



POLICY PAPER

Renewable Energy Incentive Rates: Potential Opportunities for Iowa Farmers

Prepared by



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Acknowledgements

Thanks to the Leopold Center for Sustainable Agriculture for supporting this project. Thanks to the utility staff who discussed their renewable energy incentive programs and to the farmers who shared their renewable energy projects, both of which are discussed in the case studies. Thanks to Brad Klein and Warren McKenna for reviewing drafts of this paper.

Executive Summary

Renewable energy is already generating significant benefits to Iowa's economy and environment. Thousands of Iowans are employed at companies that provide goods and services for wind energy and solar energy. Meanwhile, the thousands of recently installed wind turbines have allowed Iowa utilities to generate less electricity from fossil-fueled power plants, which means cleaner air and water for Iowa and beyond. Compared to just ten years ago, there has been a huge increase in the renewable energy technologies installed in both urban and rural Iowa, but the state has only begun to tap the enormous potential for renewable energy. As these resources are developed with solar photovoltaic panels, solar hot water systems, wind turbines, and other technologies, the considerable economic and environmental benefits will only grow.

The mix of public policies and utility practices that are in place across Iowa are a fundamental part of how – or whether – we will continue to develop renewable energy resources and attain the many benefits that they provide. In this report, we focus on the potential for a policy that is among the most popular globally to support renewable energy, but is little used in Iowa. Known commonly as feed-in tariffs, FITs provide an incentive price or incentive rate paid for each kilowatt-hour of renewable energy delivered to the grid, for a set period of time. Rates paid in Iowa today are artificially low. FIT incentive rates provide a price that fairly compensates for the renewable energy delivered to the grid and accounts for its many benefits. In the following pages, we discuss in more detail the following key points:

FIT incentive rates are legal and can be created without risk of federal preemption. Utilities can offer FIT incentive rates voluntarily, and, indeed, many utilities in the U.S. are doing so today. States can require more comprehensive FITs with legislation. In fact, the Federal Energy Regulatory Commission (FERC) recently established a clear road map for state action on FITs.

FIT incentive rates can be established with no rate impact or with a minimal rate impact. There are many options for creating FIT incentive rate programs. If utilities or policymakers are concerned about potential rate impacts, there are proven ways to create FIT programs without a rate impact or with a very minimal rate impact. For example, some utilities successfully fund their FIT incentive rate programs with voluntary green power purchase programs. Other utilities that are already constructing renewable energy systems can offer a FIT program for the same cost. All Iowa utilities use some ratepayer funds to provide incentives for energy efficiency and demand reduction programs; some of these funds could be used for a FIT incentive rate that supports smaller-scale, customer-sited renewable energy.

FITs are a necessary policy tool, given the lack of an effective free market. Most farmers, small businesses, homeowners, and others interested in developing a renewable energy project – from a small residential solar system to a farmer-owned utility-scale wind turbine – run into the same basic problem. The only buyer for their renewable energy, the local monopoly utility, offers a price that is too low and too skewed to make most projects work. Without effective markets at work, there is a critical role for public policy to ensure renewable energy projects get a fair price.

FITs are a proven policy that will succeed in bringing more renewable energy on-line. FIT incentive rates are the most popular renewable energy policy globally. More megawatts of clean energy, like wind and solar, were developed using FIT incentive rates than any other policy. The recently created FIT incentive rate programs in the U.S. have been very successful. And because they reward performance, FITs help ensure that the renewable energy projects actually deliver clean energy year after year.

The distributed renewable energy that successful FIT policies deliver will provide many benefits to Iowa. In addition to clean electricity, distributed renewable energy will generate jobs, local economic development, environmental benefits, and benefits to Iowa's electric grid. These benefits create value that is commensurate with the incentive rate paid by the FIT.

Policy Recommendations

Three related sets of actions are needed to see more FIT incentive rates offered across Iowa:

- **Iowa utilities should begin offering FIT incentive rates now.** One utility in Iowa, and many utilities around the U.S., are voluntarily offering FIT incentive rates. FIT programs can be structured to target specific technologies, minimize rate impacts, and address any other concerns that the utility and its regulators or governing body may have.
- **Iowa policy makers should institute a comprehensive FIT policy.** The state legislature should follow the set of guidelines set out by federal regulators to establish a FIT program statewide. Under such a program, the legislature should identify long-term energy requirements for Iowa utilities (such as setting goals of 200 or 300 or 400 MW of distributed solar PV, a similar quantity of distributed wind, etc.) and require utilities to procure that energy using appropriate FIT incentive rates.
- **Federal policy makers should provide further authority and flexibility to states to adopt the best type of FIT programs in each state.**

Introduction

Iowa has some of the richest renewable energy resources in the country. Iowa ranks 7th among all U.S. states for its wind energy resource.¹ If fully tapped, Iowa could generate enough wind-powered electricity alone to equal 44 times our current electricity needs. Put another way, Iowa has over 570,000 megawatts (MW) of wind capacity potential, compared to approximately 4,000 MW of installed wind today and about 11,000 MW of coal, nuclear, natural gas, and petroleum capacity.²

Iowa has begun tapping this considerable wind resource, but there remains a tremendous amount of potential for wind expansion. For example, a Department of Energy analysis on moving the entire United States to 20% wind energy allocated approximately 20,000 megawatts (MW), or 20 gigawatts (GW), of capacity to Iowa.³ The Iowa Wind Energy Association has recently endorsed this as a goal for the state.

Iowa has many renewable energy opportunities beyond utility-scale wind turbines, including significant potential for solar energy and a variety of biomass-related energy resources. An analysis prepared for the Iowa Utility Association in 2008 found that a combination of distributed solar, wind, and biomass technologies alone could provide more electricity than Iowa generates from all sources used today (coal, natural gas, nuclear, wind, and hydro) and could do so by year 2018.⁴ That analysis focused on using smaller-scale distributed technologies, like residential rooftop solar panels. In fact, solar PV was the highest potential source of distributed renewable energy in the study.

With over 90% of Iowa's landscape in production agriculture, much of Iowa's renewable energy resources are located on, or can be accessed from, Iowa farms. The maps below show that Iowa's best wind resources are typically found in areas of the state where the land use is primarily in cultivation for crops.⁵

Figure 1: In this map, the orange areas are dedicated to crop production.

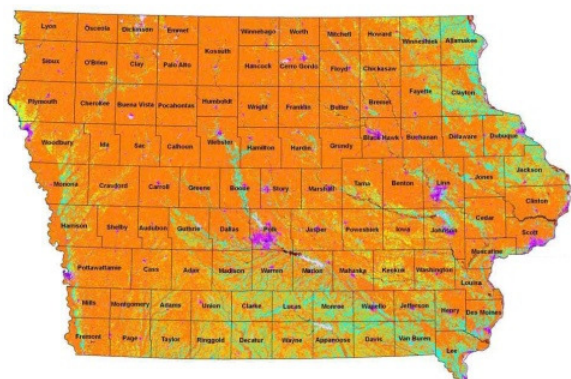
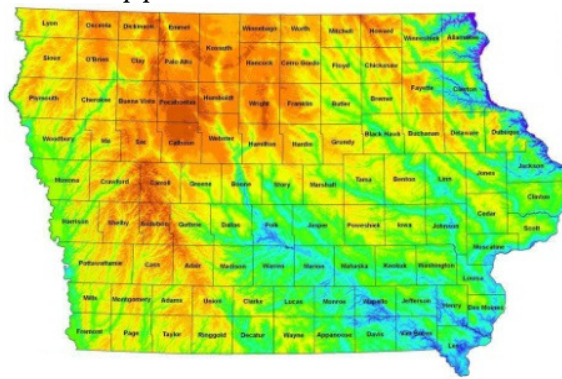


Figure 2: In this map, the orange and yellow areas represent the best wind resources and clearly correlate with the areas above in crop production.



¹ American Wind Energy Association, *Wind Energy Facts: Iowa* (2010) at http://www.awea.org/learnabout/publications/factsheets/factsheets_state.cfm.

² National Renewable Energy Lab, *Estimates of Windy Land Area and Wind Potential, By State* (2010) at http://www.windpoweringamerica.gov/wind_maps.asp#us (30 percent capacity factor at 80 meters).

³ The DOE 20% Wind by 2030 report can be accessed at <http://www.20percentwind.org/>. DOE did not release its state-by-state wind capacity assumptions as part of this report, but has shared the state-by-state assumptions and these have been used in various reports. See, for example, Governor's Wind Energy Coalition, *Wind Energy & Green Jobs* (2009) at <http://www.governorswindenergycoalition.org> and Center for Rural Affairs, *Renewable Energy and Economic Potential in Iowa, Kansas, Nebraska, and South Dakota* (2009) at <http://files.cfra.org/pdf/Renewable-Energy-and-Economic-Potential.pdf>.

⁴ Iowa Utility Association, *Assessment of Energy and Capacity Savings Potential in Iowa* (February 2008).

⁵ Both maps courtesy of Wind Utility Consulting, April 2011.

So far, most of Iowa's renewable energy resources have been developed with utility-scale wind farms, owned by Iowa utilities (primarily MidAmerican Energy and Alliant Energy) or by large independent power producers (such as FPL Energy, NextEra Energy, and Horizon Wind Energy). Under these arrangements, farmers lease out the land used for the wind turbine or turbines and access roads, often earning around \$3,000 to \$4,000 per megawatt of capacity annually for twenty years.⁶ The utility or independent power producer owns the turbines and takes the earnings or profits from the project. Given the current set of barriers, incentives, and policies related to renewable energy development, these are primarily the only type of projects that can be successfully developed. These projects represented an important step forward for renewable energy development in the state, and there is room for more such projects in the future.

However, there are additional important approaches to renewable energy development that could bring a larger number of geographically distributed, smaller-scale wind, solar, and biomass projects on-line. Adding substantially more distributed renewable energy will bring many benefits to Iowa, including: increased farmer income, increased jobs and local economic development, and benefits to the local utility grid (we discuss these in more detail later in this report). While Iowa leads the nation in utility-scale wind development, the state lags behind in the installation of solar PV, small-scale and community-scale wind projects, and other types and sizes of renewable energy technology.

To make such renewable energy projects work, utilities and policy makers will need to improve the way renewable energy is developed by improving relevant public policies. One such policy, commonly known as a feed-in tariff, or FIT, is among the most successful and popular policies globally to support renewable energy.⁷ FITs create an incentive by guaranteeing that a renewable energy producer gets a fair price (or rate) for every kilowatt-hour delivered to the electric grid.

FIT incentive rates are particularly well-suited to help support smaller-scale distributed renewable energy projects that are owned by farmers, businesses, homeowners, or other entities that are not utilities. FIT incentives can be used to support a range of renewable energy technologies, such as solar photovoltaics, wind, and biomass (from biomass combustion to anaerobic digestion) that are relatively small in size. While definitions of distributed renewable energy vary on size requirements, most range from micro-scale generators as small as 1 kilowatt (kW) to community-scale projects as large as 20 megawatts (MW).

⁶ These numbers can be difficult to estimate, given that most wind developers require use of non-disclosure agreements. Annual lease payments account for a relatively small share of the overall gross revenue of a wind farm.

⁷ Other terminology is often used to describe this policy, such as advanced renewable tariffs, CLEAN Contracts, standard offer contracts, renewable energy payments, and more.

The Need for Policy

Utilities Are Monopolies: There Is No Effective Free Market

Gas and electric utilities in Iowa are regulated monopolies. Farmers and other electricity customers who want to develop a smaller-scale renewable energy project to generate and sell renewable electricity cannot sell that product into a competitive marketplace to the highest bidder.⁸ In fact, there really is no free market for farmer-produced electricity in Iowa. Instead, the farmer has one buyer – the local, monopoly utility. Like any other situation with a monopoly, the utility monopoly can get away with offering a low price – too low, in many cases, to support the development of renewable energy.

Because utilities are monopolies, they are regulated by a mix of local, state, and federal laws and authorities that try to simulate the outcome that markets would achieve. Investor-owned utilities must meet certain federal requirements while having their rates and service largely regulated by the Iowa Utilities Board. Consumer-owned utilities like municipal and cooperative utilities must also meet certain federal requirements, while the Iowa Utilities Board regulates aspects of their service, and local authorities (e.g., city councils and boards of directors) regulate rates and other aspects of their service.

In most cases, these utilities have not structured their rates and service to create advantages, or even a level playing field, for farmers or other customers to develop and own renewable energy technology. Many types of barriers exist, such as high monthly fees and standby rates, unreasonable insurance requirements, and long delays and high costs to connect renewable energy technologies to the utility grid.⁹ However, the low offer prices are a fundamental barrier present in nearly every utility service territory.

Although utilities are generally required to buy energy from small or independent producers under federal law,¹⁰ they typically attempt to pay an extremely low price for that power. This price is known as the avoided cost rate and often referred to as a buyback rate.

An Edison Electric Institute analysis of avoided costs under the Public Utilities Regulatory Policy Act (PURPA) highlights the fact that states use many different methods to arrive at the avoided cost rate for local utilities.¹¹ There is considerable flexibility and variability in determining these rates among states and utilities. In Iowa, utilities tend to use a method that produces a very low rate. MidAmerican Energy updated its buyback rates in a filing to the Iowa Utilities Board in July 2011. Although the tariff provides several different options and requires accounting for a few factors to get the exact price, the basic rate is around 2 cents/kWh in the summer and as little as 1.25 cents/kWh in the winter.¹² Alliant Energy's buyback rates are listed in a

⁸ Larger renewable energy projects may have access to energy markets to sell their energy, rather than just the local monopoly utility.

⁹ The Iowa Utilities Board has adopted good rules for interconnection that set out clear and fair standards for insurance requirements, equipment, fees, review timetables, and other aspects of the interconnection process. However, the IUB has only required Iowa's rate-regulated utilities, such as MidAmerican Energy and Alliant Energy, to follow the rules. The Iowa's many municipal and cooperative utilities offer a patchwork of interconnection rules and processes.

¹⁰ The Public Utilities Regulatory Policy Act of 1978 institutes this general requirement that utilities must buy energy offered by independent producers, also known as qualifying facilities. However, PURPA only requires that the utility pay their so-called avoided cost for that power. Determining what the right avoided cost is has been a matter of controversy for many years.

¹¹ Edison Electric Institute, *PURPA: Making the Sequel Better than the Original* (2006). See also Carolyn Elephant, *Reviving Purpa's Purpose: The Limits of Existing State Avoided Cost Ratemaking Methodologies in Supporting Alternative Energy Development and a Proposed Path for Reform* (2011).

¹² MidAmerican Energy, Iowa Utilities Board Docket No. TF-2011-0069 (filed June 29, 2011).

tariff available on its website, updated in November, 2008. At that time, it listed a rate of approximately 6 cents/kWh.¹³

There are approximately 175 municipal and cooperative utilities in Iowa. A review of the tariffs offered by a selected number these utilities indicates that they rarely provide a set, up-front buyback rate. Rather, most of these utilities state that they will negotiate a buyback rate on a case-by-case basis. Anecdotal information suggests that these utilities typically offer similar low rates, often 2 to 3 cents/kWh and sometimes even less.

Depending on the utility in question, some projects may be able to take advantage of net metering, which allows the renewable energy owner to take credits for energy generated at the retail rate. This rate is higher than the avoided cost rate, which can be thought of as a wholesale rate. However, many Iowa utilities either do not offer net metering or only offer it with significant restrictions, such as to limited numbers of customers, or with limited commitments to net meter in future years. Whether this creates an incentive also depends on the utility's retail rates, which vary in Iowa from 6 cents/kWh to 12 cents/kWh.

These low prices mean that many potential renewable energy projects face significant economic challenges. They can produce very long payback times and difficulty getting a project to cash flow. This means the farmer or other prospective developer may not commit existing capital to such a renewable energy project and may have trouble financing it without substantial upfront capital.

For example, a typical residential solar PV system can face a simple payback period of over twenty years with current policies. Depending on the utility and the mix of policies that can be used, the payback period could be even longer. A FIT rate can reduce this considerably, getting the payback close to ten years. Pack back analysis for large or commercial-scale wind is more difficult to perform, as developers and equipment manufacturers do not make information readily available (as noted with landowner lease payments above). However, a simple example can illustrate the problem with low prices offered by Iowa utilities. A 1.5 megawatt GE wind turbine will generate approximately 5,320,155 kWh/year in Iowa.¹⁴ If the wind turbine is owned by an Iowa utility that “pays themselves” 9 cents/kWh for the electricity generated, the turbine will bring in \$478,814 in annual revenue. If the same wind turbine were developed as a community wind project by a group of farmers, and the utility buys the energy for a typical rate of 2 cents/kWh, it would only generate \$106,403 annually in revenue for those farmers.

Realistically, the “farmer owned” wind turbine would not be built. The low avoided cost rate would not allow the project to properly service the debt incurred in constructing it or cover operation and maintenance costs. A number of state and federal incentives attempt to assist community projects dealing with low avoided cost rates (discussed in more detail below). However, the different rules and timelines associated with using these incentives may not resolve the difficulties of financing community energy projects. Projects offered low rates of 2 cents/kWh are very unlikely to be successful even if they can utilize available federal and state incentive programs. Projects offered higher rates might successfully finance wind projects, though with longer payback periods than an investor owned utility project would have. A FIT incentive rate of approximately 9 cents/kWh could enable the project to be developed and to achieve a payback time similar to utility-owned projects, such as in 10 years or less.

¹³ Interstate Power and Light Company, Electric Tariff, Cogeneration & Small Power Production Tariff Sheet, available at <http://www.alliantenergy.com/UtilityServices/UtilityRatesFacts/019474#RateSheets>.

¹⁴ Using the Iowa Energy Center's online wind calculator for a wind turbine located in Pocahontas County, Iowa. The wind calculator is available at <http://www.energy.iastate.edu/renewable/wind/windstudy-index.htm>.

Artificially Low Prices Do Not Reflect All Costs and Benefits

By offering such low prices, the utilities are significantly underpaying for renewable energy. The low prices do not account for the many benefits that renewable energy projects provide. These include no or minimal environmental externalities, local economic development benefits, potential for grid benefits, and more (we discuss these more detail below). A detailed study that quantifies these benefits specifically for Iowa would be useful. Studies in other parts of the U.S. reveal that distributed renewable energy can be worth as much as 14 cents/kWh delivered to the grid, even without quantifying every potential benefit.

The low buyback rates also do not reflect all of the costs that are avoided when renewable energy is used. For example, most electric utilities in Iowa generate at least 50% of their energy from coal-fired power plants. Some have a much higher percentage of coal and the state, as a whole, generates about 75% our electricity from coal. Many of these plants are old and have been relatively cheap to operate, so utilities claim their avoided cost of electricity is very low. However, the costs the utility pays directly – and thus avoids – do not reflect all costs. A recent analysis from the Hamilton Project, part of the Brookings Institute, states that 3-4 cents/kWh should be added to the utility’s reported cost of coal power to account for a variety of externalized costs. These are costs that are created by the generation of coal power but paid for other entities, not the utility.¹⁵ This is consistent with a recent analysis by the National Academies of Sciences as well as several other recent economic analyses on the cost of burning coal and other fossil fuels.¹⁶

Finally, the low buyback rates that some utilities offer, such as MidAmerican Energy, are particularly troublesome because the utility is actively developing and owning their own wind power projects at a cost that is higher than these offers. MidAmerican Energy is in the process of developing 1,001 MW of wind power. While MidAmerican has not publicly released its levelized cost of this wind energy, an analysis of likely costs was filed during a proceeding at the Iowa Utilities Board by a utility with significant experience developing wind projects, including wind projects in Iowa. NextEra Energy filed estimated information indicating that MidAmerican’s proposed wind projects could cost approximately 8 cents to 9 cents/kWh.¹⁷ So while MidAmerican is “buying” wind power from itself at a price that could be 8-9 cents/kWh, it is offering farmers and other potential independent wind developers 2 cents/kWh.

Table 1: This compares the prices that utilities in Iowa typically offer for renewable energy against the like range of values for this energy and the typical range of costs that utilities incur to build similar, or exactly the same, sources of energy.

Typical Utility Buyback Rates	Estimated Range of Value of Distributed Renewable Energy Delivered to Grid	Estimated Utility Cost to Build Renewable Energy
2-6 cents/kWh	6-14 cents/kWh	6-15 cents/kWh

When this is all added up, there is a fundamental mismatch between the price utilities offer and the value that distributed renewable energy provides. Iowa utilities are offering a price that is artificially low, the result of incorrectly assessing of the costs avoided from existing coal-fired power plants, not accounting for the utility’s cost of new electrical generation (whether it is renewable or not), and ignoring the many benefits provided by distributed renewable energy. Many distributed renewable energy projects offer a value in the

¹⁵ Michael Greenstone and Adam Looney, *A Strategy for America’s Energy Future: Illuminating Energy’s Full Costs*, Hamilton Project/Brookings Institute (2011).

¹⁶ National Academy of Sciences, *Hidden Cost of Energy: Unpriced Consequences of Energy Production and Use* (2009). See also Epstein et al, *Full Cost Accounting for the Life Cycle of Coal*, Annals of the New York Academy of Sciences (2011).

¹⁷ NextEra Energy Resources, Direct Testimony of Michael O’Sullivan, Iowa Utilities Board, Docket No. RPU-2009-0003 (May 22, 2009).

range of six to fourteen cents per kWh, but are being offered a price of two to six cents. As a result, only a few projects match up at six cents and actually get developed. The price signals are broken.

Other Policies Must Compensate for Low Prices

With such low buyback rates, policy makers have enacted a variety of incentives using grants, loans, and tax credits to help get some projects installed. At the federal level, grants and loans have been included in recent farm bills and are administered by the USDA. There are also upfront cash grants and production tax credits for renewable energy projects. Most of these programs require federal spending or a loss in federal revenue in some form and are vulnerable in the ongoing budget and deficit debates.

At the state level, there are a variety of programs, including a revolving low interest loan fund, production tax credits, reduced or exempted property and sales taxes, and a few utility rebate programs. These financial incentives help offset the upfront cost and capital investment for renewable energy projects, making the low price offered by the utility less of a problem.

These types of incentive programs have been critically important in supporting renewable energy technologies. In many cases, however, these incentive programs are not enough to overcome the artificially low prices offered by utilities. There is also difficulty to fully take advantage of many tax credit programs for many people who are interested in developing renewable energy, such as tax-exempt entities (schools, hospitals, etc.) or those without enough tax liability, such as farmers.

In addition to incentives, many states have passed some form of renewable energy goal or requirement, such as a 20% by 2020 target. Some of these programs have specific requirements for achieving certain amounts of distributed renewable energy. There is good evidence that long-term targets or requirements can complement a FIT incentive rate. In fact, as we discuss below, a state law to create a FIT incentive rate program will also need to set out long-term renewable energy requirements.

Potential Role for FITs and Rate Incentives

A higher, fairer, and more accurate buyback rate can provide a significant incentive to develop renewable energy. In fact, a fixed and fair price, guaranteed for a fixed period of time, is among the most popular and successful policies globally to encourage the development of renewable energy technologies like wind and solar. The common term for this policy, feed-in tariff, or FIT, is the translation of the German word “Stromeinspeisungsgesetz” (StrEG) which means “law on feeding electricity into the grid.” We use the abbreviation FIT and the phrase “incentive rate” interchangeably throughout this document.

A FIT incentive rate has three key components:

1. Guaranteed access to the grid for the renewable energy project.
2. A fair and fixed price paid for the renewable energy on an on-going basis.
3. A guaranteed time period for the fixed renewable energy price to be paid (typically 20 years).

The combination of access, price, and time period creates a powerful policy for those interested in developing a renewable energy project. All three components create certainty that the upfront costs will be recovered over a reasonable period of time.

The first FIT was the German StrEG law referenced above, which was passed in 1990. This law set special prices for solar, wind, biomass and hydro, each based on a percentage of the retail rate of electricity. StrEG proved beneficial to the lower cost technologies like wind but did little for solar generation until the law was re-written in 2000. The modified approach tied the price paid per kWh to the cost of generation from each type of renewable technology. The change in the law set off a boom in the solar industry, making Germany the world leader for solar electrical generation.

Many countries have followed Germany's lead and instituted variations on Germany's StrEG, including Spain, Belgium, Sweden, Greece, Finland, Italy, and Netherlands, Canada, Australia, China, India, Israel and South Africa.¹⁸

U.S. energy policy has included some, but not all, of the three above required components for a successful FIT policy. In theory, federal law guarantees access to the grid for renewable energy projects. However, barriers still exist in many jurisdictions, such as a high cost, administrative burdens, paperwork, and utilities that are simply uncooperative to potential renewable energy project owners. As discussed above, federal law provides some minimal requirements on the price to be paid, but in most circumstances the pricing is far too low. Finally, federal law typically does not provide requirements or standards for maintaining the price for a set or long period of time, although this is sometimes arranged using contracts.

Renewable energy technologies differ significantly from other ways of generating electricity, such as coal and natural gas. The costs of a renewable energy project are nearly all incurred at the beginning, so the availability of upfront capital is critical. This is because the fuel in most cases (e.g., the wind or sun) is free, so the costs are primarily upfront capital costs. Renewable energy projects also pay for all costs associated with generating the electricity, while many fossil fuel costs are externalized, as we discuss above.

Renewable energy costs have come down in recent years, a trend that is expected to continue into the foreseeable future. Depending on the technology, the renewable resource, and local electricity costs, some or many forms of renewable energy are competitive with conventional generation (coal, natural gas, nuclear) today or will be in a few years. Renewable energy costs typically come down as more and more projects are installed. For example, in 2010, installed costs for residential solar PV were considerably lower in Germany than in the U.S: \$4.2/watt in Germany compared to \$6.9/watt in the U.S.¹⁹ Germany had 17,000 MW of solar installed by the end of 2010 compared to 2,100 MW in the U.S. The size of the German market is a significant factor in this price difference, meaning the successful FIT incentive rates there have helped reduce costs by driving the market for solar PV.

As a result, FIT incentive rates are needed to help expand the use of renewable energy in the near term, to help costs come down further and faster. FITs can be seen as a transition policy tool, not necessarily a permanent policy.

FITs Offer Significant Advantages

As a policy intended to support the development of renewable energy technology, particularly distributed or smaller-scale installations, FITs offer a range of advantages and benefits:

¹⁸ For a comprehensive and frequently updated list of FIT policies around the world, see Paul Gipe's website www.wind-works.org.

¹⁹ Jason Barbose et al, Lawrence Berkley National Laboratory, Tracking the Sun IV: An Historical Summary of the Installed Cost of Photovoltaics in the United States from 1998 to 2010 (2011).

- **Pay for energy, not capacity.** FITs only pay for energy delivered to the grid over time, so the renewable energy producer has a direct incentive to develop renewable energy projects that perform well and to maintain them over time. FITs help ensure that utilities can rely on the energy to be delivered to the grid.
- **Simple, straightforward, and easy to administer** for both the utility and the prospective renewable energy developer. The price and terms are fixed and set up front. Eligibility is typically open to all customers. Tax status, geographic location, and other eligibility criteria that often limit participation in other incentive programs will not limit participation in FIT programs.
- **A proven track record around the world, with recent examples of success in the U.S.** For example, between 1990 and 2005, Germany, Spain and Denmark installed 31,000 MW of wind using FITs, or 53% of the global total of wind energy installed during that time period.²⁰ Recent activity in the U.S. suggests the policy can be very successful here as well. For example, the FITs recently offered by municipal utilities in Gainesville and Sacramento reached their annual program caps quickly and have waiting lists.

FIT Incentive Rates Are Flexible

FIT policies are flexible and often vary from location to location to reflect local renewable energy resources, needs, and goals. Utilities and policy makers in Iowa should consider what sizes and types of renewable energy technologies are most important to develop as well as a range of other issues in designing local or state FIT programs.

Some common design choices include:

- **Re-evaluating the prices for new projects at regular intervals.** It is important to note that when an individual locks in the FIT price, that price is fixed at the upfront rate for the set period of time. However, the price for future participants can be re-evaluated to reflect changes in technology, changes in the price of technology, and the needs of the local energy economy.
- **Reducing the price over time.** Some FIT programs have prices that reduce over time for some or all technologies. The idea is to encourage individuals to install renewable technology now rather than later, so the incentive is most attractive in the early years and less attractive in the future. Reducing the price also reflects the expectation that the cost of renewable energy typically decreases over time and will be less in five or ten years than it is today. Again, the price is reduced only for new participants. When an individual locks in the FIT price, it is fixed for the set period of time (e.g., 10 years).
- **Targeting specific renewable energy technologies, specific sizes, and/or specific locations with a premium price.** Certain renewable energy technologies may be more valuable in certain locations, reflecting the needs of the power grid, population centers, or larger users of energy. FIT incentive rates can account for these characteristics and differences.
- **Capping the program** in some way, such as an annual limit on participants or megawatts of capacity for all or certain types of renewable energy.
- **Local procurement requirements** so that some portion of the equipment and labor are required to be, or preferred to be, provided by the local economy.

²⁰ Wilson Rickerson et al, *If the Shoe Fits*, The Electricity Journal (2007).

- **Deciding on who gets to keep the renewable energy credits generated by the renewable energy technology.** Renewable energy credits have value on trading markets and can help utilities meet environmental and/or energy policy commitments or requirements.

FIT Pricing

Among the most important, and most difficult, choices to make is the price to set the FIT incentive rate. A rate that is set too high will provide the incentive to get renewable energy projects moving, but will not result in as many projects since more of any limited funds will be distributed to fewer projects. On the other hand, a rate set too low may not provide a sufficient incentive or even cover the costs of the renewable energy project.

Cost Plus Reasonable Profit

A common approach in FIT programs is to assess the cost of production for different types of renewable energy and add on a reasonable profit for the renewable energy developer. This allows the homeowner, farmer, or business to recoup the investment and have an incentive to undertake the project. This pricing approach should be familiar to most utilities in the U.S., as it is quite similar to how utility regulators set rates for utilities building new sources of electrical generation – e.g., the utility is allowed to recover its costs plus a reasonable return on equity through its electric rates.

Resource Specific Utility Cost for New Generation

The cost plus reasonable profit FIT program is feasible in the U.S. under certain circumstances, such as when utilities are voluntarily offering a FIT program to customers. For more comprehensive programs required by state legislatures, however, federal regulators have recently set out a different approach to avoid concerns about federal preemption (we discuss this in more detail the Policy Recommendation section below). Under this approach, utilities can be required to pay a rate that is the same as their cost of generation for the new construction of the specific type of technology, such as wind, solar PV, etc. In many cases, the utility's cost and return on equity can be expected to be similar to the cost incurred by a private developer. For example, farmers in Iowa that are installing utility-scale wind turbines either individually or via a community-based approach are reporting roughly the same costs utilities report. After all, the type of turbine installed may be exactly the same. Thus, this approach should work for many technologies. There may be some instances where a utility's cost is lower than the price needed by a non-utility developer. It is too early to identify these instances.

Other Approaches and Resources

A number of models are publicly available to help determine an initial FIT incentive rate for different renewable energy technologies. Many of the jurisdictions that have created FITs have made the model tools available for broader use, including California, Gainesville, Vermont, and others.²¹ In addition, the National Renewable Energy Laboratory has developed a spreadsheet tool (Cost of Renewable Energy Spreadsheet Tool (CREST)) and accompanying report that summarizes the pros and cons of many of these models.²²

²¹ Appendix 2 includes a list of resources with more information on FIT incentive rates, including these models, utility program information, and other addition information.

²² NREL, *Cost of Energy Models* at <https://financere.nrel.gov/finance/content/crest-cost-energy-models>. At this link NREL's report, *Renewable Energy Cost Modeling: A Toolkit for Establishing Cost-Based Incentives in the United States*, as well as spreadsheet tools for solar PV, wind, and geothermal, are all available.

As the cost of renewable energy technologies comes down, so do the FIT incentive rates needed to support them. These are mutually reinforcing trends – FIT rates spur the market, costs come down, so FIT rates themselves can come down. Once an initial price is set, it is very important to monitor both the cost of renewable energy technology and the interest from renewable energy developers. If there is an immediate flood of interested developers, the price may be too high, while little or no interest could indicate the price is too low. Allowing for frequent evaluation and modification by using factors such as renewable energy cost and level of interest will help ensure the FIT rate is set at an appropriate price.

Common FIT Incentive Rates in the U.S.

These FIT incentive rates illustrate the range of programs offered by utilities across the U.S. today. Other than the Farmers Electric Cooperative rate, all other rates are offered by utilities outside of Iowa. Iowa utilities and policymakers should consider engaging Iowa-based stakeholders, such as renewable energy installers and related businesses, farmers, and other interested developers, in order to identify initial FIT incentive rates and to adjust them over time.

In addition to the rate itself, other factors are important to making the program successful, including the time period that the rate is paid (e.g., 10 years, 20 years), the size or cap of the program (e.g., 5 or 100 MWs), and the types of technologies supported.

Table 2: FIT incentive rates for select group of state and utility programs in the U.S.²³

	Solar PV			Wind			Biomass
	Small	Medium	Special	Small	Medium	Utility-size	
Gainesville (FL) (2012 only)	24¢/kWh	22¢/kWh	19¢/kWh	n/a	n/a	n/a	n/a
Indianapolis Power & Light	24.7¢/kWh	20.6¢/kWh	n/a	14¢/kWh	10.5¢/kWh	7.5¢/kWh	n/a
Northern Indiana Public Service Co.	30¢/kWh	26¢/kWh	n/a	17¢/kWh	10¢/kWh	10¢/kWh	10.6¢/kWh
Consumers Energy (MI)	25.9¢/kWh	22¢/kWh	n/a	n/a	n/a	n/a	n/a
Farmers Electric Coop. (IA)	20¢/kWh	n/a	n/a	20¢/kWh	n/a	n/a	n/a
Sacramento Municipal Utility District*	9.5¢/kWh (annual avg)	9.5¢/kWh	9.5¢/kWh	9.5¢/kWh	9.5¢/kWh	9.5¢/kWh	9.5¢/kWh
Tennessee Valley Authority**	12¢/kWh (adder)	5.5¢/kWh (annual avg)	n/a	3¢/kWh (adder)	5.5¢/kWh (annual avg)	5.5¢/kWh (annual avg)	5.5¢/kWh (annual avg)

* The SMUD FIT incentive rate varies based on the time of day and time of year the renewable energy technology delivers electricity to the grid. The 9.5 cent/kWh above is the annual average. The lowest rate is Spring, Off-Peak at 6.8 cents/kWh and the highest is Summer Super Peak at 24.7 cents/kWh. The price range reflects the times that are more and less valuable to SMUD to have energy delivered and create an incentive for the renewable technologies that can deliver during the summer peak, such as solar PV.

** The TVA FIT incentive rate for small systems is configured as an adder on top of the existing retail rate: 12 cents/kWh for solar and 3 cents/kWh for wind and biomass, for projects between .5 kW and 50 kW. TVA offers an incentive rate that varies based on the time of day and year for projects between 50 kW and 20 MW. The annual average is 5.5 cents/kWh with a low rate in the off-peak spring and fall at 3.7 cents/kWh and the high rate during summer peak at 15.9 cents/kWh.

²³ Sources include DSIRE, Wind Works, and utility websites. See Appendix 2 for more information and links to various utility programs.

Policy Recommendations: Implementing FITs in Iowa

Utilities Can and Should Start Now

Utilities are generally free to implement FITs or similar incentive rates voluntarily. One utility in Iowa, Farmers Electric Cooperative (FEC), has recently done this, and the program recently won a national award from the Department of Energy.²⁴ All types of utilities around the U.S. have voluntarily implemented FITs, including municipal utilities in Gainesville, Florida and Sacramento, California, investor-owned utilities in Wisconsin, Indiana, and North Carolina, and rural electric cooperatives like FEC in Kalona, Iowa (see case studies later and the appendix for more information on some of these utilities).

One way to begin funding a FIT program is with existing voluntary green power pricing programs. Under Iowa law, all utilities are required to offer some type of green power pricing program.²⁵ In these programs, ratepayers voluntarily contribute to a fund that the utility can use to invest in renewable energy projects. Some utilities have used these funds to invest in renewable energy projects in the local community, but others use the money to buy 'green power' from a project that may be located hundreds of miles away. As a result, many ratepayers do not contribute voluntarily, and the funds do not have sufficient resources. We believe that making a clear connection between local projects and the green power pricing program would increase participation, thereby making many more resources available for local investment through a FIT incentive rate.

We urge all utilities in Iowa to consider implementing a FIT that meets the needs of the utility and its customers. To that end, we have included some model tariffs that utilities can adopt in the appendix. This is something that can and should be done now.

State Policymakers Should Require Utility FITs

Policy makers in Iowa should adopt the policies needed to make a more comprehensive and widespread program available across the state, consistent with federal law as it stands today and following the specific recommendations of recent FERC orders.

Specifically, state policy makers should:

- **Set long-term requirements for renewable energy development**, such as requirements that specific types of renewable generation should constitute specific percentages of each utility's portfolio of generation resources. For example, Iowa could require all utilities to meet a particular percentage (say 2%) of load with distributed solar energy, as well as percentages from distributed wind and biomass.
- **Require utilities to meet these goals by offering a FIT incentive rate.** We believe recent FERC orders set a framework for determining this rate.²⁶ The starting point for the rate would be the utility's own cost to develop the same renewable energy technologies. Under the example cited

²⁴ NREL *Highlights 2010 Utility Green Power Leaders*, National Renewable Energy Lab (2011) at <http://www.nrel.gov/news/press/2011/1367.html>. Farmers Electric had the third-highest customer participation rate in its green power purchase program as of December, 2010.

²⁵ See Iowa Code § 476.47 (2010).

²⁶ Federal Energy Regulatory Commission, Order Granting Clarification and Dismissing Rehearing, *California Public Utilities Commission*, Docket Nos. EL10-64-001 and EL10-66-001, 133 FERC ¶ 61,059 (issued October 21, 2010) and Order Denying Rehearing (issued January 20, 2011). See also David Boom et al, *State Feed-in Tariffs: Recent FERC Guidance for How to Make Them FIT under Federal Law*, The Electricity Journal (2011).

above, if it costs a utility 8 cents/kWh to develop a wind project, then the utility should offer to buy wind energy for 8 cents/kWh from a farmer, small business, or other customer. In addition to this base rate, policy makers could supplement it with other costs avoided by the renewable energy technology, such as reduced need to build distribution or transmission lines and environmental benefits.

We note that these rates would be significantly higher than the current buyback rates paid by most utilities in Iowa, at least for most types of technologies, and would thus present a significant step forward. However, this approach is different from the rate calculated in most other jurisdictions globally and may not provide a sufficient incentive for every technology.

FIT legislation of various forms has been proposed by legislators at the Iowa statehouse for several years. In the 2011 legislative session, a bipartisan group of state senators introduced Senate File 225.²⁷ This legislation is a good example of an attempt to allow Iowa to adopt FITs within the constraints of federal law today. The bill required utilities to purchase renewable energy at standard rates based on the utility's own costs. The bill capped the amount of energy utilities would be required to purchase on an annual basis and tied that cap to the utility's load growth. This measure was intended to prevent a utility that is not experiencing load growth from adding a lot of additional renewable energy generation to its system. Due primarily to opposition from the utility lobby, the bill did not move forward in 2011, but we encourage legislators to continue working on policy options similar to this in future years.

Federal Policy Should Give States More Authority and Flexibility

Policy makers at the federal level should provide states the opportunity to develop more comprehensive FIT policies. For example, in 2010, Senator Harkin co-sponsored legislation that clarified the state authority to adopt a full range of FIT incentive rate policies under state law.²⁸ This legislation would remove federal constraints to allow for more types of FIT incentive rates. These would include FIT rates similar to those offered in Europe and elsewhere around the world, where the rate is set to cover the cost of the project plus a reasonable return on that investment.

A Note on State and Utility Action and Federal Preemption

In several orders issued in 2010 and early 2011, the Federal Energy Regulatory Commission (FERC) provided a road map for states to create FIT policies that are consistent with current federal law.²⁹ The FERC set out several steps that state policy makers can take to create FITs. First, the state must adopt requirements for utilities to procure certain types of energy from certain sources. For example, the state could require a utility to obtain a certain percentage of total energy from solar PV, such as 2%. Once this is done, the state can require the utility to meet this percentage goal by purchasing the energy rather than owning the solar PV itself. For those purchases, the utility's avoided cost rate is based on the utility's own cost to build that type of new energy generation. So, if it costs a utility 15 cents/kWh to develop solar PV, it must offer a 15 cents/kWh price to interested renewable energy developers.³⁰

²⁷ Senate File 225, 84th Iowa General Assembly, at <http://coolice.legis.state.ia.us/Cool-ICE/default.asp?Category=billinfo&Service=Billbook&menu=false&hbill=sf225>.

²⁸ S. 3923, Let the States Innovate on Sustainable Energy Act, 111th Congress.

²⁹ Federal Energy Regulatory Commission, Order Granting Clarification and Dismissing Rehearing, *California Public Utilities Commission*, Docket Nos. EL10-64-001 and EL10-66-001, 133 FERC ¶ 61,059 (issued October 21, 2010) and Order Denying Rehearing (issued January 20, 2011).

³⁰ David Boom et al, State Feed-in Tariffs: Recent FERC Guidance for How to Make Them FIT under Federal Law, *The Electricity Journal* (2011).

The approach FERC created differs somewhat on pricing from the cost plus reasonable profit pricing. As discussed above, many FIT policies base the price on the cost of development plus a reasonable profit. This ensures that upfront costs are recovered over time, and that there is an incentive to take on the risk and work of developing a renewable energy project. For the FERC approach to work, individual developers must be able to recover costs from the same rate or price as the utility's cost. Anecdotal information suggests that installed wind costs are comparable for utility-scale projects and community or farmer-owned projects of the same size (e.g., a 1.5 MW turbine), so this pricing may work for utility-scale wind. It may take some time to determine whether other forms of generation, such as smaller-scale wind (e.g., 100 kW), solar PV, and biomass, will be viable under this pricing approach.

One potential benefit from this pricing approach is that ratepayers should be indifferent, as the overall price is the same regardless of whether the utility or an individual develops the technology.

The Case for Building More Distributed Renewable Energy

Introduction

Distributed renewable energy offers a range of benefits to Iowa, including benefits to the utility system, local economy, Iowa's energy mix, and farmer incomes. Iowa has not had much success reaping these benefits in recent years, but FIT policies offer a promising way to start. The next section outlines many of the utility system and economic benefits that can be expected from adding more distributed renewable energy across Iowa's landscape.

Some utilities in Iowa have criticized or questioned the expansion of distributed renewable energy, and many have criticized the FIT incentive rate as a mechanism for getting there. For example, the national association of electric cooperatives has issued a policy position paper criticizing FITs.³¹ Utility lobbyists have registered against bills introduced that would authorize or create FITs in Iowa. However, we believe that adding distributed renewable energy to the grid offers benefits to both ratepayers and to utilities. In fact, there are utilities in Iowa and elsewhere in the U.S. that have actively pursued adding more distributed renewable energy. In this section, we explore some of the benefits that can be realized by adding more distributed renewables.

Potential Benefits to the Utility System & Grid

Adding smaller-scale renewable energy technology, distributed geographically and primarily tied in to utilities' lower-voltage distribution lines, can actually help the grid become more stable and reliable. In recent years, a number of studies have analyzed the potential benefits that distributed renewable energy can offer to the utility grid.

A great example of one potential grid benefit comes from a study concluding that the widespread blackout that the northeastern U.S. suffered on August 14, 2003 could have been prevented if more distributed solar PV had been on the grid.³² Several specific events in combination triggered that blackout, including a baseload coal-fired power plant that shut down and uncleared tree branches that caused nearby transmission lines to fail. This ultimately overloaded yet another line and caused further failure that spread across the northeastern U.S. The blackout also occurred on a hot summer afternoon when air conditioners were causing a peak load and when solar PV would have been fully available. Had there been more solar PV dispersed across the system, less stress would have been placed on the coal plant and various transmission lines and could have prevented some or all of these triggers. A relatively small amount of solar PV could have provided this benefit – about 20 to 200 MW, depending on geographic location, or just a few percent of the peak load of the regional system involved in the outage.

A few studies have quantified the benefits that distributed renewable energy offers in cents/kWh. For example, a study focusing on the value of solar PV to the Austin, Texas utility system concluded that a typical kilowatt-hour of solar PV was worth nearly 11 cents delivered to the grid from a distributed installation.³³ Another comprehensive study examined the potential value that distributed solar PV could deliver to the grid in Arizona, finding a range of 7-14 cents/kWh.³⁴

³¹ National Rural Electric Cooperative Association, *Feed-In Tariffs* available at <http://www.nreca.org/issues/FuelsOtherResources/DistributedGeneration/Pages/default.aspx>.

³² Richard Perez et al, Availability of Dispersed Photovoltaic Resource During the August 14th 2003 Northeast Power Outage.

³³ Clean Power Research LLC, The Value of Distributed Photovoltaics to Austin Energy and the City of Austin (2006).

³⁴ RW Beck, Distributed Renewable Energy Operating Impacts and Valuation Study, prepared for Arizona Public Service (2009).

Both of these studies examine and quantify a variety of benefits that increased distributed renewable energy can offer, including reduced use of conventional power plants (e.g., coal, gas, nuclear), the ability of solar PV to provide electricity at peak when it is most expensive, the reduced need to upgrade or build new transmission and distribution lines or to build new conventional power plants, and many other factors. Such studies are resource-intensive and beyond the scope of our analysis here. However, we have attempted to summarize many of the grid benefits that distributed renewable energy can offer, including Iowa-specific analysis where possible.

Utility History and Distributed Energy

Electric utilities have been exposed to distributed sources of energy ever since the beginning of the electric utility industry. Indeed, the earliest competition between electric utilities in the U.S. was the “war of the currents” between Thomas Edison and George Westinghouse. Edison had developed the first model for generating and distributing electricity, which involved placing relatively small distributed generation stations among the electric customers in fairly small distribution areas and using direct current. The system started with the Pearl Street Station,³⁵ a small coal-fired plant in lower Manhattan that served a one square mile service territory at today’s cost of \$3.03 per kWh.³⁶ The widespread use of large remote electric generation stations started with the transmission of alternating current electricity from hydropower generators in Niagara Falls to Buffalo, New York in 1896. By today’s standards this is a small renewable generator, but at the time it was a large-scale and advanced power plant.³⁷ The economy of scale associated with these larger, remote power plants, combined with a tolerance for high voltage transmission lines, eventually won out over the distributed coal-powered generators (no one wanted a coal fired power plant in their back yard). It became the standard to construct ever larger power plants further away from load centers and use high voltage transmission lines to bring that electricity to customers.

Siting and building new large power plants and, in some cases, large transmission lines has become more difficult for a variety of reasons. Environmental impacts of fossil fuel generation, the increased capital cost of conventional electrical generation, fuel price volatility, and decreasing costs of renewable energy generation technologies have led to price uncertainty and the rapid deployment of renewable energy technologies.³⁸ Most new generation appears to be natural gas-fired plants and large scale wind farms. These generation technologies still require transmission system access at high voltages and still follow the central system generation model. In this model, the flow of electric power is one way: from the generation station through the high voltage transmission system grid, and through lower voltage distribution systems to the end use customer. There is also more and more on-site generation and generation not owned by utilities.³⁹

Distributed Renewable Energy and Utilities Today

Distributed renewable energy may be located on the distribution system or in transmission substations. Distributed renewables may be owned by the utility or by utility customers (e.g., on-site or customer-owned generation). These resources may take different forms and use different fuels but in general the resources impact the utility by changing the electric demand on transmission systems and the timing and quantities of energy use.

³⁵ Institute of Electrical and Electronics Engineers Global History Network, *Pearl Street Station*, at http://www.ieeeahn.org/wiki/index.php/Pearl_Street_Station.

³⁶ Energy Information Administration, *The Changing Structure of the Electric Industry: An Update, Appendix A: History of the U.S. Electric Power Industry, 1882-1991 (1996)* at http://www.eia.doe.gov/cneaf/electricity/page/electric_kid/append_a.html.

³⁷ *Niagara Falls History of Power* at <http://www.niagarafrontier.com/power.html>.

³⁸ National Energy Technology Laboratory, *Tracking Coal-Fired Power Plants* (2011) at <http://www.netl.doe.gov/coal/refshelf/ncp.pdf>.

³⁹ Energy Information Administration, *History of the U.S. Electric Power Industry*.

Utilities may view an increase in distributed renewable energy as a threat or an opportunity. One key issue is economic. For most utilities, distributed renewable energy owned by customers will reduce the power and energy generated by utility-owned power plants. Utility revenues have traditionally depended on generating and selling energy from central station power plants, so increasing the amount of distributed renewable energy can result in decreased utility revenues.⁴⁰

A second key issue is the degree of control the utility has – or wants to have – over the distributed renewable energy resource.⁴¹ FIT incentive rates are typically intended to support non-utility owned, intermittent generation like solar PV and wind. Utilities perceive a loss of control over their business and may have technical concerns, such as a loss of the power quality that they are expected to maintain.⁴²

The actual impact of distributed renewable energy to the grid depends on a number of different variables, including the following:

- Location of the distributed renewable energy technology relative to substations and line regulation equipment;
- Capacity of the individual renewable energy technology;
- Variability of the load profile of the utility.

Many utilities in the U.S. have actively limited the amount of distributed renewable energy on their systems to a few percent of the total load,⁴³ while in Europe, some countries are attaining over 20% of total load supplied by distributed renewable.⁴⁴

FIT incentive rates are focused on providing incentives to electric generating resources, not to energy efficiency, conservation or direct load control measures. Energy efficiency and direct load control integrate well with distributed renewable energy resources, especially when the utility has dispatch control of the direct load control and distributed renewables.

Fuel Savings

The most obvious utility benefit of distributed renewable energy is fuel savings. Every kilowatt-hour generated by distributed renewable energy results in fuel savings from conventional power plants that do not need to generate that kilowatt-hour, regardless of whether the fuel is coal in a coal-fired power plant or natural gas in natural gas-fired plant. The value of each of these depends largely on the time of day when it is saved (see on-peak generation capacity section below). The amount of fuel that is saved also depends on the efficiency of the power plant that would have generated that kilowatt-hour. It is important to recognize that in power plants that burn fossil fuels such as coal and natural gas, the conversion efficiency can be less than 20 percent⁴⁵ and is never more than about 61 percent in the most efficient combined cycle plant.⁴⁶ Most of

⁴⁰A feed-in tariff will need to address this decrease, as viable distribution utilities will be needed into the foreseeable future.

⁴¹ For example, active dispatchable control, assumed performance of the distributed renewable energy in a passive sense, or no control over the renewable energy resource at all (energy only resource).

⁴² Utility standards of voltage and frequency maintenance impose requirements on utilities to install controls in substations and along lines to keep voltage and frequency within established guidelines (generally +/- 5% of a target voltage or frequency in the U.S.).

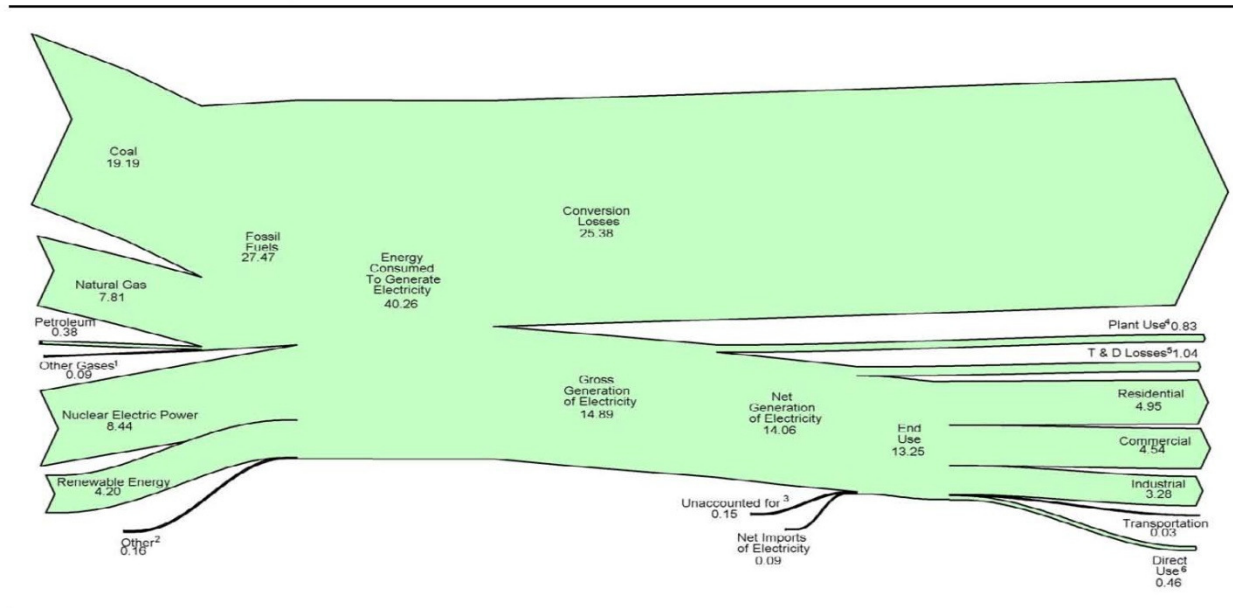
⁴³ Interstate Renewable Energy Council, *State and Utility Net Metering Rules for Distributed Generation*, at <http://irecusa.org/irec-programs/connecting-to-the-grid/net-metering>.

⁴⁴ Der Spiegel Online International, *Crossing the 20 Percent Mark: Green Energy Use Jumps in Germany* (August, 2011) at <http://www.spiegel.de/international/0,1518,783314,00.html>.

⁴⁵ U.S. Department of Energy, *How Gas Turbine Power Plants Work*, at http://fossil.energy.gov/programs/powersystems/turbines/turbines_howitworks.html.

the energy from burning the fuel is released as heat into the atmosphere or into bodies of water and does not actually generate electricity. Most electricity – including in Iowa – is generated by burning coal at about 35% plant efficiency. Combined with line losses from central station power plant to the end user (see below), the overall plant to end use efficiency could be as low as 17.2 percent

Figure 3: This graphic illustrates that of all the primary energy (e.g., coal, natural gas) used to generate electricity, up to two-thirds is lost during the process used to convert those energy source to electricity.



¹ Blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.
² Batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, miscellaneous technologies, and non-renewable waste (municipal solid waste from non-biogenic sources, and tire-derived fuels).
³ Data collection frame differences and nonsampling error. Derived for the diagram by subtracting the "T & D Losses" estimate from "T & D Losses and Unaccounted for" derived from Table 8.1.
⁴ Electric energy used in the operation of power plants.
⁵ Transmission and distribution losses (electricity losses that occur between the point of

generation and delivery to the customer) are estimated as 7 percent of gross generation.
⁶ Use of electricity that is 1) self-generated, 2) produced by either the same entity that consumes the power or an affiliate, and 3) used in direct support of a service or industrial process located within the same facility or group of facilities that house the generating equipment. Direct use is exclusive of station use.
 Notes: • Data are preliminary. • See Note, "Electrical System Energy Losses," at the end of Section 2. • Net generation of electricity includes pumped storage facility production minus energy used for pumping. • Values are derived from source data prior to rounding for publication. • Totals may not equal sum of components due to independent rounding.
 Sources: Tables 8.1, 8.4a, 8.9, A6 (column 4), and U.S. Energy Information Administration, Form EIA-923, "Power Plant Operations Report."

Value of coal fired generation: Approximately 72% of Iowa’s electric energy is generated by coal fired power plants.⁴⁷ The cost of coal in the U.S. is about \$2.23/million Btu.⁴⁸ The generation fuel cost at a typical coal fired plant in the U.S. is \$32.3 per MWh.⁴⁹ Coal-fired generation is generally used for base load, because coal plants are unable to manage variable loading very well.

Value of natural gas fired generation: Approximately 2% of Iowa’s electric energy is generated by natural gas fired power plants.⁵⁰ The cost of natural gas in the U.S. is about \$4.58/million Btu⁵¹ (down from a high of about \$9.00/million Btu in 2008), about twice the cost of coal per million Btu. The generation fuel cost per kWh at a typical natural gas fired plant in the U.S. is \$57.55/MWh.⁵² It is important to note that natural gas

⁴⁶ Siemens, *Efficiency Record of Combined Cycle Power Plant*, at <http://www.siemens.com/innovation/en/news/2011/efficiency-record-of-combined-cycle-power-plant.htm>.
⁴⁷ Institute for Energy Research, *Iowa Energy Facts*, at <http://www.instituteforenergyresearch.org/state-regrs/pdf/Iowa.pdf>.
⁴⁸ Energy Information Administration, *State Electricity Profiles: Iowa* (April, 2011, based on 2009 data), at http://www.eia.gov/cneaf/electricity/st_profiles/iowa.html.
⁴⁹ Energy Information Administration, *Electricity: Average Power Plant Operating Expenses for Major U.S. Investor-Owned Electric Utilities* at <http://www.eia.doe.gov/cneaf/electricity/epa/epat8p2.html>.
⁵⁰ Institute for Energy Research, *Iowa Energy Facts*.
⁵¹ Energy Information Administration, *State Electricity Profiles: Iowa*.
⁵² Energy Information Administration, *Electricity: Average Power Plant Operating Expenses for Major U.S. Investor-Owned Electric Utilities*.

prices are volatile, and the price volatility adds uncertainty to the price of natural gas fired electric generation.⁵³ While prices are low today, prices above \$18.00/million Btu have been experienced in the last decade.

Figure 4: Natural Gas Prices 1994 – 2007.⁵⁴

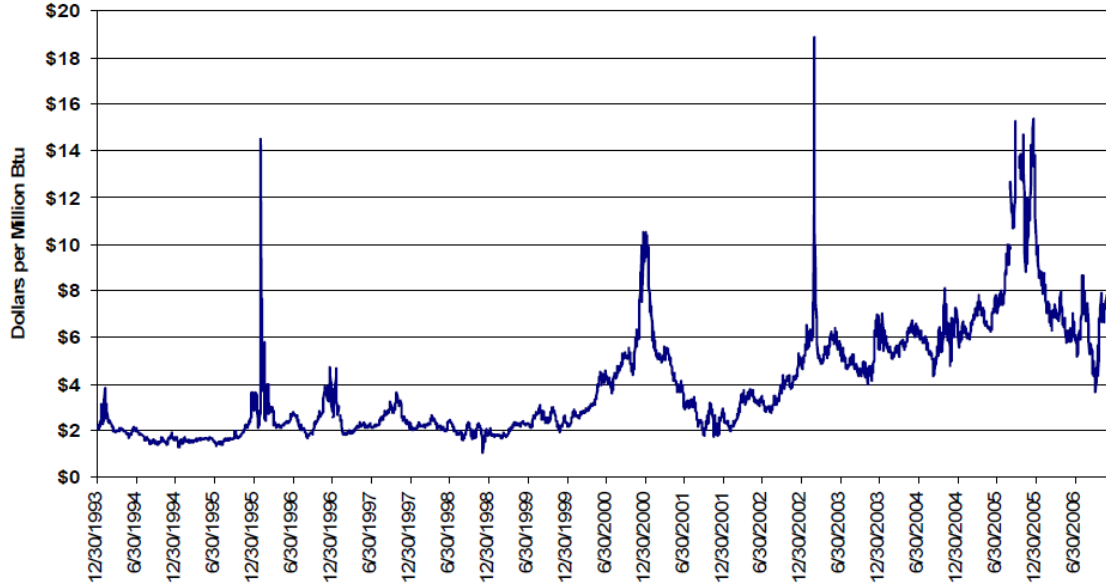
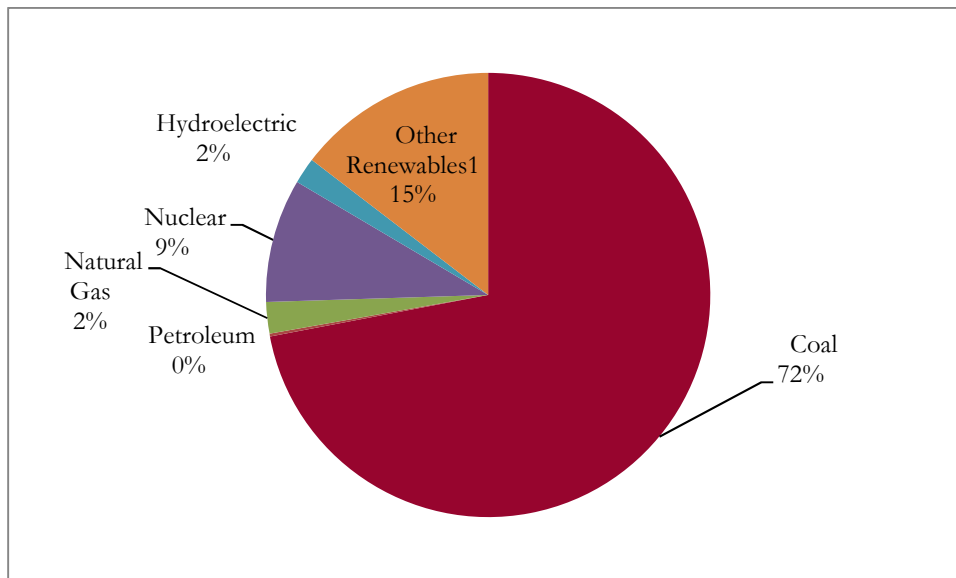


Figure 5: Percentage of Iowa’s electrical generation in 2009 by type of generating technology. Note that this chart does not reflect the additions in wind energy since 2009.⁵⁵



⁵³ Energy Information Administration, *An Analysis of Volatility in Natural Gas Markets* at http://www.eia.gov/pub/oil_gas/natural_gas/feature_articles/2007/ngprivolatility/ngprivolatility.pdf.

⁵⁴ Energy Information Administration, *An Analysis of Volatility in Natural Gas Markets* at http://www.eia.gov/pub/oil_gas/natural_gas/feature_articles/2007/ngprivolatility/ngprivolatility.pdf.

⁵⁵ Energy Information Administration, *State Electricity Profiles: Iowa*.

Reduction in Line Losses

Utilities have to ship electricity to customers using transmission and distribution lines and electricity is lost along the way, about 7% on average in the U.S.⁵⁶ Anecdotal evidence suggests that transmission and distribution losses may be as high as 14% in some locations. The utility, and ultimately all of its customers, pays for this line loss. Distributed renewable energy avoids the line loss by putting the generation resource at or close to the point of consumption, thus saving money. This is not to say that this line loss reduction is straightforward; it depends upon the location of the renewable energy resource relative to the load and central station power plants, and the power factor of the renewable energy.⁵⁷ However, the savings can be significant. A California distributed renewable energy impact study found a loss reduction average of 3.14 percent of the energy generated by distributed renewables, and estimated the value of distribution system losses alone to be \$8 million annually on three utility systems.⁵⁸ An ABB presentation estimated the cost of line loss in transmission and distribution in the U.S. in 2005 at 19.5 billion dollars.⁵⁹

Figure 6: Distribution system loss savings – California SGIP

Year	Utility	SGIP Generation (MWh)	Distribution Loss Savings (MWh)	Loss Savings (\$/year)	Total Savings (\$/year)
2005	PG&E	432,451	15,003	\$ 864,512	
	SCE	625,546	14,707	\$ 861,491	
	SDG&E	249,062	10,669	\$ 624,948	\$ 2,350,951
2006	PG&E	460,797	15,986	\$ 921,177	
	SCE	478,397	11,247	\$ 658,840	
	SDG&E	247,761	10,613	\$ 621,682	\$ 2,201,699

Deferral of Capital Projects

According to the California SGIP impact study, another major utility benefit of distributed renewables is the deferral of capital projects to reduce feeder peak loads. A “feeder” is a distribution line running from a substation to end users. The SGIP study found insignificant peak reduction for a couple of reasons: first, there was insufficient penetration of distributed renewables to see any reduction, and second, the renewable operators did not know when the utility peak occurred and so could not react to utility peak requirements.⁶⁰ However, the California Public Utility Commission accepted distributed renewables as having potential for capital project deferral, and chose to treat this potential on a case by case basis.⁶¹

A review undertaken by the Oregon Public Utility Commission in 2002 identified avoided costs for transmission and distribution system deferrals. The review cited the NorthWest Power and conservation Council’s default values for deferral of line improvement costs to be \$20.00/kW-yr for installed distributed renewables. Pacificorp’s filings in Oregon show avoided costs of \$57.59/kW-yr for distribution and \$21.40/kW-yr for transmission system improvement deferrals. Pacific Gas and Electric estimated avoided

⁵⁶ Market Development Group, *Distribution Line Loss Management Offers Significant Savings for Electric Cooperatives* at http://www.utilityexchange.org/docs/white_line1101078x11.pdf.

⁵⁷ P. Chiradeja, *Benefit of Distributed Generation: A Line Loss Reduction Analysis*, Institute of Electronic and Electrical Engineers Transmission and Distribution Conference (2005) at http://ieeexplore.ieee.org/xpl/freecabs_all.jsp?arnumber=1546964.

⁵⁸ Iron, Inc., *CPUC Self-Generation Incentive Program Sixth Year Impact Evaluation* (2007) at http://energycenter.org/uploads/SGIP_M&E_Sixth_Year_Impact_Evaluation_Final_Report_August_30_2007.pdf

⁵⁹ ABB, Inc., *Energy Efficiency in the Power Grid*, [http://www04.abb.com/global/seitp/seitp202.nsf/c71c66c1f02e6575c125711f004660e6/64cce3203250d1b7c12572c8003b2b48/\\$FILE/Energy+efficiency+in+the+power+grid.pdf](http://www04.abb.com/global/seitp/seitp202.nsf/c71c66c1f02e6575c125711f004660e6/64cce3203250d1b7c12572c8003b2b48/$FILE/Energy+efficiency+in+the+power+grid.pdf)

⁶⁰ ABB, Inc., *Energy Efficiency in the Power Grid*.

⁶¹ California Public Utilities Commission, *Decision Adopting Cost-Benefit Methodology for Distributed Generation* at http://docs.cpuc.ca.gov/published/FINAL_DECISION/105926-04.htm#P232_56913.

costs of \$15.40 and \$7.18/kW-yr for distribution system and transmission system improvement deferrals respectively resulting from installation of distributed renewables.⁶²

Improvements in Reliability of the Transmission System

Several studies indicate that distributed renewable energy can make the transmission system more reliable. The California SGIP study used transmission system modeling and concluded that there were system reliability improvements as a result of installing distributed renewable energy. However, the study did not quantify specific cost, demand, or energy benefits.⁶³ A study by members of the Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology Association of Thailand (ECTI Thailand) indicated that if intentional islanding is used, some distribution customers will experience higher levels of system reliability.⁶⁴ In intentional islanding, the distributed generation technology continues to power a location when power is not available from the grid. Another study by IEEE determined that distributed renewables installed as backup generation can improve utility reliability as measured by common utility reliability indices such as average system and customer interruption duration (SAIDI and CAIDI) and the Energy Not Supplied index (ENS). The best improvement is experienced when the distributed renewable energy is installed at the end of the distribution line⁶⁵.

Reduction in Utility System Peak and On Peak Generation Capacity

Some types of renewable energy produce electricity when demand for utility-supplied electricity is at its highest, at the peak. In Iowa, most utilities have peaks on hot summer afternoons when air conditioning use is highest. In order to illustrate the value of distributed renewables during peak times, we obtained the MidAmerican Energy's Hourly Total System Class Loads from MidAmerican filings with the Iowa Utilities Board⁶⁶ and compared it to the energy produced by typical solar photovoltaic technology in Iowa.

⁶² Oregon Public Utility Commission Staff, *Distributed Generation in Oregon: Overview, Regulatory Barriers and Recommendations* (2005) at http://www.oregon.gov/PUC/electric_gas/dg_report.pdf?ga=1.

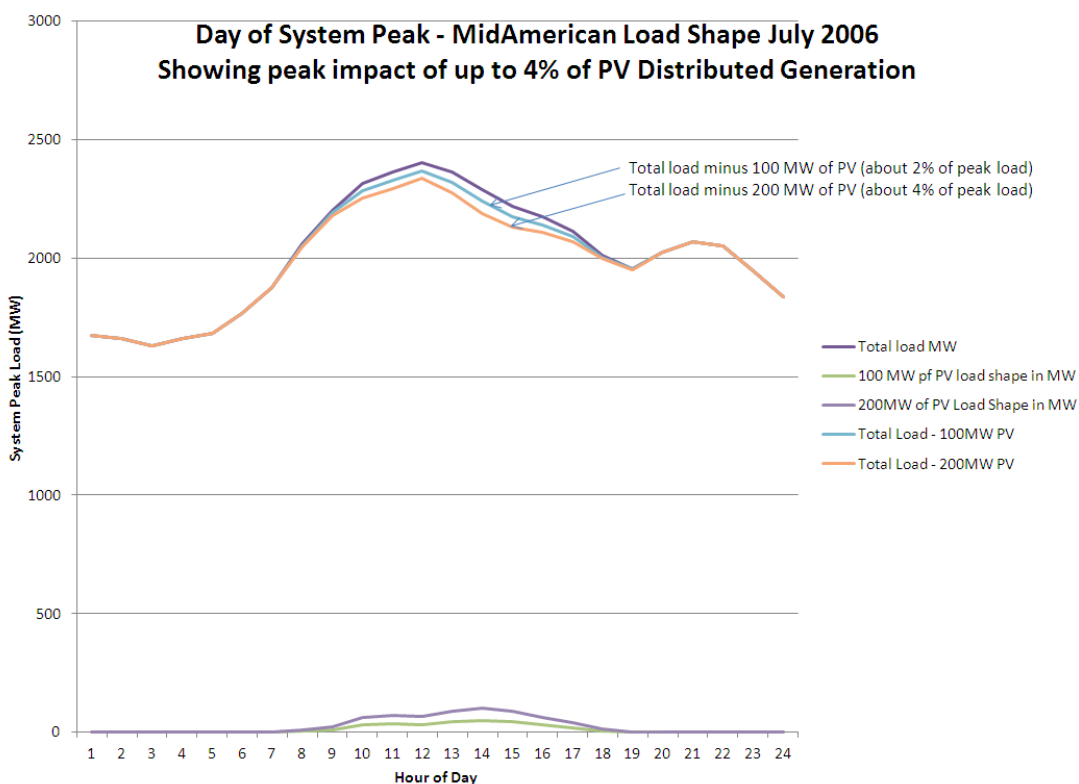
⁶³ Chowdury et al, *Reliability Modeling of Distributed Generation in Conventional Distribution Systems Planning and Analysis*, IEEE Transactions on Industry Applications (2003) at http://www.localpower.org/documents/reporto_ieee_reliabilityplanning.pdf

⁶⁴ Sritakaew et al, *The Reliability Improvement of Distribution Systems Using PV Grid-Connected Systems*, at http://www.ecti-thailand.org/assets/papers/191_pub_16.pdf.

⁶⁵ Center for Energy and the Global Environment, *Reliability Benefits of Distributed Generation as a Backup Source*, at http://www.ceage.vt.edu/sites/www.ceage.vt.edu/files/reliability_benefits_dg_as_a_backup_source.pdf.

⁶⁶ MidAmerican Energy Co. filings in the Iowa Utilities Board Docket No. EEP-2008-02.

Figure 7: Ability of distributed solar PV to reduce system peak on a typical July day in Iowa.



In general, utilities have provided peak capacity value with distributed renewable energy by maintaining dispatch control. Historically, dispatch of customer-owned generation is “lumpy,” being dispatched in increments of 5 MW and larger. Some distributed renewable energy technologies can be dispatched when economic conditions are right, and the “resolution” of the generators being controlled gets smaller all of the time – e.g., some generators are being dispatched by utilities in the 50 kW size range. Another way to provide control is frequency responsive spinning reserve control. This type of control takes the utility operator out of the loop, and enables the generator to respond independently when utility AC frequency gets low. Generation “aggregators” may also be able to play a role by presenting the utility with a suite of distributed renewable energy options, handling the problem of many small generators as a service for the utility.⁶⁷

Distributed resources enable elastic demand response, which makes central peaking and combined cycle units uneconomic and hard to finance in a competitive wholesale market.⁶⁸

Voltage Support/Power Quality

Distributed renewable energy can affect the utility distribution system’s voltage, depending upon where it is located on the system and the kind of distributed renewable technology. In some cases distributed renewables have been shown to be advantageous, in other cases detrimental.⁶⁹

⁶⁷ Oak Ridge National Laboratory, *Bulk-Power Reliability and Commercial Implications of Distributed Resources* (2000) at <http://www.ornl.gov/sci/btc/apps/Restructuring/Rapdr.pdf>.

⁶⁸ E. Kyle Datta, Rocky Mountain Institute, *Incorporating Distributed Generation into Hawaii’s Utility Planning and Regulatory Processes*, at <http://hawaii.gov/dbedt/info/energy/publications/dg04-1datta.pdf>.

⁶⁹ Pepermans et al, *Distributed Generation: Definitions, Benefits and Issues* (2003) at <http://www.econ.kuleuven.ac.be/ew/academic/energimil/downloads/ete-wp-2003-08.pdf>.

Reserve/Standby Capacity

As long as the amount of distributed renewable energy on the utility system is small, the reserve and standby capacity value is low. However, as the amount and penetration of distributed renewables increases, the opportunity to use these resources for reserve capacity grows to the point where the utility could lean on the distributed renewables at times and/or even use islanding areas with large installed renewable energy capacity to avoid brownouts and blackouts.⁷⁰ This may help defer utility investment in transmission, distribution, or generation facilities for reserve and standby capacity service.

Summary

Some utility and grid benefits of distributed renewables can be quantified and monetized more easily, such as energy and reductions in line losses. Other benefits can be identified and described qualitatively, but their value in dollars is too dependent on the situation to put a generalized value on them. Solar PV offsets peak generation energy in the summer, and so has additional value for some on-peak hours, the value of which is further amplified by increased line losses in hot summer days. Computer modeling indicates that with higher utility penetration of distributed renewable, other on-peak benefits may be realized such as voltage support, load shedding and intentional islanding, yielding fewer outages and higher system reliability.

Potential for Disaster Recovery & Grid Resilience

Utilities are required to maintain emergency plans for continued operations and for recovery in the face of a natural or human-caused disaster. Distributed renewable energy has the potential to be an effective tool for the utility in planning for threats to the electric system. This idea is timely given the natural disasters Iowa has suffered in recent years.

The link between distributed renewables and disaster recovery has been explored in several recent studies, including the analysis that Clean Power Research LLC conducted for the City of Austin in 2006.⁷¹ The study indicated that significant deployment of solar PV systems would change the region's energy security profile. Even the small amount of power produced by these systems could support continuing use of homes, retail businesses, and selected public buildings for extended period of time. One key consideration is the need for additional equipment to safely allow for the distributed renewable energy equipment to disconnect from the grid while still providing power to the home or business.

In the five years since this study was completed, technological advances for all types of distributed generation have progressed considerably, as have smart grid applications. It is time for Iowa utilities to consider how increased commitment to distributed renewables could play a positive role in disaster recovery. Technologies such as on-farm digesters, large-scale solar PV, and industrial cogeneration or combined heat and power (CHP) applications, if properly located, could provide critical back-up power in the threat of an emergency or disaster.

The potential for disaster recovery could be enhanced with use of micro grids. Micro grids are a concept being considered in British Columbia.⁷² The concept is to establish a renewable energy generation system or micro-grid that would distribute electricity to a limited group of customers connected to the system. The micro-grid would be connected to the main grid, enabling it to import power from the main grid in case of a power shortfall or to export power to the main grid if there is surplus. This micro-grid might support an

⁷⁰ Scott Storms, *Reliability of Electric Systems in the United States*, at http://www.narucpartnerships.org/Documents/Reliability_of_Electric_Systems_in_the_US_eng_Scott_Storms.pdf.

⁷¹ Clean Power Research, *The Value of Distributed Photovoltaics to Austin Energy and the City of Austin* (2006).

⁷² <http://www.communityenergy.bc.ca/sites/default/files/REG%20-%20Utilities%20&%20Financing.pdf>

entire neighborhood or business district. In British Columbia, the micro-grid is actually owned by the government. In Iowa, a utility could consider financing a customer or group of customers in the installation of the renewable resource, while maintaining ownership of the actual micro-grid, or some variation of capital investment and financing. New construction projects such as housing subdivisions, business parks, or industrial parks may be best suited for consideration of micro-grid technology.

Potential for Job Creation & Economic Development

Job Creation Potential for Renewable Energy

Iowa is already experiencing the economic benefits of renewable energy. For example, over 2,300 workers are employed in the direct manufacturing of wind turbine equipment in Iowa today, and over 80 Iowa companies are doing business in the wind energy supply chain.⁷³ These are diverse businesses that include finance, manufacturing, parts and supplies, trucking, logistics, maintenance, service, and repair and that operate in counties all across the state.⁷⁴

Developing significant amounts of new renewable energy will lead to substantial new job growth as well as other economic benefits. For example, according to the Iowa Wind Energy Association, nearly 10,000 new permanent jobs would be created by reaching a 20 gigawatt wind goal by year 2030. Those jobs would bring nearly \$250 million in salary income. Reaching this goal would also create over 60,000 temporary construction jobs, according to a 2009 analysis by the Center for Rural Affairs, using information from the National Renewable Energy Laboratory.⁷⁵

Job creation is not limited to wind energy. A recent study on the economic potential for solar energy examined the job creation potential from adding 300 MW of solar over five years. In the first year of the program, adding 12 MW of solar would create approximately 500 jobs. In the last year, adding 115 MW would create nearly 5,000 jobs.⁷⁶

Locally owned and distributed renewable energy can provide yet more economic benefits.

Utilities & Economic Growth

Iowa's investor-owned utilities have a history of commitment to growing Iowa's economy. Economic growth in the state of Iowa is one sure way for utilities to benefit financially. An expanding economy, especially expanding manufacturing industries, creates jobs, increases the tax base, and increases energy usage. Utilities make more money when they sell more energy. Thus, as Iowa's renewable energy sectors have grown, the utilities have benefitted. Just as the an expansion of utility-scale wind industry means real economic growth and jobs for Iowans, utility support for distributed renewable energy could result in increased job creation or retention within the state.

Utility Business Models

Customer demand for cleaner, low-carbon electricity is reshaping the electric power sector. A recent Ceres⁷⁷ report *The 21st Century Electric Utility: Positioning for a Low-Carbon Future*, examines the implications for investors

⁷³ Environmental Law & Policy Center, *The Wind Energy Supply Chain in Iowa* (2010).

⁷⁴ Iowa Department of Economic Development, *Wind Turbine Manufacturing, Suppliers, Financing, and Farms in Iowa* at http://www.iowalifechanging.com/business/downloads/IA_WindTurbine.pdf.

⁷⁵ Add citations.

⁷⁶ Iowa Policy Project, *Shining Bright: Growing Solar Jobs in Iowa* (2010).

⁷⁷Ceres is a leading coalition of investors, environmental groups and other public interest organizations working with companies to address sustainability challenges such as global climate change.

and utilities' business strategies going forward. According to the report, utilities need to make significant changes to their traditional business model to succeed in the new century.

“The economics of electric power generation in the U.S. are changing dramatically,” said Ceres President Mindy Lubber. “The traditional paradigm of building large fossil fuel power plants to sell ever-increasing amounts of electricity is fast becoming obsolete. New business models must include aggressive energy efficiency measures and delivery of cleaner, low-carbon energy through renewable and smart grid technologies. Realizing these changes, as a handful of utilities have begun to do, requires a fundamental rethinking of how we produce, transmit, and use electricity in the U.S.”

The study states that utilities that pursue diversified strategies using cost-effective energy efficiency and distributed renewable energy resources are likely to reduce capital investment risk. The most successful utilities will likely be those that pursue this agenda aggressively, transparently, and across all aspects of the business. The inherent risk management benefits of this approach are likely to be recognized by the financial institutions that rate and lend to electric utilities.

Finally, utilities should consider the possible revenue generating opportunities that may exist in financing, equipment sales, and service of renewable technologies. A utility company could meet growing customer demand by offering renewable energy generation products and services. Many Iowa utilities already sell equipment and services directly to customers, such as hot water heaters and efficient light bulbs. Utilities have the potential to leverage well-established energy efficiency and demand side management relationships, thus expanding service offerings in a fast growing business sector, while protecting existing relationships with their customer base.

Case Studies

Farmer Case Study: Small Farm, Solar Panels With No FIT Rate

Bert Miller's decision to install solar panels on his 4-acre farm in Mount Pleasant, Iowa had little to do with saving money. The school librarian, who raises fruit, vegetables and eggs on his property, said he was motivated by environmental and energy issues to pay \$23,819 in August of 2010 for a 22 Kyocera 210 watt modules system with a Fronius 5.1 KW inverter. Electrician bills and an engineering study added another \$3,000.

Miller will recoup about one-third of his investment in the 4.6 kilowatt system when his power company, Access Energy Cooperative, comes through with a promised \$250/kilowatt rebate and he collects a federal tax credit. But given that his utility has a low buyback rate of just under 4 cents per kilowatt hour, Miller, 54, accepts that this is one investment he may never see a return on, at least not financially. The first check he received from Access Energy for electricity sold to them was for \$7.06.

"If money were the only consideration, I would not have done it," he said. "I think it is not practical on a purely financial basis - but when all factors are considered, I think it is totally impractical not to go solar."

Before he installed solar panels, Miller used about 850-900 kilowatt hours of energy each month. The solar system has been able to generate an average of 500 kWh/month. In addition to the low buyback rate, another key obstacle he has faced is the \$1 million in liability insurance Access Energy required him to purchase for his system, an unreasonable interconnection requirement that some utilities in Iowa require and some do not.

Miller said he knows interest in solar is high because of the number of questions he fields about his solar panels. But he thinks it will take a combination of technological breakthroughs, better compensation for electricity sold via a FIT or other incentive rate, more generous tax incentives, and elimination of prohibitive requirements by utilities (such as his liability insurance) before solar panels become widespread.⁷⁸

Farmer Case Study: Small Wind Turbine with No FIT Rate

Mark Rundquist and his wife Linda Barnes are proprietors of High Hopes Gardens near Melbourne, Iowa. The century farm is the base of operations for a small-scale diversified farming operation that includes livestock, fruit, vegetables, and flowers.

In 2008, Mark and Linda decided to purchase a small wind turbine. They installed a Southwest Windpower Skystream model 3.7, with a rated output of 2.4 kW, mounted on a 70-foot tower. The Skystream is connected to their local utility grid through a net metering agreement with Consumers Cooperative, a rural electric cooperative based in Marshalltown. With an estimated annual output of between 4200-4800 kWh, the machine provides for 25-50% of their electric needs depending on the season and available wind.

After taking advantage of federal tax incentives for 30% of the installed cost, the Skystream cost about \$10,400. There were no other incentives available from the state or utility company. Despite the lack of additional incentives and the potentially long payback period, Mark and Linda chose to become "early adopters" of renewable energy technology and made a personal investment in the machine. Mark and Linda feel that the investment is a hedge against higher electric prices and a shaky economy.

⁷⁸ Since this case study was written, Bert Miller has added another 2.9 kW of solar PV capacity.

Mark and Linda are able to net meter with Consumers Energy at the full retail rate for the energy that their Skystream offsets (currently 12 cents per kWh). Assuming a 2% annual increase in electricity prices, the machine will pay for itself in about 18 years.

If a FIT rate of 22 cents per kWh were available, it would provide a 10-year payback. A 25 cent per kWh payment would provide a 10 year payback and a 10% return on investment.

Utility and Faemer Case Study: Iowa's Farmers Electric Cooperative Offers a FIT to Customers

Farmers Electric Cooperative (FEC) is the oldest electric cooperative in Iowa and one of the smallest, with only 650 customers, most of them rural. It is also a state leader in renewable energy as the only utility in Iowa offering a FIT program to its customers.

Launched in 2009, FEC's Experimental Consumer Renewable Energy Sales program provides homeowners and farmers with an incentive to install small wind turbines or solar photovoltaic systems by offering to pay them 20 cents per kilowatt-hour for the power they generate for 10 years.

Capped at 25 percent of the customer's monthly usage, the rate is almost double the coop's usual rate of 12.5 cents per kilowatt-hour. Farmers Electric also offers rebates of up to \$5,000 (\$1 per watt) to help offset the cost of purchasing and installing solar panels or a wind turbine.

Warren McKenna, general manager of Farmers Electric Cooperative, explains that FEC's Green Power program provides funds the experimental renewable energy program. The Green Power program is a voluntary program for customers to pay an additional \$3 per month to support green energy. About ten percent of the FEC's customers participate in the Green Power program, which indicates to McKenna that the community has a high level of interest in renewable energy. McKenna has also fielded a large number of inquiries from customers interested in purchasing a wind turbine or solar array if they can secure financing.

Two Farmers Electric customers have emerged as renewable energy pioneers. Ken Bender of rural Wellman purchased a 1.8-kilowatt solar array, and Leighton Yoder of rural Wellman invested in an 18-kilowatt wind turbine. Yoder, a Mennonite who owns a dairy operation, said he uses about 150 kilowatt-hours of energy per day between cooling milk and cooling cows, so he likes the idea of generating some of his own energy. Still, even with the FIT and rebates, he was not convinced he would be able to recoup the expense of a new wind turbine. When a used turbine became available for \$15,000, though, he decided he could not pass it up. He paid another \$8,000 or so to move the turbine to his farm and install it.

In December of 2009, Yoder consumed 4,400 kilowatt-hours and generated 1,254 kilowatt-hours of wind energy. Normally, his utility bill for the month would have been \$518. With the 20 cents per kilowatt-hour from the FIT program, it was \$226. "I think I can make this pay," Yoder said. "I wouldn't have done it without the 20 cents. I don't know how I could have recovered my costs."

McKenna says adding renewable energy with a FIT will make Farmers Electric customers less vulnerable to fluctuations in the energy market. Although electric rates are low right now, historical patterns show they will rise. And when they do, utilities that have invested in the capacity to generate some of their own renewable power will be able to soften the blow for their customers.

McKenna is convinced FITs are the best mechanism for this, both from the standpoint of the customer and the utility. He supports a statewide approach to FITs because he says the guaranteed return would make

banks feel more comfortable financing small residential wind and solar projects. Customers get a stable rate of return. And utilities gain because they are able to spread their incentive program out over a period of years, instead of paying everything up front in a rebate. Plus, every time the base rate goes up, the utility's incentive decreases comparatively in cost.

"It sounds crazy, but with a feed-in-tariff rate, everybody wins as the cost of energy rises," McKenna said. "Utilities need to do more to encourage renewable sources of energy. Someday power rates are going to be 20 cents per kilowatt-hour and customers are going to demand it. And the margin is so close so why not?"

Utility Case Study: Large Municipal Utility Offers FIT for Solar

The Gainesville Regional Utilities in Gainesville, Florida was challenged to increase its solar capacity when city leaders passed a resolution in 2005 to meet the terms of the Kyoto protocol.⁷⁹ The utility first tried boosting interest in solar with only a net metering program, but response was tepid. "It was going nowhere fast," said Ed Regan, assistant general manager for strategic planning for the municipal utility.

When a resident originally from Germany suggested a feed-in-tariff at a workshop, Regan admitted at first he was skeptical. Among other things, there was a concern that the utility could not afford to pay the incentive rates. But a trip to Germany left Regan convinced the concept could work in Gainesville. City commissioners agreed, and in March 2009, Gainesville passed the first solar feed-in-tariff ordinance in the United States.

Regan said the utility deliberately kept its feed-in-tariff simple—32 cents/kWh for a pavement or roof-mount system, 26 cents/kWh free-standing "greenfield" unit for a period of 20 years—but a great deal of thought went into the rate structure. "If you get into a program and have to raise the rates because of a lack of participation, that would be a mess," Regan said. "We decided we'd rather err on the side of having rates a little high because you can always bring them down."

Given that the utility's normal retail power rate is 13 cents per kilowatt hour, the feed-in system allowed for a 5 percent internal rate of return after taxes, assuming the owner of the solar system took advantage of all the available federal incentives. To make sure costs of the program did not spiral out of control, the utility, one of only 14 in the country with an AA bond rating, set a cap of 4 megawatts per year on new solar capacity.

Applications flooded in, Regan said, catching utility officials by surprise. The 4 megawatts filled in two weeks and the utility set up a first-come-first-serve line for future years. In a very short time, they had projects lined up through to 2016. Some of the applicants had difficulty completing their projects on time, which freed up 16 megawatts of solar capacity through 2016 and gave the utility a chance to tweak the FIT program.

The utility created a differentiated rate system for 2011. Systems smaller than or equal to 10 kilowatts in capacity get 32 cents, larger systems receive 29 cents, and green field systems receive 24 cents. The utility is trying to encourage residential solar by setting aside 400 kilowatts for systems of 10 kilowatts or less. Owners of residential properties can choose between the feed-in-tariff or the utility's old rebate and net metering programs. Applicants for 2011 were selected by an independent third party, The Bureau of Economic and Business and Research at the University of Florida. They selected 55 projects totaling 2.7 megawatts. The program application period will reopen in January 2013.

⁷⁹ For the United States, the protocol called for reducing greenhouse gas emissions to seven percent below 1990 levels by the year 2012.

“We started off with two contractors in town, now we have six. It’s creating employment, it’s created a lot of publicity for our community so it has been good in terms of economic development. And we’re getting power cheaper than if we’d built it ourselves.”

It’s not just solar contractors that have benefited from the feed-in-tariff. Barry Jacobson, an engineer who owns Solar Impact, a three-year-old Gainesville company with his wife Elaine, said the solar incentive has given a much-needed boost to the local construction industry as well. “Just our company alone, we’ve probably done \$500,000-\$600,000 in subcontracting,” Jacobson said. “We are personally keeping several electricians and roofing companies in business.”

The program is fully subscribed and Gainesville Regional Utilities plans to reopen its feed-in-tariff in January 2012. Jacobson hopes the small businesses and non-profits that moved too slowly to participate early in the program will be ready when it reopens. Schools and other non-profits especially stand to gain because the feed-in-tariff allows them to rent their rooftops to third-party solar providers, something they were prohibited by state law from doing under net-metering.

In the short run, Regan said, investment in renewable energies can place a utility at a competitive disadvantage because “it does tend to push prices up,” even if the average customer’s bill only increases by 60 cents per month, like in Gainesville.

In the long run, though, investing in renewable energies makes almost as much sense fiscally as it does environmentally. Gainesville Regional Utilities derives 65 percent of its energy from one coal-fired plant, Regan said, which could prove costly if legislation regulating carbon emissions is passed or if a second plant is someday required. Renewables have cut the utility’s risk exposure in half, Regan said, adding “the rating agencies would like to see us being even further hedged.”

Regan said it’s not unusual now as he’s driving through Gainesville to hear an ad for solar electricity on the radio. “It never used to happen,” he said. “It strikes me with all the economic stimulus, if the country had a feed-in-tariff for solar instead, you’d be amazed all the factories being built, the jobs created, all kinds of investments from offshore. I hope something like that happens.”

Utility Case Study: Investor-Owned Utility Offers Solar FIT Incentive Rate

We Energies, based in Milwaukee, became one of the first investor-owned utilities in the nation to offer a FIT for solar PV in 2005. With several years of experience offering the incentive program now, the utility is declaring the program an all-around success. Solar capacity increased from less than 30 kilowatts to nearly 1,000 kilowatts. Customers unwilling to pay extra for solar power saw no increase in their bill. Meanwhile, We Energies gained valuable experience in incorporating solar energy into its power network.

Carl Siegrist, senior renewable energy strategist for the utility, points to two factors that motivated We Energies to offer the incentive rate. First, customers in the utility’s Energy for Tomorrow program, a voluntary green power program in which customers pay a little extra to support renewable energy, were pushing for solar to be added to the mix of wind, biomass and hydropower. Second, customers wanted to put those solar panels on their homes or businesses and campaigned for We Energies to offer an incentive that would help offset the cost of those investments.

Siegrist and several others at the utility came up with the idea to use the Energy for Tomorrow program to fund a special solar buyback rate that would entice businesses and homeowners to install solar panels. At the

time, about 17,000 of the utility's 1.1 million electric customers contributed to the program. They crunched the numbers and came up with a rate of 22.5 cents per kilowatt hour for 100 percent of energy produced for 10 years, for solar PV systems up to 100 kilowatts in capacity. The goal was to make the rate high enough to move the market but not so high that it would affect customers' utility bills. Siegrist said, "We'd made commitments to be supportive to renewable energy. This seemed like a relatively low-risk, low-cost initiative."

The solar incentive program was originally scheduled to be offered for three years with a cap of 500 kilowatts. But when the program began pushing against that cap in its second year, We Energies expanded the cap to one megawatt and extended the deadline to 2011. An increase in the number of customers contributing to the Energy for Tomorrow program paid for the cost of raising the cap.

Siegrist believes the experimental FIT program, which was mimicked with slight revisions by other investor-owned utilities in Wisconsin, laid some important groundwork for solar electricity in Wisconsin. First, the installation of nearly 100 new solar systems, most in the 1.5 kilowatt residential range, helped counteract the belief that solar energy was not a viable option in Wisconsin because the climate was too cold and snowy. Second, the number of customers in the Energy for Tomorrow program increased from 17,000 to 21,000. "Odds are all 4,000 didn't sign up because we added solar but some of them probably did," Siegrist said.

Finally, the utility gained valuable experience in incorporating large numbers of small solar systems into its power network, from connecting each array to tracking the power generated to making sure customers' bills were properly credited. "It makes us a smarter utility because we understand something about solar that a utility that hasn't done this may not," he said. "The beauty of this in the end is that non-participating customers who were neither putting in solar nor willing to pay a premium for renewable energy were not impacted. We would definitely do it again."

Appendix 1: Key Utility Terms & Concepts

- **Safety:** Safety is the most important thing for the utility. No one wants to injure or kill someone by electrocution, and the utility spends a lot of time and money making sure that customers and utility workers are safe. Electric power is inherently dangerous and distributed renewable energy, like any other electric power source, can injure or kill if mishandled. Fortunately, the industry has developed codes and standards over the years that improve electric safety. The codes are the National Electric Code (for the customer's side of the electric meter) and the National Electric Safety Code (for the utility side of the electric meter). Also, there are interconnection standards for small generators, and equipment that is made for connecting generators to the grid is tested by Underwriter's Laboratories and other safety testing labs. Distributed renewables are safely interconnected nearly everywhere. California alone has over seventy thousand small generators interconnected to the grid.
- **System Reliability:** The second most important thing to the electric utility is reliability. There are five reliability indices that utilities use to track their systems reliability and compare to other utilities. SAIDI (System Average Interruption Duration Index) and CAITI (Customer Average Interruption Duration Index) have to do with how much time on average customers and system are not getting power. MAIFI (Momentary Average Interruption Frequency Index) and SAIFI (System Average Interruption Frequency Index) have to do with how many interruptions customers and the system experience. ENS (Energy Not Supplied) the load not served multiplied by the time that it was not served. Distributed renewable energy may help to increase system reliability.
- **Power Quality:** Power quality affects how electric equipment runs and how long the equipment will last. Voltage sags and spikes, voltage flicker, harmonic distortion, and bad grounding are each a kind of power quality problem. Sometimes power quality problems are easy to identify and repair. Sometimes power quality problems are intermittent and take sophisticated metering to determine the problem. Power quality problems are frequently caused by improper wiring, corrosion, and sometimes are caused by electronic devices. Infrequently, power quality problems are caused by distributed renewable energy technology. The most common power quality problem caused by distributed renewables is high distribution voltage near the generator. Inductive generator wind turbines can cause "flicker" or voltage variations in the distribution line. On the other hand, distributed renewables can help support voltage in areas where the voltage is low, and static inverters interconnecting some kinds of distributed renewables can actually correct some power quality problems. Power quality problems can in general always be solved using various methods.
- **Frequency:** Alternating current is generally used in transmission and distribution systems because it can be transformed from one voltage to another. The frequency of alternating current is important because many electric devices use the timing of the electric power wave form for their control. If the frequency of the AC drops below a certain point, other generators are turned up to compensate. If the frequency is too high, generation is turned back. Some distributed renewables can help to support system frequency, other types cannot.

- **Voltage:** High or low voltage is also a measure of electric supply health. High or low voltage can damage electric equipment and shorten equipment life. Some kinds of distributed renewables may cause high voltage near the generator. If this is anticipated by the utility, more sophisticated controls may need to be installed on the line. Most utilities will charge the owner of the generator for the cost to install the new controls or for other improvements needed to accommodate the generator.
- **Scheduling:** The utility (usually the Transmission System Operator) must constantly balance the load with generation. To accomplish this complex effort involves the use of a number of different contractual and physical tools.
- **System Peak:** The time that the utility has to meet the maximum load is called the system peak. In Iowa, the system peak is in the summertime, and is caused largely by the use of space cooling equipment (air conditioning). On hot summer days, everyone has their air conditioners running, and the utility has to have the resources available to meet the needs of those air conditioners along with all of the other loads people want to run at the same time. The system peak may be several times as much power as is required by the system on average, and sometimes there is not enough generation to meet the loads. If the utility cannot meet the loads, the voltage and frequency can drop below safe levels and generators will start to shut down. When that happens, there can be brownouts (low voltage) and blackouts (no voltage). Sometimes, to avoid uncontrolled system outages, the utility will shut certain loads off. This is called load shedding or rolling blackouts.

Appendix 2: Additional Resources on FIT Incentive Rates and Utility Programs

For general information about many state and utility programs

Database of State Incentives for Renewable Energy (DSIRE): www.dsireusa.org.

Paul Gipe, Wind Works: www.wind-works.org.

CLEAN Coalition: www.clean-coalition.org.

National Renewable Energy Lab reports, particularly *A Policymaker's Guide to Feed-in Tariff Policy Design* at <https://financere.nrel.gov/finance/content/policymakers-guide-feed-tariff-policy-design>.

For information about specific utility programs

Consumers Energy

<http://www.consumersenergy.com/content.aspx?id=4844>

Farmer's Electric Cooperative

<http://sites.google.com/site/feckalona/energy/renewable-energy>

Gainesville Regional Utilities

<https://www.gru.com/OurCommunity/Environment/GreenEnergy/solar.jsp>

Indianapolis Power & Light

<http://www.iplpower.com/ipl/index?page=IPLGeneral&Menu=01000000&DocID=020391af33d6012801538fc10057cb>

Northern Indiana Public Service Company (NIPSCO)

<http://www.nipsco.com/en/our-services/connecting-to-the-grid.aspx>

Sacramento Municipal Utility District

<http://www.smud.org/en/community-environment/solar-renewables/Pages/feed-in-tariff.aspx>

Tennessee Valley Authority

<http://www.tva.gov/greenpowerswitch/partners/index.htm>

<http://www.tva.com/renewablestandardoffer/>