

BIOGAS OPPORTUNITIES ROADMAP PROGRESS REPORT

USDA - EPA - DOE



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Table of Contents

ROADMAP INTRODUCTION	1
ACHIEVEMENTS	1
Policy and Program Achievements	1
Government Agency Achievements	1
Private Industry Achievements	4
Technology Achievements	5
Projects Funded	5
Technology Information Developed, Updated, and Revised	7
Dissemination of Resources and Information for Stakeholders	8
CHALLENGES AND OPPORTUNITIES	9
Challenges	9
Opportunities	11
Sector Trends	11
Stakeholder Engagement	11
Next Steps	13
Coming Soon	13
Future Strategies/Direction	14

ROADMAP INTRODUCTION

This report is a progress report of the *Biogas Opportunities Roadmap* originally published in August 2014. The U.S. Department of Agriculture (USDA), U.S. Department of Energy (DOE), and U.S. Environmental Protection Agency (EPA) created the Roadmap as a response to the White House Climate Action Plan's directive to develop an interagency strategy to reduce methane emissions. Strategically deployed biogas systems offer the nation a cost-effective and profitable solution to reducing emissions, diverting waste streams, and producing renewable energy.

The Roadmap identified more than 2,000 sites across the United States that produce biogas, as well as the potential for an additional 11,000 biogas systems. If this full potential is reached, the climate and environmental benefits are expected to be great. While methane emissions have been reduced and the amount of renewable energy, chemicals, and fuels being generated by these projects is growing, the rate of growth in the sector needs to increase to realize the potential 2030 reductions that were enumerated in the Roadmap.

The Roadmap also identified a number of Federal interagency actions to increase the use of biogas, including the following:

- Promote biogas utilization through existing agency programs
- Foster investment in biogas systems
- Strengthen markets for biogas systems and products
- Improve coordination and communication.

Since the release of the first *Biogas Opportunities Roadmap*, the Federal Government has made great strides in identifying and prioritizing policy and technology opportunities to expand the biogas industry and greenhouse gas (GHG) reductions.

In addition, the Roadmap spurred the creation of the interagency Biogas Opportunities Working Group, which is responsible for the development and publication of this progress report. As part of the process, the working group sponsored a stakeholder forum in July 2015, headlined by USDA Secretary Vilsack, at which participants highlighted the progress made since last year.

ACHIEVEMENTS

There have been many notable policy and technological achievements following publication of the *Biogas Opportunities Roadmap* in 2014. These successes highlight the individual efforts of each agency and also serve to illustrate how government and private agencies are collaborating to expand the biogas industry and reduce GHG emissions. This section highlights successful national efforts over the past year.

POLICY AND PROGRAM ACHIEVEMENTS

Accomplishments supporting biogas within the policy and program arena can come from the creation of new efforts, a revision of scope to existing programs or policies to specifically enable biogas activities, or through increased collaboration of existing programs. It is important to have this robust approach across the spectrum, including both government agencies and the private sector, in order to create new avenues for the success of the biogas industry and to strengthen and reinvigorate the existing avenues. The following section provides details on policy and program achievements of different government agencies, as well as the private sector.

Government Agency Achievements

Many government agencies already have programs and policies that are designed to support renewable energy or even, more specifically, bioenergy. While these efforts are often beneficial for biogas projects as is, there are occasionally minor updates or changes that can be made to the policies or programs in order to maximize their value to the biogas sector. For example, DOE has specifically broadened its

ACHIEVEMENTS

organic resource strategy to incorporate biogas and similar renewables as feedstocks that supply biogenic carbon and hydrogen. Below are some examples of how programs and policies have been revised in an effort to further support the growth of the biogas industry.

USDA Achievements

Rural Energy for America Program (REAP):

- USDA published the final rule for REAP on December 29, 2014, developing a streamlined application and a new scoring criteria for energy generated or saved per REAP dollar requested, under which anaerobic digesters should score well.
- The rule includes revised provisions for personal guarantees, which may help farmers obtain financing for anaerobic digester projects, and also allows for the inclusion of nutrient recovery systems and renewable gas conditioning systems, including renewable hydrogen and fuel cell systems.¹

9003 Biorefinery, Renewable Chemical, and Biobased Product Manufacturing Assistance Program:

- The Rural Business-Cooperative Service published an interim final rule on June 24, 2015, and a funding notice for the program to provide loan guarantees to eligible projects (up to 80 percent of the total eligible project cost).
- This funding assists commercial, municipal, and industrial biogas plant deployment, allowing biogas plants to sell the biogas, use the biogas to generate electricity or heat and power, or process the biogas into renewable chemicals.²

Rural Utilities Services (RUS):

- In April 2015, RUS updated its website announcing the availability of Federal Financing Bank loan guarantees to project developers of distributed generations projects that produce wholesale and retail electricity (with Power Purchase Agreements) to serve rural areas.

Natural Resources Conservation Service (NRCS)

Environmental Quality Incentives Program (EQIP):

- EQIP is a voluntary program that provides financial and technical assistance to agricultural producers through contracts (a maximum term of 10 years in length) to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air, and related resources on agricultural land and non-industrial private forestland.⁵

Program Coordination (Stacking):

- To coordinate and maximize the potential assistance programs, Rural Development (RD) and Natural Resources Conservation Service (NRCS) met and developed a working partnership to deliver USDA services to producers interested in getting an anaerobic digester for their farming operation.
- When “stacking,” both RD and NRCS funding mechanisms can be used to assist in funding a project, but each has limitations; for instance, the \$450,000 cap on EQIP encompasses financial assistance for any practice that the producer wants to implement during the life of the Farm Bill.
- One of the most successful collaborations is for an anaerobic digester project, which demonstrates exactly how the two assistance programs (REAP and EQIP) can work together to help the producer implement the project while avoiding duplicate funding.
- A detailed breakdown of the project costs and a EQIP/REAP program split is shown in the call out box.
 - » Coincidentally for this project, costs broke down into a roughly 50 percent split in terms of what each program is authorized to cover with assistance, and because the producer had no other contracts with NRCS, up to \$450,000 in financial assistance was available (to EQIP eligible producers) through the NRCS EQIP program

1. More information is available at www.federalregister.gov/articles/2014/12/29/2014-30133/rural-energy-for-america-program.

2. More information is available at www.federalregister.gov/articles/2015/06/24/2015-14989/biorefinery-renewable-chemical-and-biobased-product-manufacturing-assistance-program.

3. More information is available at www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/.

ACHIEVEMENTS

Proposed EQIP and REAP Program Cost Split				
Anaerobic Digester System Costs - 850 Head Equivalent Dairy				
		EQIP*	REAP*	
I. Mixing Pit				
	Pit/Plumbing/Pump/Mixer	\$108,000	\$108,000	
II. Digester				
	Walls and Floor (poured concrete)	\$170,000	\$170,000	
	Precast Roof	\$90,000	\$90,000	
	Insulation/Concrete Coating/Foam	\$87,000	\$87,000	
	Excavation (only for digester)	\$25,000	\$25,000	
III. Digester Heating System				
	Heat Exchanger Header	\$8,800	\$8,800	
	Heat Exchangers	\$32,850	\$32,850	
	Heat Piping	\$10,000	\$10,000	
	Piping Racks	\$7,000	\$7,000	
	HDPE Draft Wall	\$8,950	\$8,950	
	Circulation Pumps/Solenoids (5 digester/1 barn)	\$10,000	\$10,000	
	Sludge Recirculation Pump	\$6,100	\$6,100	
	Misc Piping/Valves	\$12,500	\$12,500	
	Labor/Mobilization/Equipment Rental	\$70,000	\$70,000	
IV. Gas Mixing System				
	Diffuser Heads/Header	\$15,500	\$15,500	
	Blower/Solenoids/H2S reduction system	\$45,000	\$45,000	
	Labor/Equipment Rental	\$8,750	\$8,750	
V. Building Interior Plumbing and Electrical				
	Labor	\$25,000	\$25,000	
	Electrical (includes digester controls)	\$52,500	\$52,500	
	Automatic Flare and Flame Arrestors	\$19,000	\$19,000	
VI. Electrical Gen-Set				
	225 kW Gen-Set	\$207,000	\$207,000	
	Gen-Set Pumbing/Hook-up	\$50,000	\$50,000	
	Utility Interconnection (estimate only)	\$150,000	\$150,000	
VII. Building				
	Solids Press/Handling Equipment	\$70,000	\$70,000	
	Electrical	\$80,000	\$80,000	
	Building Shell	\$100,000	\$100,000	
	Concrete	\$15,000	\$15,000	
	Engineering/Start-Up	\$100,000	\$50,000	\$50,000
	Administrative	\$95,000	\$47,500	\$47,500
	Contingency	\$100,000	\$50,000	\$50,000
	Total	\$1,778,950	\$863,700	\$915,250

* \$450,000 limitation on EQIP, \$500,000 maximum grant, and \$25 million maximum loan on REAP.
Price is an estimate only. 50%-50% EQIP-REAP split of equipment building, engineering, and project administrative.

ACHIEVEMENTS

EPA Achievements

Renewable Fuel Standard (RFS):

- As part of the 2014 final rule for RFS Pathways II, biofuels produced using an approved pathway can generate credits or Renewable Identification Numbers (RINs) under the RFS program, which specifies that a certain portion of annual renewable fuel volume requirements must come from cellulosic advanced fuels, which can include biogas and electricity derived from biogas used to power electric vehicles.
- Biogas projects have the potential to provide notable volumes of cellulosic biofuel to the market in complying with the RFS, especially in the generation of fuels for the transportation sector.⁴

DOE Achievements

Resource Assessment on Renewable Hydrogen Potential from Biogas in the United States:

- DOE completed an update of this biogas resource assessment study, which includes total potential and net availability of methane in raw biogas from wastewater treatment plants; landfills; animal manure; and industrial, institutional, and commercial sources.
- The study estimates the potential bio-methane annual production at 16 million metric tons, and the net annual production at 6 million metric tons. It also estimates that these bio-methane streams have the potential to produce 4.0 million and 1.6 million metric tons of renewable hydrogen per year.⁵

Bioenergy Technologies Office (BETO) Multi-Year Program Plan (MYPP):

- BETO's MYPP identified that "wet municipal, industrial, and agricultural wastes are a potential high-impact resource for the domestic production of biogas,

biofuels, bio-product precursors, heat, and electricity" and also expanded the definition of "biomass" to explicitly call out "wet waste (e.g., biosolids), municipal solid waste, urban wood waste, and food waste," which are key resources in biogas production.⁶ This plan guides BETO's research and development activities, so explicit inclusion of these feedstocks signals increased focus on biogas and related products"

Private Industry Achievements

Efforts within the private sector to support and improve the biogas industry indicate the current trends of the market and substantiate the efforts already underway by various government agencies. A biogas industry with strong supply and demand is critical to long-term growth, and the following effort by non-governmental organizations indicates that the market is moving in this direction.

Newtrient:

- On July 1, 2015, representatives from 11 dairy cooperatives and their trade association, the National Milk Producers Federation and Dairy Management, Inc., launched Newtrient LLC, focusing on manure management and assisting dairy farmers with selection, design, financing, installation, and management of renewable energy-producing and nutrient-recovery technologies.
- Newtrient seeks to foster trusted partnerships in order to drive improvements in technologies and markets to reduce costs and generate new capital, resulting in important economic and environmental improvements for farmers and the surrounding communities.

4. More information is available at www.epa.gov/otaq/fuels/renewablefuels/.

5. The report can be accessed at www.nrel.gov/docs/fy14osti/60283.pdf.

6. The March 2015 MYPP can be accessed at energy.gov/sites/prod/files/2015/04/f22/mypp_beto_march2015.pdf.

ACHIEVEMENTS

TECHNOLOGY ACHIEVEMENTS

Technology achievements are often the cornerstone of realizing growth and success within an industry. Often, though, this does not only include developing brand new technologies, but also revising existing technologies, as well as making stakeholders and the general public aware of what has already been developed. USDA, EPA, and DOE are working across all of these fronts, offering funding for project development, updating existing projects and efforts, and ensuring resource and technical information is thoroughly and appropriately disseminated. The following section highlights some of the recent technology achievements.

Projects Funded

Funding can often be one of the most important factors in achieving success within the realm of technology. This critical area is where many government agencies are able to provide financial assistance, supporting worthwhile projects and concepts in making it to the market. USDA, EPA, and DOE have been able to recently offer funding that is available specifically to the biogas projects. Below are some examples of funding opportunities that the biogas industry could utilize.

USDA National Institute of Food and Agriculture (NIFA):

- USDA-NIFA launched the new Data Gateway tool to strengthen transparency and provide easy access to data and metrics on how the agency distributes funding.⁷
- In the past year, USDA-NIFA has funded work dedicated to anaerobic digestion through universities involved in the S-1041 Multistate Committee “The Science and Engineering for a Biobased Industry and Economy” utilizing Hatch funds.
- Projects focus on producing economically valuable co-products of digestion along with fuel, developing economical processes for biogas purification, and examining nutrient-recovery processes for recovering nitrogen and phosphorus as fertilizer.

Milk Trucks Run on Biofuel Generated from Dairy Operation's Waste

USDA Rural Development backed a \$5.5 million loan to Renewable Dairy Fuels, an affiliate of Fair Oaks Farms with the Business and Industry Loan Guarantee Program in Fiscal Year 2013. The financing was used to purchase machinery and equipment to convert methane gas from the dairy's digester into renewable compressed natural gas (CNG) and to install a fueling station with gas drying, compressing, and dispensing operations. The equipment scrubs the biogas clean of carbon dioxide so that it can be used as a clean transportation fuel for the Fair Oaks Farm's dairy hauling fleet.

(<http://www.rd.usda.gov/newsroom/success-stories/milk-trucks-run-biofuel-generated-dairy-operations-waste>)

The CNG generated by the dairy's main waste product, animal manure, now powers Fair Oaks Farms' fleet of big rigs hauling milk to processing plants in Indianapolis, as well as Murphysboro, Tennessee, and Winchester, Kentucky.

Biomass Research and Development Initiative:

- USDA-NIFA and DOE's BETO issued a request for proposals titled “Biomass Research and Development Initiative,” targeting the development of feedstocks, biobased products, and biofuels (work related to biogas utilization for fuels and products is acceptable).⁸
- Proposals from the 2015 funding cycle are currently being reviewed, and the program is expected to continue on a biannual basis.

Pilot Biorefinery and Energy Park:

- USDA Agricultural Research Service (ARS) researchers in Albany, California, developed a large pilot-scale biorefinery located at the Crazy Horse Landfill in Salinas, California, which converts rural and urban solid waste into ethanol, biogas, compost, and/or value-added recyclables.
- Together, ARS and the City of Salinas are creating an “energy park” that converts both agricultural biomass

7. This tool is available at nifa.usda.gov/data.

8. More information is available at www.csrees.usda.gov/fo/biomassresearchanddevelopmentinitiative.cfm.

ACHIEVEMENTS

and curb-collected garbage into bioenergy in the same biorefinery, demonstrating the facility's flexibility in handling and processing different feedstock supplies.⁹

Wastewater to Energy Project:

- USDA Rural Development Loan Guarantees are facilitating a major plant upgrade with Pennsylvania's Milton Regional Sewer Authority (MRSA), which will result in a state-of-the-art green sewer treatment plant that complies with the Chesapeake Bay Tributary Strategy by increasing treatment capacity and reducing nutrients discharged.
- The excess food waste from an adjacent ConAgra processing plant provides the necessary feedstock to fuel the onsite digesters that in turn create biogas and ultimately electricity to run the sewer plant and sell back to the grid.¹⁰

Conservation Innovation Grants (CIG):

- USDA NRCS CIG is a program intended to stimulate the development and adoption of innovative conservation approaches and technologies, and CIG will be awarding up to \$20 million in CIG program grants in the fourth quarter of Fiscal Year (FY) 2015.
- Recent CIG projects demonstrated dry digestion of manure and food waste, aerobic drying of dairy digester solids, improved nutrient solid/liquid separation of digestate, and increased denitrification of digester effluent.¹¹

Ultra-Low NO_x Biogas Engine Demonstration Project:

- EPA's Pacific Southwest Office (Region 9) provided funds to the San Joaquin Valley Air Pollution Control District's Technology Advancement Program to demonstrate an ultra-low nitrogen oxides (NO_x) advanced compact selective catalytic reduction system on a biogas-powered engine at a farm.

- The system includes advanced monitoring and reductant metering equipment to prevent ammonia slip, which has previously been a primary source of NO_x emissions.¹²

Renewable Natural Gas-Fueled Refuse Trucks:

- EPA's Region 9, through the Diesel Emission Reduction Act, funded refuse trucks fueled by renewable natural gas at the Atlas Disposal Industries facility in Sacramento, California.
- Through anaerobic digestion, food waste from nearby companies is converted into compressed natural gas to run the trucks and provide electricity and heat used at the facility, while the remaining processed material is turned into fertilizer and soil amendments.

DOE-Funded Biogas as a Feedstock Projects:

- The first project, at the National Renewable Energy Laboratory (NREL), uses methanotrophic microorganisms to convert the methane in biogas to muconic acid, a key building bioproduct and biofuel building block.
- The second, with Natureworks, LLC, targets the fermentation of biogas to produce lactic acid, a key component in bioplastics that also has potential in producing biofuels.
- Total funding over project lifetimes could reach \$5 million.¹³

Enhanced Anaerobic Digestion:

- A DOE project at Argonne National Laboratory (ANL) succeeded in developing an enhanced anaerobic digestion process, which produces biogas with more than 90 percent methane from sludge generated by municipal wastewater treatment plants.

Fountain Valley Energy Station:

- The DOE co-funded station was completed in 2014 to become the world's first tri-generation hydrogen energy

9. More information is available at www.ars.usda.gov/research/projects/projects.htm?ACCN_NO=418775&fy=2014.

10. More information is available at www.rd.usda.gov/files/success-story/PA_WEP_Milton.pdf.

11. More information is available at nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/

12. More information is available at valleyair.org/grants/documents/technologyadvancement/C-4236_EF&EE_FinalReport.pdf.

13. More information is available at energy.gov/eere/articles/energy-department-announces-134-million-develop-advanced-biofuels-and-bioproducts.

ACHIEVEMENTS

and electrical power station (combined heat, hydrogen, and power system) that can co-produce hydrogen from biogas in addition to electricity and heat.

Landfill Gas Demonstration Project:

- DOE's Fuel Cell Technologies Office (FCTO) funded this project to produce hydrogen from landfill gas to operate material handling equipment (MHE) powered by fuel cells at a nearby BMW manufacturing plant in Greer, South Carolina.
- A report will be prepared to identify key findings from the project.



The BMW manufacturing plant in Greer, South Carolina. Landfill gas accounts for about 30 percent of the plant's electrical needs and about 50 percent of the plant's total energy requirements.
Photo courtesy of BMW.

Technology Information Developed, Updated, and Revised

In an industry such as the biogas industry, technical information and resources made available by the government can be very important to organizations within the sector looking for trustworthy information. Similarly, it is then important to ensure this set of information, tools, and resources remains up-to-date. Outdated resources are no longer relevant to the

industry and can often become an obstacle to those seeking support. To this end, the following information portals provide examples of how the government is actively working to ensure its technology information is accurate and up-to-date.

EPA Technology Information

AgSTAR:

- EPA's AgSTAR program updated its Vendor Directory, which allows users to find companies and organizations involved in the implementation of anaerobic digester projects in the livestock sector.¹⁴
- AgSTAR also updated its Livestock Anaerobic Digester Database, which provides current information on the status of anaerobic digester implementation in the livestock sector.¹⁵

EPA Combined Heat and Power (CHP) Partnership:

- In October 2014, the CHP Partnership published a fact sheet titled "Approaches to Streamline Air Permitting for Combined Heat and Power: Permits by Rule and General Permits," which provides information on two streamlined air-permitting processes for CHP projects: permit by rule and general permits.¹⁶
- In May 2015, the CHP Partnership published another fact sheet titled "Treatment of CHP in LEED® for Building Design and Construction: New Construction and Major Renovations," which summarizes how CHP is treated under the Leadership in Energy and Environmental Design® (LEED) for Building Design and Construction New Construction and Major Renovations rating system.¹⁷

Green Power from Landfill Gas:

- In May 2015, EPA's Landfill Methane Outreach Program (LMOP) published a fact sheet, "Green Power from Landfill Gas," describing the benefits of using landfill gas as a renewable energy resource in the form of electricity and fuel. The fact sheet also summarizes

14. More information is available at www2.epa.gov/agstar/agstar-vendor-directory.

15. More information is available at www2.epa.gov/agstar/livestock-anaerobic-digester-database.

16. The fact sheet is available at epa.gov/chp/documents/PBRFactsheet-10162014.pdf.

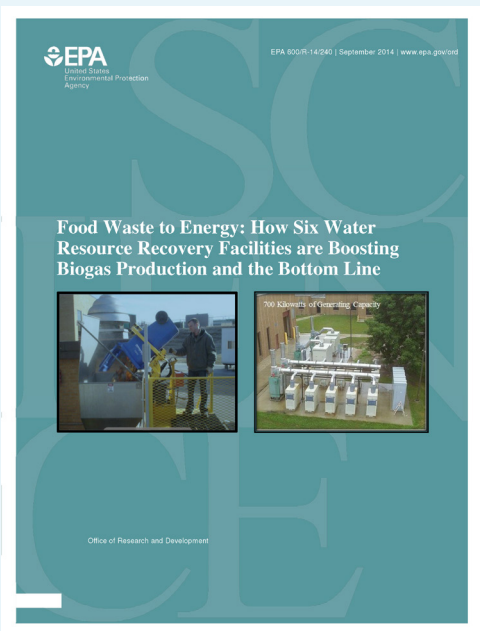
17. The fact sheet is available at epa.gov/chp/documents/treatment_of_chp_in_leed_building_design.pdf.

ACHIEVEMENTS

the status of landfill gas energy projects in the United States, including opportunities for additional landfill gas use projects, and highlights examples of organizations using landfill gas energy.¹⁸

Food Waste to Energy Report:

- In September 2014, EPA published a report titled “Food Waste to Energy: How Six Water Resource Recovery Facilities are Boosting Biogas Production and the Bottom Line,” presenting the co-digestion practices, performance, and experiences of six such water resource recovery facilities.
- The report describes the types of food waste co-digested and the strategies—specifically, the tools, timing, and partnerships—employed to manage the material and describes how the facilities manage wastewater solids, providing information about power production, biosolids use, and program costs.¹⁹



The Food Waste to Energy Report Cover.
Image courtesy of EPA.

DOE Technology Information

Clean Cities' Renewable Natural Gas (RNG) Project Database:

- DOE's Clean Cities and ANL are developing a database of existing and planned projects producing RNG for vehicle fuel or pipeline injection, as well as a toolkit to assist coordinators in communicating the benefits of RNG.

Clean Cities' Expansion of the ANL Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model:

- Clean Cities supported the expansion of ANL's GREET Model to permit calculation of well-to-wheel GHG benefits for RNG from landfill gas, manure-based anaerobic digesters, and wastewater treatment plants as compared with fossil natural gas or petroleum.
- Clean Cities also supported the expansion of ANL's Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool to permit well-to-wheels comparisons of different types of vehicles fueled by RNG, fossil natural gas, or petroleum.

Dissemination of Resources and Information for Stakeholders

One potential challenge that can arise after developing information resources is ensuring that the target audiences are aware of their availability and understand how to utilize them. To this end, disseminating information to stakeholders about current projects and information resources is a very valuable set of activities undertaken by the government. The following provides some examples of what is being done in this area.

Science Inventory:

- EPA's Science Inventory is a searchable database of research products, including biogas research supported by EPA.²⁰

AgSTAR Website:

- In June 2015, AgSTAR updated its website to provide easier access to information about biogas data, tools,

18. The fact sheet is available at epa.gov/lmop/documents/pdfs/green_power_from_landfill_gas.pdf.

19. The report is available at epa.gov/region9/organics/ad/epa-600-R-14-240-food-waste-to-energy.pdf.

20. Website is available at cfpub.epa.gov/si.

CHALLENGES AND OPPORTUNITIES

and information for the livestock sector and anaerobic digester projects.²¹

Alternative Fuels Data Center (AFDC) Website:

- DOE updated its AFDC website to include RNG as an emerging fuel, along with reports and resources provided by EPA, USDA, and industry groups.²²

CHALLENGES AND OPPORTUNITIES

CHALLENGES

Even as many of the recent activities by biogas stakeholders have resulted in the achievements listed above, these efforts have also helped to identify some of the remaining challenges facing the growth of the U.S. biogas industry. The original *Biogas Opportunities Roadmap* listed six barriers that were inhibiting the achievement of a robust biogas industry. The barriers identified include the following:

- Lack of awareness of biogas benefits
- Unpredictable biogas market conditions
- Lack of market maturity
- Lack of full valuation
- Inconsistencies across Federal, state, and local governments
- Lack of technical and applied research and development.

Growth of the biogas sector continues to be limited due to many barriers that remain unresolved. Some of the most pertinent policy, technology, and financing challenges are identified below. Achieving growth in the biogas sector will require continued progress in engaging stakeholders to eliminate or overcome these barriers.

Policy Challenge in Dairy Nutrient Management: Federal, state, and local nutrient management policies are designed to protect the environment and the quality of local water resources, but they can also impact sectors like the dairy

POLICY CHALLENGE SPOTLIGHT: COMMUNITY ASSOCIATION FOR RESTORATION OF THE ENVIRONMENT (CARE), ET AL. V. COW PALACE, LLC

As summarized by MacDonald and McBride in *The Transformation of U.S. Livestock Agriculture: Scale, Efficiency, and Risks*: “Livestock wastes are becoming more geographically concentrated in the United States, and excessive applications of the nutrients contained in manure pose risks to air and water resources. There is a clear association between farm size and the concentration of manure—larger operations are more likely to ship manure to other operations and apply manure to their own fields more intensively.” A January 2015 court case in Washington, Community Association for Restoration of the Environment (CARE), et al. v. Cow Palace, LLC, illustrates the potential concern for the environment. In the case, the U.S. District Court for the Eastern District of Washington determined that manure is a “solid waste” where it is

- Applied to crop fields at rates in excess of what the crop could use
- Stored in lagoons that leak by design
- Placed by the dairy on bare ground to compost.

While this is a singular case, it highlights the opportunity for producers to realize significant co-benefits from anaerobic digestion systems. These highly engineered systems can help producers ensure that they have adequate storage and treatment of manure prior to its use as fertilizer. The digestion process transforms the manure, significantly decreasing solids and increasing the percentage of inorganic nitrogen and phosphorous, offering increased flexibility for management of the digestate. Anaerobic digestion systems can also be coupled with enhanced nutrient recovery technologies to give producers greater control over potential pollutants, like the nitrogen and phosphorus in manure.

Reference: MacDonald, James M. and McBride, William D. *The Transformation of U.S. Livestock Agriculture: Scale, Efficiency, and Risks*, Economic Information Bulletin No. 43. Economic Research Service, U.S. Dept. of Agriculture. January 2009.

21. Website is available at www2.epa.gov/agstar.

22. Website available at available.at.afdc.energy.gov/fuels/emerging_biogas.html.

CHALLENGES AND OPPORTUNITIES

industry. As dairy farms grow in size to capitalize on profitability from larger economies of scale, a challenge can arise in dealing with excess nutrients from the larger volumes of manure generated.

Policy Challenge in the Digestate Market—Organic Certification:

A large potential market exists in organic agriculture for fertilizers made from the solid and liquid outputs (digestate) of anaerobic digesters, but in order to access that market, a digestate-based fertilizer must be listed under the USDA's National Organics Program (NOP) in order to receive certification as organic. Industry has discovered that if the digestate is treated, significantly more nitrogen can become available, making the product commercially attractive and potentially making anaerobic digester projects more economically viable. At least one petition has been submitted to the National Organics Standards Board requesting such a product be included in NOP's list of approved substances, which would result in improved economics for biogas systems.

Biogas Classification and Performance Data: A number of biogas organizations are currently pursuing the creation of a North American Industry Classification System code for biogas. Another parallel effort is focusing on creating North American Product Classification System codes for biogas products. These efforts are designed to help address an existing challenge, which is the lack of data on biogas loan performances. This gap is contributing to a perceived higher risk for biogas projects, ultimately making it more difficult to secure financing.

Technology Challenge with Low NO_x Engines: Combustion of biogas generates NO_x, which contributes to the formation of atmospheric ozone. In EPA-designated ozone nonattainment air quality areas, Federal, state, and local government emission control rules limit the levels of NO_x generated from biogas-fueled engines. For example, the South Coast Air Quality Management District in southern California requires biogas engines to meet stringent emission limits for NO_x of 11 parts per million by volume. Several biogas engine manufacturers are currently trying to demonstrate or prove the success of their low- NO_x technologies; however, few biogas engines are able

to meet these low emission levels. To allow biogas projects in ozone nonattainment areas to continue, the successful demonstration of low NO_x engines are needed to meet these ultra-low emission limits.

Expiration of Power Purchase Agreements, Investment Tax

Credits: Changes in availability or terms of power purchase agreements and investment tax credits can have significantly adverse impacts on biogas projects that are depending upon them within their business model. One of the first biogas systems built on a dairy farm in Wisconsin recently shut down because the original utility contract expired and the current rate had dropped, meaning the local utility will now pay less than half of the rate when the project was first built. Since Wisconsin's Renewable Portfolio Standard (RPS) had been met, there was a reduced need for renewable energy for RPS compliance. With less than half of the revenue now available, it was no longer economically attractive for the farm to run the digester. The owners of the dairy decided to shut down their digester and to pursue other manure management practices, giving up the odor reduction and environmental benefits they had been contributing.

Reliance on Single Revenue Stream from Electric Generation:

Revenues, in addition to energy sales, are required to grow and strengthen the biogas industry. In order to fully finance biogas systems, it is often necessary to be able to market co-products in addition to the energy produced by the system. This could include focusing on separated nutrients, marketable fertilizers, or soil amendments. Local niche markets can sometimes exist for these co-products, but in order to make financing more available and attractive, developing a stable and reliable national market for these co-products would be important.

Industry Perspective on Financing Challenges with Using RIN Revenue to Secure Project Financing:

Revenue from RINs can be helpful to the project developer or owner, but most banks will not count RIN revenue when evaluating a project because of the lack of consistency over the last few years with regard to EPA's Renewable Volumetric Obligations (RVOs). The RVOs drive most of the value of RINs in the RFS because the RVOs create a demand for renewable fuel that renewable

CHALLENGES AND OPPORTUNITIES

fuel producers can supply. In a market-based system, the consumer perception can have significant impacts on demand and, therefore, the value of RIN credits. These perceptions of risk or inconsistency can cause a variability in the RIN credit values that is unattractive to banks.

OPPORTUNITIES

Despite many of the challenges highlighted in the previous section, the biogas sector continues to recognize many opportunities for growth. Market-based opportunities arise to meet needs and solve supply or demand challenges. Government agencies can help maximize and expand these opportunities through efforts such as disseminating information and increasing outreach to stakeholders.

Sector Trends

The biogas market is continually shifting and changing, often influenced by the changes in peripheral issues or markets that can open up new opportunities. A current push by many communities for food and organic waste diversion is paving the way for new potential anaerobic digester projects. Similarly, as the drive for renewable energy and alternative fuels continues, the biogas sector is being recognized as a potential solution to help meet sustainability goals.

Reducing Disposal Costs and GHG Emissions While Increasing Energy Efficiency: Wastewater treatment plants, food processors, and other organic waste generators may be able to reduce costs associated with the disposal of wastes by incorporating anaerobic digestion into their waste management plan. Depending on the type of facility, these benefits may be realized as reduced hauling costs (due to a reduced volume of solids) or reduced tip fees when compared to nearby landfill tip fees or reduced sewer fees (due to a reduction in organic load). These savings could result in higher profits for both the waste generator and receiver.

Reducing Waste: Reducing the amount of food waste sent to landfills continues to be an opportunity for improvement across the United States. EPA estimates that if 50 percent of



USDA Office of the Chief Economist Sustainability Director Elise Golan and Agricultural Marketing Service Senior Economist Don Hinman hosted a “Wasted Food” exhibit at the 2015 Agricultural Outlook Forum that took place in February, highlighting the challenges and opportunities of the U.S. Food Waste Challenge.
Photo courtesy of USDA.

the food waste generated each year in the United States was anaerobically digested, enough electricity would be generated to power 2.5 million homes for 1 year.²³ Increasing the volume of organic wastes processed using anaerobic digestion also decreases the amount of wastes sent to landfills. The shift from landfilling waste to digesting waste can result in value-added products generated from the processed waste such as soil amendments and animal bedding. EPA and USDA are continuing efforts to reduce the amount of food discarded to landfills through the U.S. Food Waste Challenge and the Food Recovery Challenge. As of May 2015, the combined EPA and USDA effort had more than 4,000 participants.

Stakeholder Engagement

USDA, DOE, EPA, and other government agencies regularly host, present at, and participate in events specifically designed to share information and resources with biogas stakeholders in order to facilitate growth throughout the industry. These events are intentionally organized as an active way to bolster the passive information provided on websites and in reports. Interacting with stakeholders to demonstrate and explain the resources available is important to ensure their value and utilization within the industry. Additionally, interacting with

23. More information is available at www.epa.gov/region9/waste/features/foodtoenergy/.

CHALLENGES AND OPPORTUNITIES

stakeholders is a critical way to obtain feedback on issues, programs, and policies, which can directly influence the shaping of future strategies and activities. An opportunity

exists to continue and strengthen these types of stakeholder engagement efforts. Listed below are some examples of recent activities.

WORKSHOPS

EPA's LMOP National Landfill Gas Energy Workshop:

- March 2015

Indiana Biomass Energy Workshop:

- November 2014

Mid-West Energy Research Consortium Workshop:

- January 2015

German American Chamber of Commerce of the Southern United States Bioenergy Workshop:

- June 2015

Clean Cities State Series of Workshops and Webinars:

- June 2013, January 2014, June 2014, April 2015, August 2015
- RNG-related technical assistance

DOE Waste-to-Energy Workshop:

- November 2014

DOE Hydrogen, Hydrocarbons, and Other Bioproduct Precursors from Wastewaters Workshop:

- March 2015

DOE/EPA Energy-Positive Water Resource Recovery Workshop:

- April 2015

DOE Gas Cleanup for Fuel Cell Applications Workshop:

- March 2014

WEBINARS

Clean Cities Webinar on RNG Opportunities:

- June 2015

USDA Rural Development Participation on Financing Biogas Systems Webinar Series:

- January and June 2015

USDA Rural Development Participation with Dairy Power Team Webinar:

- August 2014

EPA's Managing Wasted Food with Anaerobic Digestion: Incentives and Innovations:

- November 2014

LMOP Webinar on Landfill Gas as a Vehicle Fuel:

- November 2014

CONFERENCES

Dairy Environmental Systems and Climate Adaptation Conference at Cornell University:

- July 2015

Western Dairy Sustainability Conference:

- September 2014

BioCycle East:

- October 2014

Waste to Biogas Finance Summit:

- March 2015

Waste to Worth Conference:

- March 2015

BioCycle West Coast Conference:

- April 2015

DOE's Bioenergy 2015:

- June 2015
- Two sessions on biogas

Request for Information (RFI)

DOE RFI on Gas Cleanup for Fuel Cell Applications:

- Issued June 2015

NEXT STEPS

Ongoing efforts will be required to overcome many of the challenges identified previously for growth of the biogas sector. The number of activities planned should provide a clear signal to stakeholders that the government intends to continue its efforts to support and promote biogas projects. Additionally, biogas work aligns with many existing goals of the government; therefore, it often makes sense to keep biogas in mind while moving forward in planning and outlining the broader strategies and future directions of programs.

COMING SOON

Government activities are ongoing within the biogas sector, and some near-term activities have already been planned. USDA, EPA, and DOE have many efforts that are anticipated to begin or be completed within the next year or two. The following section provides some examples.

USDA

NRCS Anaerobic Digester Practice: USDA NRCS is currently updating the Conservation Practice Standard for Anaerobic Digesters (Code 366). A draft is scheduled to be posted in the Federal Register for public comment in spring 2016. Other facilitating practices, Nutrient Management (Code 590), Waste Transfer (Code 634), and Roofs and Covers (Code 367) have been revised recently and are current. NRCS also anticipates posting a revised draft of Waste Storage Facility (Code 313) in the Federal Register in the near future.

DOE

Clean Cities Revised Strategic Plan: DOE's Clean Cities has included RNG in the program's strategic planning activities since 2010. In February 2015, Clean Cities began developing a new strategic plan in which outreach and education will play a prominent role, providing coordinators with improved tools and resources to assist local stakeholders involved in RNG planning and development.

DOE Modeling Efforts with NREL: Building on data published by EPA's LMOP, DOE has launched a modeling effort with

NREL to understand the marketplace dynamics of various possible utilization pathways for biogas. Initial efforts are focused on model validation and extension beyond existing capture operations to candidate landfills. Efforts in FY 2016 will expand coverage to include biogas, biofuels, and biopower potential from wastewater treatment plants, and possibly animal husbandry operations.

DOE Workshop Documents: In fall 2015, DOE will release documents from the March 2015 workshop on Anaerobic Membrane Bioreactors and Microbial Electrochemical Systems, as well as the April 2015 NSF-EPA-DOE event on Energy Positive Water Resource Recovery.

DOE Resource Assessment Project: DOE launched a resource assessment project with two of its national laboratories, Pacific Northwest National Laboratory and NREL. The goal is to build on previous work to develop a more geographically precise inventory of potential wet organic waste streams, including biogas, in order to lay the groundwork for a possible distributed network of conversion systems.

EPA

EPA Office of Water's Manure Nutrient Recovery Technology Innovation Challenge: EPA is partnering with dairy and swine producers, USDA, and academic experts to launch an innovation challenge in 2015 for nutrient-recovery technologies that can help manage nutrients in livestock manure. The competition is intended to encourage the development and adoption of affordable and effective technologies that can extract and transform nutrients in livestock manure and sequester them into reusable or sellable products, to yield both environmental and economic benefits. The challenge is anticipated to launch in fall 2015.

EPA Food Recovery Guides: EPA Region 9 is publishing food recovery guides for six metropolitan areas in the Pacific Southwest, which will include listings for anaerobic digestion of food scraps and fats, oils, and grease recycling opportunities in addition to information on source reduction and donation opportunities. The guides are intended for food waste-

NEXT STEPS

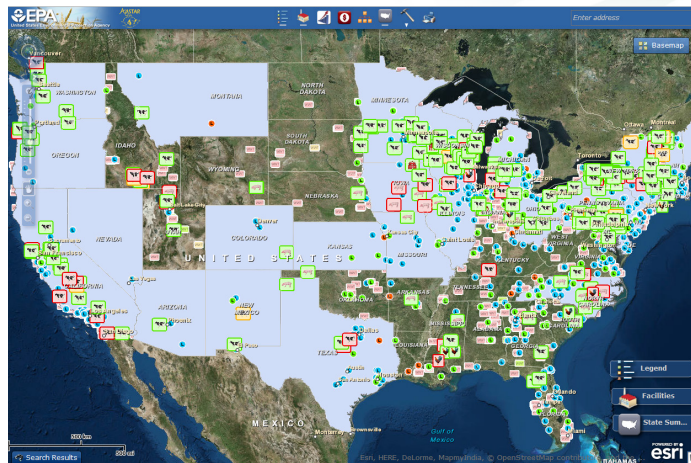
generating businesses to facilitate greater food recovery. The guides are expected to be published in fall 2015.

Integrated Resource Management (IRM): EPA is conducting research into the concept of IRM in a joint project between EPA Region 1, the Office of Research and Development, and the Office of Science and Technology. IRM is a stakeholder-driven process that considers all ‘wastes’ as resources and finds markets for these resources. The goal is to deliver multiple environmental and social benefits at equal or reduced total life-cycle costs compared to more traditional waste management methods. IRM projects often, but not always, incorporate anaerobic digestion as a resource conversion technology.

In early 2015, EPA began conducting a model IRM planning process in New Bedford, Massachusetts. The project will collect data on available resources; conduct stakeholder outreach to determine community interests and potential markets; and provide guidance to the city on potential long-term solutions to complex water, solid waste, and energy issues. The project is expected to be complete in mid-2016. The stakeholders and research team are investigating a number of scenarios that might include anaerobic digestion.

Waste Reduction Model (WARM): In March 2015, EPA updated WARM to incorporate meat, non-meat, and mixed food wastes. EPA is currently working on updating the model to add anaerobic digestion as a waste management practice. WARM helps solid waste planners and organizations calculate the GHG benefits of alternative end-of-life waste management decisions. These new updates will allow them to consider the potential impacts of anaerobic digestion and other waste management options of food wastes when making decisions for their operations. These updates are expected to be completed by fall 2015.²⁴

AgSTAR National Mapping Tool: EPA is expanding the scope of AgSTAR’s national mapping tool to include sources of wasted food and other organic wastes, as well as facilities



The EPA AgSTAR Mapping Tool interface.
Image courtesy of EPA.

with capacity to receive these materials. This update will allow organic waste generators to find anaerobic digestion facilities and allow biogas project developers to understand the potential organics available in a given area. The updates are expected to be completed by fall 2016.²⁵

EPA Website for Anaerobic Digestion and Biogas: In fall 2015, EPA will launch a new website for anaerobic digestion and biogas that will serve as the first stop for stakeholders searching the EPA website for information on anaerobic digestion. The website will provide general information and include resources such as technology diagrams, FAQs, case studies, and pictures. It will also direct stakeholders to more in-depth resources available for specific sectors, such as AgSTAR, the U.S. Food Recovery Challenge, and biosolids management, among others.

FUTURE STRATEGIES/DIRECTION

USDA, EPA, and DOE all anticipate that biogas will continue to be a fundamental part of the government’s broader and longer-term strategy, as it aligns with existing agency missions and goals. A biogas project has the advantage of supporting USDA’s development of climate-smart agriculture, focusing on systems that provide economic and environmental benefits.

24. More information is available at epa.gov/epawaste/conserves/tools/warm/index.html.

25. More information is available at www2.epa.gov/agstar/agstar-national-mapping-tool.

NEXT STEPS

This same biogas project would support EPA's efforts to reduce GHG emissions and promote a clean energy economy in order to address climate change. Finally, the biogas project would also align with DOE's efforts to support the development and utilization of alternative fuels.

In terms of specific future strategies, USDA announced a comprehensive approach in April 2015 to support farmers, ranchers, and forest landowners in their response to climate change called "Building Blocks for Climate Smart Agriculture."²⁶ Through this voluntary initiative, USDA expects to reduce net emissions and enhance carbon sequestration by more than 120 million metric tons of carbon dioxide equivalent per year by 2025—about 2 percent of economy-wide net GHG emissions. The framework consists of 10 "building blocks" that span a range of technologies and practices to reduce GHG emissions, increase carbon storage, and generate renewable energy. Of specific relevance to the biogas community is the Livestock Partnerships building block. This part of the initiative encourages broader deployment of anaerobic digesters, lagoon covers, composting, and solids separators to reduce methane emissions from cattle, dairy, and swine operations.

In conjunction with its partners, USDA plans to support 500 new digesters over the next 10 years, as well as expand the use of impermeable covers on anaerobic lagoons used in dairy cattle and hog operations. As part of this initiative, USDA is also exploring how other biomass products can be used for both direct energy generation (e.g., biomass combustion) and fuel development (e.g., ethanol and biodiesel). These aspects will be incorporated into the building blocks over the next several months.

As illustrated by this report, DOE, EPA, and USDA have taken many steps during the past year to identify existing programs that support the biogas sector as well as to work collaboratively, both with each other and the private sector, to connect stakeholders with available resources. While growth in the biogas sector currently remains slow, the agencies continue to seek ways to integrate biogas activities into broader strategies and meet goals for reduced GHG emissions, increased diversion of wastes, and greater energy independence.

26. More information is available at www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=climate-smart.html.



