The Need for Feed-in Tariffs to Accelerate Biogas Plant Development in the State of Oregon

Dean C. Foor, P.E., P.S.
EC Oregon, 1328 W 2nd St, Eugene, OR 97402
Phone: 1 (541) 485-9095, Email: dean@ecoregon.com

Renewable energy is critical to addressing climate change by providing distributed renewable thermal and electrical energy without the production of detrimental greenhouse gas emissions generated by traditional fossil fuel based energy. Renewable energy also presents a massive opportunity for economic development and the creation of permanent, so-called, "green collar" jobs often located in rural regions. Biomass energy technologies, such as biogas plants, provide the added benefit of managing problematic organic residue while increasing energy and fertilizer independence. The growth of the renewable energy market in the United States has suffered from inconsistent and/or inadequate support at both the Federal and State level. Feed-in Tariffs, which require electrical utilities to purchase renewable energy at above-market rates, have shown to stabilize the growth of renewable energy market in Germany and other countries. Feed-in Tariffs typically support all renewable energy development, although some technologies, such as biogas plants, require less support then their geothermal or photovoltaic counterparts. Should the State of Oregon adopt a Feed-in Tariff for biogas plant development it would stimulate an estimated USD$900+ million in economic development throughout the state.

Abbreviations:
BETC, Business Energy Tax Credit; CNG, Compressed Natural Gas; CHP, Combined Heat and Power; EU, European Union; ELP, Energy Loan Program; FiT, Feed-In Tariff; GHG, Green House Gas; ODOE, Oregon Department of Energy; REC, Renewable Energy Credit; USDA, United States Department of Agriculture; VER, Verifiable Emissions Reduction

Introduction

The European nations of Austria, Germany, Italy, and Spain, among others, have shown that properly planned Feed-in Tariffs (FiTs) can facilitate accelerated evolution of renewable energy markets, job creation and stabilize manufacturing industries all in a cost efficient way. A FiT is an incentive structure to encourage the adoption of renewable energy through government legislation. The regional or national electricity utilities are obligated to purchase renewable electricity at above market rates set by the government.

One such proven technology that would benefit from FiTs is biogas plants. A biogas plant is a facility utilizing a combination of equipment that employs both anaerobic digestion to produce biogas (a blend of methane and carbon dioxide) and an energy recovery technology to produce renewable thermal and/or electrical energy.

Anaerobic digestion is a process that utilizes a consortium of bacteria in an engineered system to produce biogas from biomass. While anaerobic digestion is traditionally associated with livestock manures, nearly any biomass may be appropriate for biogas production. Anaerobic digestion of multiple biomass types in combination, known as co-digestion, generates the greatest methane yield and is commonly used in modern biogas plants.

The energy recovery technology may be as simple as biogas lamps and kitchen burners or as complex as an industrial-scale combined heat and power (CHP) system which simultaneously provides for heat and power (aka thermal and electrical energy). Efficiency of methane use may exceed 85% in well engineered distributed energy systems (compared with less than 30% at traditional centralized power plants). Alternately, biogas may be upgraded to pipeline standards for use as a natural gas replacement and/or compressed for utilization as transportation fuel in compressed natural gas (CNG) vehicles.

With various degrees of sophistication anaerobic digestion technology has been widely implemented at both large and small scale throughout the European Union (EU) and Asia. Throughout Asia and the Indian sub-continent literally millions of low technology biogas plants have been in operation for decades to provide the essential energy needed for rural subsistence. On the European continent biogas plants have reached a state of high technology and efficiency where they are used to simultaneously manage waste, recover nutrients, and provide sustainable renewable energy from biomass.

In Germany biogas plants have been deployed as one of the primary technologies to increase energy independence in food production, primarily located in the rural communities. Over the last several decades the German government developed and orchestrated FiTs to stimulate biogas plants and nearly all renewable thermal and electrical energy. With over 3,800 biogas plants and an installed capacity of more than 1,400 MW Germany is seen as the leading country for this technology development (Gomez, 2008). Studies have determined that the EU's natural gas needs can be entirely met by biogas, eliminating all imports and that an EU-wide biogas feed-in strategy will result in 2.7 million new agricultural, construction, and management jobs (Thrän et al, 2007).

Biogas Plants in the United States and Oregon

In the U.S. approximately 100 farm-based biogas plants have been developed since the 1970's as reported by the USDA AgStar program. Until recently, these biogas plants have generally been developed as waste management technology for livestock manures as a first priority and for renewable energy as a second priority.

Due to the fact that the revenue potential for the methane as a fuel source for thermal or electrical energy has been traditionally low – efficiency in the designs deployed has not been a critical design element. Often times when anaerobic digesters are used primarily as waste management technology the solution with the lowest capital expenditure is chosen. Such technology choices have led to a multitude of failures and even more plants with extreme operation and maintenance challenges. Only when the revenue potential for the renewable energy is stable, and financially appealing, can high efficiency biogas plants be designed and deployed.

There are two existing farm-based biogas plant in operation in Oregon both of which are located on dairies. In both cases the anaerobic digester components have been reported to perform far below the potential of the manure feedstock. That is, the total energy generated from manure is as much as 300% less than similar scaled anaerobic digesters in Germany. This pattern of under performing low-technology anaerobic digesters appears to extend throughout the many installations across the USA.

Renewable Energy Incentives in Oregon

The renewable energy industry in Oregon benefits from state-based incentives. The Oregon Department of Energy (ODOE) has developed the innovative Business Energy Tax Credit (BETC) and provides for loans via the Energy Loan Program (ELP). Both of these programs have facilitated energy efficiency and renewable energy development in Oregon for more than two decades. Recently, a biomass energy tax credit has been made available that further assists projects that convert biomass into renewable energy.

While the BETC does improve the investment potential in biogas plants it does so in a much different, and often more complex, manner than a FiT. The BETC can either reduce the total state tax obligation of the enterprise when in operation or, if sold, reduce the total capital expenditure of the development. It does not, however, necessarily improve the annual revenue potential or stimulate efficient biogas plant designs.

The Oregon Public Utility Commission mandates the acceptance of renewable energy generated from Qualified Facilities, which are

interconnected to investor owned utilities, for a standard contract period of 20 years. In Oregon as with other regions of the U.S. environmental credits also provide financial incentive once the project is operational. Both Renewable Energy Credits (RECs / "greentags") and Verifiable Emissions Reductions (VERs / "carbon credits") originating from a biogas plant may be traded in the appropriate voluntary markets.

The future of these voluntary markets is undetermined and thus there is no long-term certainty. This means that there is reluctance on behalf of investors to get involved in the first place and those that do get involved are often short-term speculators rather than long-term entrepreneurs and so instability is inherent.

While all of the aforementioned incentives benefit the development of biogas plants they do so in a manner irrespective of the size of energy generation and quality of feedstock. Thus, large project realize an economy of scale. That is, small projects realize no additional incentive over those of large projects. This results in small projects not being able to achieve a similar return on investment and fails to provide incentives to maximize methane yields regardless of scale.

Barriers to Development

The development of biogas plants in Oregon is technically feasible. Large-scale biogas plants (over approximately 1,500 kW installed capacity) with quality feedstock have also been determined to be financially feasible when the biogas is used to fuel renewable thermal and electrical energy generation. This is due in part to the fact that interconnected electrical sales are secure and not effected by commodity prices as is seen with biofuels. At least one large-scale, state-of-the-art, biogas plant is know to be in development in Oregon at a food processing facility and is expected to become operational in early 2009.

For small-scale digester projects regardless of feedstock quality and for large digesters with poor quality feedstock, such as manure, financial feasibility, in Oregon, remains elusive. Due to the fact that much of the infrastructure and development cost are fixed and that the energy yield from manure will be substantially lower than most biomass used in a large-scale project the return on investment will be much less attractive. For example, an $8 million capital expenditure at a large-scale project would yield about 1,500kW of electrical capacity where a $4.5 million capital expenditure at small-scale, manure based, project would yield about 450kW. These values have been taken from one project under development and another in planning, respectively.

Given these two simple cases; the smaller-scale project would require nearly 90% greater revenue from electrical sales to achieve a similar simple return on investment. That is, unless FiTs were in place to improve the return on investment for small-scale biogas plants, it is unlikely that they will be developed. Or – if they are developed, they will almost certainly be done so with less efficient technology solutions.

Current Structure of Existing German and Proposed U.S. Feed In Tariffs

The current status of FiTs in Germany and the U.S. proposed FiTs for biogas, shown in Table 1, support smaller projects with higher fixed prices. Four U.S. states (MN, RI, MI, and IL) have proposed identically structured Biomass or Biogas FiTs that mimic Germany's structure (Rickerson 2008).

Table 1. FiTs Germany and U.S. Proposed

	Germany	U.S. Proposed
Electrical Production	**Fixed Price (€ cent / kWh)**	**Fixed Price (US cent / kWh)**
< 150 kW	11.5	14.5
> 150 kW and < 500 kW	9.9	12.5
> 500 kW and < 5 MW	8.9	11.5
> 5 MW and < 20 MW	8.4	10.5

In Germany, additional production bonuses are also available in the range of 2 to 10 €cents/kWh for plants that operated in an efficient manner and utilize innovative technology. Some of the U.S. proposed FiTs also establish a

Reasonable Profit as well as an efficiency requirement. In all four U.S. state cases, the proposals would sell 100% of the electricity to the utility and the utility would bear the cost of interconnection. This type of FiTs structuring benefits both small scale projects and provides incentives for maximizing biogas plant efficiency at all scales.

The current FiTs in Germany and those proposed in the U.S. suggest that biogas FiTs are cheaper than both geothermal and photovoltaic FiTs (Rickerson 2007 and 2008). German geothermal FiTs at the 5 MW limit (15 €cent/kWh) are approximately twice that of biomass FiTs. Photovoltaic FiTs range from 45.7 to 54 €cent/kWh or 4 to 6 times greater than that of biomass FiTs.

Case for Feed-In Tariffs

Throughout the state of Oregon there are estimated 350 dairy farms. Of these – less than 5% are likely to have the potential to be large-scale projects. That is, the mass majority of the biogas plant development in Oregon is at the small-scale. The cost of developing efficient biogas plants at these locations is estimated to range from USD $0.25 Million to 6 Million and is thus estimated to represent a potential of USD $900 Million in economic development (The Pacific Northwest in total would represent about 5x the potential of Oregon).

These small-scale projects are primarily located in rural areas on family-farms and they require FiTs to be developed successfully and with the same financial returns as their larger counterparts.

In 2007 energy from biomass and organic residues contributed to the German primary energy demand with a share of 4.6%; for 2020 it is expected to be 10%. Nearly 100,000 people are employed; the corresponding reduction of CO2eq emission was 54 million metric tons (Ott 2008). The state of Oregon alone represents a total surface area about 70% the total surface area of Germany. If the entire Pacific Northwest was considered the potential for biogas development is likely to be equal to or greater of that demonstrated in Germany and other European countries.

Summary

The immediate benefits of FiTs for biogas plants are as follows:

1. Distributed Renewable Thermal and Electrical Energy Development
2. Greenhouse Gas Emission Reductions
3. State-wide Economic Development and Permanent Job Creation
4. Beneficial Management of Problematic Organic Residues
5. Increased Energy and Fertilizer Independence for Family Farms
6. Stabilizes Renewable Energy Markets
7. More Economical to Support When Compared with other Renewable Energy Technologies

References:

Gomez, C. da Costa, *Renewable Energy Act amendment – consequences for the biogas industry*, Proceedings to the 17th Annual Convention of Fachverband Biogas e.V., January 2008

Thrän, D.; Seiffert, M.; Muuler-Langer, F.; Plattner, A.; Vogel, A., *Moglichkeiten einer europaischen Biogaseinspeisungsstrategie*, January 2007

Rickerson, W. and Grace, C., *The Debate over Fixed Price Incentives for Renewable Electricty in Europe and the United States: Fallout and Future Directions*, February 2007

Rickerson, W.; Bennhold, F.; and Bradbury, J., *Feed-in Tariffs and Renewable Energy in the USA – a Policy Update*, May 2008

Ott, M. and Gomez, C. da Costa, *Anaerobic Digestion, Biogas and Biofuels – Background, Situation and Potential in Germany*, Proceedings to the ORBITS 2008 Conference, October 2008