access to such expertise can be a time consuming and expensive process. The situation is similar in many ways to that faced by federal facilities wanting to improve their energy efficiency; the upgrades are complex and require technical sophistication and capital to be successful. However, without access to sophisticated expertise provided by professionals with a proven track record and a willingness to conform to pre-determined standards of excellence, it is difficult for an individual building owner to truly determine if their actions and investments are based on sound technical and business principles.

USDA can help rural constituents overcome this barrier by establishing a program through which it would provide rural cooperatives and individual farmers access to experts on the various aspects of renewable project development, including negotiating power purchase and transmission access agreements, accessing capital, and establishing partnership agreements. These experts would be pre-screened by USDA to determine their level of expertise and experience in the renewable energy field.

This program would resemble, in many ways, the Federal Energy Management Program's (FEMP) Super Energy Savings Performance Contracts Program. Under this program, FEMP manages a solicitation through which energy service companies can announce their willingness to provide efficiency upgrade services to federal facilities. These solicitations specify the price of the service and the standards that the bidders are expected to adhere to in the execution of the work. Federal facilities are then able to more quickly access these organizations without having to establish their own solicitation or establish their own standards for work performance

USDA would not pay for provision of the expertise (this would remain the responsibility of the project developer), but would bear the costs necessary to screen and establish a qualified pool of experts (through a government solicitation) and the marketing of the program through the rural extension offices, cooperative and other avenues. If done successfully, this would vastly increase the pool of resources available to rural communities and individuals and greatly reduce the cost and effort involved in acquiring this expertise.

**USDA Should Generate Greater Demand for Renewable Energy Through "Green" Branding**

To assist in developing a local market for on-farm energy products, tools could be developed to create additional demand for rurally-derived renewable power the government has used similar branding campaigns to build consumer awareness and markets for environmentally friendly products to great success, most notably with the ENERGY STAR Program. The federal government could assist rural developers to create green market branding campaigns to help the public connect the benefits of rural-based renewable generation to those regions and to their own lives.

For example, USDA could work with its rural constituents, extension offices and cooperatives to develop a "green" label that would signify power generated by facilities owned and operated by rural entities. Cooperatives could use this label as a means of promoting the percentage of their power purchases that comes from rurally-owned renewable projects, or it could offer "green power" programs through which its business and consumer constituents could voluntarily pay a small premium for power generated by rural Americans. In the latter case, the label would serve the role as a "certifier" of the power in terms of its origins.

USDA's role in helping establish a "green" label for rurally-owned renewable energy would involve the following:

- Working with stakeholders to establish minimum requirements for label qualification (i.e., what percentage of rural ownership would be required to qualify?).
- Creating and testing various brand identities and themes in conjunction with its partners.
- Creating mechanisms for promoting the label through various outlets, including cooperative bill stuffers, local media, promotional events, etc. In most cases, USDA would be responsible for creating the tools to promote the label and the vast majority of the local promotion would be handled by participating cooperatives.

- Working with stakeholders to conduct and publicize case studies on the economic benefits of locally-owned and operated renewable energy in terms of job creation, tax base effects and other economic indicators.

**USDA Should Examine Options to Increase the Attractiveness and Use of Financial Incentives for Renewable Energy Projects**

Among near-term options is the creation or extension of incentive programs to enhance the development of selected renewable resources in rural areas. Many renewable energy technologies have high up-front costs, which can be a deterrent to rural cooperatives considering on-farm generation. The Federal Production Tax Credit (PTC), with its relatively short authorization periods and lapses resulting from delays in reauthorization, has had the effect of creating boom and busts periods in the industry. To avoid such cycles in the future, the federal government should develop guidelines for a consistent, integrated set of financial incentives targeted specifically at renewables and on-farm generation, including ensuring the PTC and CREBs are long-standing, consistent and fully funded.

<u>Build on existing programs</u> The ability to use public funds to leverage private investment through loan guarantees is arguably one of the most powerful government policy levers, yet loan guarantee funds have not been fully utilized. The reasons for this may include marketplace offerings of project finance structures which have access to adequate low-cost debt, lack of awareness among rural lenders, fees, transaction costs or other process challenges.

Since 2003 when the 9006 program was established, USDA has provided $87.3 million in grants and $34.3 million in loan guarantees to 844 applicants, leveraging more than $833.7 million according to USDA figures. These projects are estimated to have resulted in the production of 170 million gallons of ethanol and biodiesel fuel production and 300+ megawatts of wind power. The program provides both loan guarantees and grants and in 2006 approximately $6 million of the $11.5 million set aside 9006 funding was awarded for loan guarantees. Each year, the unused loan guarantee funding provides grants and some of these grants have been used to fund feasibility studies and pre-development costs for community wind projects. However, the impact of government's limited funds is maximized through loan guarantees vs. grants. The 9006 loan guarantees can be up to 70% of the total loan for $5-$10 million loans but the loan can be no more than 50% of project costs. The Business and Industry (B&I) program offers loan guarantees for up to 60% of the total loan for $10-$25 million loans and equity requirements are lower. USDA may wish to analyze whether its loan guarantee programs could be used to more effectively facilitate rural ownership of renewable energy assets.

In addition, the USDA is the US government's leader in direct loans and loan guarantees through the Rural Development loan program for electric utilities. The National Rural Utilities Cooperative Finance Corp estimates that over the next five years there will be about $1.5 billion to $2 billion per year spent by the generation and transmission cooperatives to build new power plants. To date there has been limited use of Rural Development funding for renewable energy projects. USDA may consider investigating ways in which it can encourage rural utilities to own and operate renewable energy generation assets.