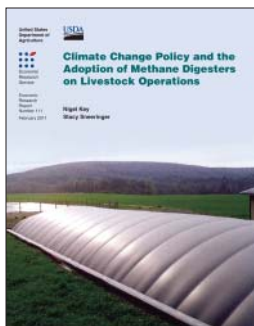


ERS *Report Summary*

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Climate Change Policy and the Adoption of Methane Digesters on Livestock Operations

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What Is the Issue?

Methane digester systems capture methane from lagoon or pit manure storage facilities and use it as a fuel to generate electricity or heat. In addition to providing a renewable source of energy, digesters can reduce greenhouse gas emissions, odors from manure, and potential contamination of surface water. Methane digesters have not been widely adopted in the United States mainly because the costs of constructing and maintaining these systems have exceeded the value of the benefits provided to the operator. Policies to reduce greenhouse gas emissions could create new opportunities for livestock producers to earn revenue from burning methane from manure, making such biogas recovery facilities profitable for many livestock producers. However, there is likely to be wide variation in the scale, location, and characteristics of livestock operations that would benefit, so these policies could have longrun structural implications for the U.S. livestock sector. In this report we estimate the number and type of hog and dairy operations that would find it profitable to adopt a digester at any given carbon price. We also estimate the relationship between the price of carbon (CO₂) and the amount of emissions reduced by digesters on these operations.

What Are the Major Findings?

The extent to which livestock operations can reduce greenhouse gas emissions from manure management depends in part on the number of livestock operations that adopt methane digesters, which in turn depends on digester profitability from energy savings, energy sales, and/or sales of emission reductions in a carbon offset market. An offset market allows livestock producers who reduce methane emissions to sell these reductions or “carbon offsets” to other greenhouse gas emitters who might face emissions caps.

Factors that influence digester profitability and that determine the characteristics and locations of the livestock operations that could benefit from the introduction of a carbon offset market include:

- operation size—costs of constructing and operating a digester decline on a per-head basis, making digesters more profitable on larger operations
- the selling price of surplus electricity—a higher price makes digesters more valuable for operations that can generate more electricity than they use onfarm
- farm electricity expenditures, which depend on electricity prices and onfarm use—higher expenditures make digester-generated electricity more valuable, especially if the operation cannot sell electricity or if the selling price of electricity is below the retail price
- participation in cost-share and other incentive programs—this can defray the cost of building digesters

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- farm's initial level of methane emissions—this determines the maximum quantity of carbon emissions reductions that can be sold
- carbon price—a higher carbon price makes digesters more profitable for operations that can sell carbon offsets.

Larger operations would be more likely to adopt a digester, and likely would earn substantially higher profits on average than smaller operations. Hence, introduction of a carbon market in a region could enhance existing economies of scale in production and result in further concentration of production on the largest operations. However, smaller livestock operations may be able to achieve a more efficient digester scale by supplementing manure with food waste products or by sharing a digester with other small operations. In addition, if the adoption of methane digesters by smaller operations is a policy goal, several tools exist—such as cost-share subsidies or tax incentives—that could be used to encourage their adoption by small farms.

Additional revenues from the sale of carbon emissions reductions (offsets) could substantially increase the number of operations that would adopt a biogas recovery system. Findings in this study indicate that a carbon price of \$13 per metric ton of carbon dioxide equivalent emissions (an initial price estimated under one scenario for a nationwide cap-and-trade program for greenhouse gases) would:

- induce dairy and hog operations to supply offsets equivalent to about 22 million tons of carbon dioxide annually, amounting to about 62 percent of the current greenhouse gas emissions from manure management in these industries, or about 5 percent of total greenhouse gas emissions from the U.S. agricultural sector
- allow dairy and hog operators as a group to earn up to \$1.8 billion in additional profits over 15 years from installing methane digesters.

Currently, the price of electricity and onfarm electricity expenditures are key determinants of digester profitability. However, when carbon prices are above \$4 per metric ton of CO₂ equivalent emissions, carbon offset sales comprise a larger source of digester revenue than electricity generation. At a price of \$13 per metric ton of CO₂ equivalent emissions, revenues from emission reduction sales (offsets) contribute 66 percent of gross digester revenues for all dairy and hog operations, electricity sales contribute 8 percent, and cost savings from avoided energy expenses contribute the remaining 26 percent.

At higher carbon prices, the distribution of profits from digesters reflects the location of large-scale operations and the prevalence of lagoons. Among States with the greatest number of dairies, the study finds that California, New York, Wisconsin, and Texas each have at least 100 such operations that would find it profitable to adopt a digester at a carbon price of \$13 per metric ton of CO₂ equivalent emissions. At the same price, North Carolina, Illinois, Indiana, Missouri and Oklahoma each have at least 100 hog farm operators who would find a methane digester profitable.

How Was the Study Conducted?

We used a model of digester profitability to estimate how farm size, manure management methods, electricity prices, and carbon prices affect producers' decisions to adopt biogas recovery systems. Hog and dairy producers are assumed to adopt a digester if the present value of the discounted stream of profits (the net present value) is positive. Profits derive from electricity generation and carbon emission reductions sales less the digester construction and maintenance costs. Using case study information, we parameterized the model. Electricity price data are drawn from the U.S. Department of Energy, and methane emissions are estimated using State-level Intergovernmental Panel on Climate Change emission coefficients.

By computing the present value of digester profits for every farm in nationally representative samples of dairy and hog operations (USDA's Agricultural Resource Management Survey or ARMS), we used the model to provide an estimate of the number, size, and location of farms that would find it profitable to adopt a digester at any given carbon price. ARMS is conducted by USDA's National Agricultural Statistics Service (NASS) in conjunction with the Economic Research Service. By predicting which operations would earn profits from digester adoption and then summing the reduction in tons of carbon dioxide equivalent emissions, it is possible to estimate the relationship between the price of carbon and the amount of emissions reduced by methane digesters on dairy and hog operations. We used the model to estimate how the present value of farm revenues changes with the carbon price and to simulate the effect of surplus electricity prices and Government cost-share policies on the potential supply of carbon emissions reductions.