Measure 7: Establishing Hub and Spoke Anaerobic Digester/Biogas Hubs for Agricultural Waste

Measure Concept

Provide incentives to develop an anaerobic digester/biogas hub near an existing natural gas pipeline. These facilities would receive and process cattle and/or hog manure from farm operations in the surrounding region. They would be designed and managed to ensure efficient and environmentally friendly operation.

Description and Background

Anaerobic digester (AD) systems convert organic matter such as animal manure, wastewater biosolids, and food waste into a nutrient-rich mixture of liquid and solids (digestate) and a blend of different gases, including methane. Methane produced in AD is referred to as “biogas” because it is a by-product of microorganisms breaking down the organic compounds found in the feedstock of the digester.

Biogas can be purified to remove inert or low-value components to create renewable natural gas that can be sold and injected into the natural gas distribution system, reducing the need for fossil fuels. Digestate can be treated in different ways to create valuable byproducts, such as fertilizer and soil amendments, bioplastics, and animal bedding.

Nebraska has over 10 million head of cattle and over 3 million head of swine. Manure management for cattle and swine account for between 1.93-2.12 MMT CO_2e and 0.968 MMT CO_2e annually, respectively.

When used for animal manure management, the typical, self-contained AD consists of:

- A reliable, large volume of manure as feedstock
- Tanks or covered lagoons containing the microorganisms required to decompose the manure
- Systems to extract biogas

Methane (also called "renewable natural gas" or RNG) refined from the biogas extract can be used on site as a fuel substitute for natural gas or concentrated to match the chemical composition of natural gas and injected into commercial pipeline grids. In its refined form, RNG is indistinguishable from natural gas in either its chemical composition or performance as a fuel.

The carbon intensity of RNG tends to be substantially lower than natural gas, however, and can be an effective strategy for reducing GHG emissions. Depending on the production efficiencies, RNG’s carbon intensity can be anywhere from half to one-third of natural gas. RNG is a true drop-in fuel that can be directly substituted for natural gas in utility pipelines, natural gas vehicles, and natural gas industrial applications.

The digestate from AD systems provides additional emission reductions as a direct substitute for chemical fertilizer. Crops can use the nitrogen and other nutrients of the digestate just as well as those contained in chemical fertilizers. The use of digestate can be an integral part of nitrogen management plans to reduce nitrous oxide emissions.

AD configurations and feedstocks can make a dramatic difference in how effectively GHGs are reduced and whether the project is technically and financially sustainable over time. The hub-and-spoke

configurations discussed below create flexible, professionally managed platforms for AD into which many different sized livestock producers can participate.

The hub-and-spoke configuration here is designed around the following:

- AD tanks are located on-site at cattle, hog, or dairy facilities (the "spokes").
- The biogas extract produced at the cattle, hog, or dairy facility is either transported by low-pressure, low-volume pipeline to a central cleaning and injection site (the "hub") or compressed and driven there.
- The central cleaning site refines the raw biogas into RNG and injects into a natural gas pipeline.
- The digestate from the tanks is then extracted and applied as a nutrient and soil amendment in the farm fields and pastures surrounding the livestock operations.

Administration

NDEE will utilize a competitive Request for Proposals (RFP) process and solicit interested organizations to construct and operate one hub-and-spoke demonstration AD project near an existing natural gas pipeline.

The department will review proposals and evaluate them based on GHG reduction, LIDAC proximity, and long-term viability of the endeavor. This measure will fund 70% of the cost of equipment, installation, and construction activities including AD tanks, pipelines, and cleaning facilities.

<u>Eligibility</u>

- Projects must be entirely within Nebraska.
- Entities must be in good standing with the Nebraska Secretary of State.
- The applicant must be in compliance with all Nebraska environmental laws and within the Department's regulations and permits at all project locations.
- The Applicant must commit to abide by and follow all state and federal subgrantee regulations, financial agreements, and reporting requirements

<u>Project Requirements</u>

- Project design must be approved by licensed professional engineer.
- The project must conform to all state and local ordinances and regulations and obtain any necessary permits. NDEE may require the applicant to submit project information to the Nebraska Game and Parks Commission using the Nebraska Conservation and Environmental Review Tool for review of potential impacts to threatened and endangered species, protected lands, and other natural resources.
- Project construction must be performed by licensed contractors.
- Project management and operations must be performed by licensed operators.
- Awardees must sign a project agreement with the Department outlining the project requirements prior to commencing work
- Each anaerobic digester must be equipped with a system to temporarily flare produced biogas during brief periods when the biogas cleaning facility is offline and/or when cleaned gas cannot be delivered to the natural gas pipeline.
- The applicant must commit to keeping the equipment in good working order through the project lifespan.

- During the grant period, revenue generated from the sale of the renewable natural gas produced must be utilized for the maintenance and operation of the anaerobic digesters and biogas cleaning facility.
- Project environmental and safety measures must be approved by a licensed engineer and the Department.
- During the term of the grant, the project operator will submit semiannual reports to NDEE. These reports shall include:
    - the amount of waste processed at each digester
    - the amounts of biogas and renewable natural gas produced
    - the amount of digestate applied to agricultural land and the total area of application
    - the number and duration of any flaring events
    - estimates of the greenhouse gas reductions being achieved
    - the amount of revenue earned from the sale of the renewable natural gas.

Additional project requirements may be required upon program development. NDEE will clearly specify all project requirements in the Request for Proposal.

Request for Proposals

Interested parties must submit the following information in their proposals:

- A detailed project proposal and business plan describing the project including:
    - Location of the proposed hub biogas cleaning facility and all anaerobic digester facilities
    - Feedstock details across the project lifespan, including annual volume of manure to be processed (Commitment letters from participating livestock operations)
    - Anaerobic digester design information
    - Design of biogas transfer system from spoke digesters to hub cleaning facility
    - Design of Biogas cleaning and injection facility
    - Agreement with pipeline owner ensuring biogas will be accepted into existing natural gas line
    - Installation details
    - Estimate of annual amount of digestate to be produced
    - Plan for digestate management and use
    - Environmental compliance plans
    - Project longevity and maintenance plans
    - Project funding for remaining 30%
- Quotes and details describing each anaerobic digester spoke, biogas transfer infrastructure, biogas cleaning and injection hub, electrical equipment, installation, and utility connections costs.
- Estimate of the annual amount of renewable natural gas to be produced and the expected annual net reduction in greenhouse gases from all components of the project.

Additional information may be required upon RFP development.

Proposal Selection

Proposals that meet the eligibility requirements and provide the required information will be considered for an award. NDEE will develop a scoring system to rank proposals based on the quality of the designs and plans, the annual quantity of RNG to be produced, and the estimated greenhouse gas emission reductions. Preference will also be given to applications with projects resulting in positive outcomes for low-income disadvantaged communities as designated by the Climate Pollution Reduction Grant

Reimbursement

Upon satisfactory completion of the project, NDEE will reimburse the recipient up to 70% of the project costs minus all available alternative revenue streams (i.e., tax credits and/or rebates) applied to the project.

A request for reimbursement must be made using the form provided by NDEE, signed by an authorized representative, and must include:

- Equipment manufacturer and model numbers for any equipment with cost over $5,000
- Name, address, phone number, and email address for all vendors/contractors and the cost of the equipment and/or service provided
- Copies of all invoices and proof of payment for each (copy of canceled check front and back, bank statement showing dates cleared, or credit card statement)
- Photos of the of the new equipment installation, including close-up photo of the equipment model and serial number plate (if applicable)

Project Agreement

Before commencing work, the selected must sign a Project Agreement that codifies all of the program requirements. The agreement also includes applicable Federal Requirements from the EPA Terms and Conditions along with standard Nebraska state government requirements.

Program Timeline and Targets

Federal Fiscal Year	**Milestones**	**Tasks**
2025	Nov-Dec. 2024	EPA Funding received in October 2024. NDEE will open a public question and answer platform for potential applicants.
	Jan-Mar 2025	Develop general guidelines, application procedures, forms, and payment procedures. Develop guidelines for reporting and tracking of hub and spoke system construction and operation. Evaluation and development of QAPP if needed. Release Request for Proposals. Answer all received questions from applicants.
	April 2025	Close application window. Evaluate proposals, Oral Interview/Presentations
	May 2025	Select bidder, begin contract finalization.
	July 2025 – July 2026	Recipient obtains all necessary permits, conducts outreach,
	October 2025	NDEE Submits LIDAC Report to EPA

	August 2026-December 2027	Commence Construction of Hub and Spoke System
2026		Recipient submits semi-annual reports to NDEE, including any program income. NDEE submission of semiannual reports to EPA. Quarterly meeting with recipient for project status updates
2027		Recipient submits semi-annual reports to NDEE, including any program income. NDEE submission of semiannual reports to EPA. Quarterly meeting with recipient for project status updates
2028	January 2028	Commence Operation of Hub and Spoke System
2028		Recipient submits semi-annual reports to NDEE, including any program income. NDEE submission of semiannual reports to EPA. Quarterly meeting with recipient for project status updates
2029		Recipient submits semi-annual reports to NDEE, including any program income. NDEE submission of semiannual reports to EPA. Quarterly meeting with recipient for project status updates
2030	January 2030	Submission of final report to EPA.

Expected Outputs and Outcomes

Outputs/ Performance Measures	**Outcomes / Projected Environmental or Programmatic Improvement**
# of anaerobic digester spokes built # of tons of manure processed # of MMBTUS of biogas produced # of tons of land applied digestate # of new jobs created Semi-annual progress reports and final report	Decreased methane emissions from the decomposition of manure. Decreased synthetic fertilizer use Decreased nuisance odor emissions Reduction in metric tons CO2e, including those in LIDAC Workforce Development Amount of funding distributed to projects in LIDAC Semi-annual progress reports and semi-annual reports

Greenhouse Gas Emissions Reductions

Methodology

The emission reductions from the establishment of a hub-and-spoke anaerobic digester system come in several forms. The first is the recovery of methane (CH_4) from biogas produced from the digested animal waste. That methane can be injected into existing natural gas lines, reducing the amount of fossil fuels required to provide energy. Secondly, the digestate can be land-applied as green manure. Green manure is used as a fertilizer instead of synthetic nitrogen fertilizers, which require large amounts of energy to manufacture, and which break down after application to produce the greenhouse gas nitrous oxide.

Net greenhouse gas reductions were calculated for the grant application assuming three hub-and-spoke biogas/AD systems in different Nebraska counties, each processing feeder cattle manure. These systems assumed different numbers of feeder cattle providing different volumes of manure to the digesters. Operation-scale data were input into the joint EPA and Global Methane Initiative's Anaerobic Digestion Screening Tool, Version 2.3 and the USDA Comet-Planner tool to calculate the overall greenhouse gas

reductions for the three systems. For this workplan the program has been modified to fund only one such system that is assumed to be installed and operational by 2028. The M7-AD-Biogas-Hubs-1 sheet in the GHG calcs.xlsx file has been modified to add GHG emissions reductions for all GHG components for one system using the average of the annual reductions for the three modeled systems. In addition, minimum and maximum values for total GHG reductions were also calculated based on the range of annual reductions from the three modeled systems. The results are summarized in the table below. The range of emission reductions may also be affected if the funded project includes other sources of animal waste, such as dairy cattle and swine.

During the course of the project, NDEE will review the data and GHG estimates provided in the project operator's semiannual reports to check and track the amount of GHG reductions being achieved.

Cumulative Emissions Reductions for One Biogas/Anaerobic Digester Hub and Spoke System to be Installed by 2028, attributed to 70% grant funding						
	Avg GHG Emissions Reductions (MT CO_2e)	Avg CO_2 Emissions Reductions (MT)	Avg CH_4 Emissions Reductions (MT CO_2e)	Avg N_2O Emissions Reductions (MT CO_2e)	Minimum GHG Emissions Reductions (MT CO_2e)	Maximum GHG Emissions Reductions (MT CO_2e)
2025	0	0	0	0	0	0
2026	0	0	0	0	0	0
2027	0	0	0	0	0	0
2028	87,302	19,492	4,384	63,426	65,401	100,040
2029	174,605	38,985	8,768	126,852	130,803	200,080
2030	261,907	58,477	13,152	190,278	196,204	300,121
2050	2,007,957	448,326	100,832	1,458,798	1,504,230	2,300,925

Longevity of GHG Reductions

Establishing a hub-and-spoke anaerobic digestion demonstration system for manure management and biogas production is significant infrastructure and considered as a long-term investment in Nebraska's bio-economy. Benefits of this program include additional income to agriculture operators from selling biogas, decreased methane and odorous air emissions in agricultural communities, reductions in synthetic fertilizer usage from switching to land application of digestate, and creation of jobs to build and operate the hub and spoke system.

LIDAC Benefits

Two of the hub-and-spoke anaerobic digestion projects modeled for the grant application are in rural counties with significant portions designated as low-income and disadvantaged. Many other rural counties in the state also have significant areas so designated. Anaerobic digesters sited in LIDAC areas would reduce local emissions of greenhouse gases and odors from open-air decomposition of manure. Application of digestate in these areas would also reduce use of nitrogen fertilizer, reducing associated greenhouse gas emissions and negative impacts on groundwater. Operation of the digesters and the biogas cleaning facility would provide well-paying jobs in these rural areas. NDEE will give preference to project application that include facilities in LIDAC areas.

Cost-Effectiveness

NDEE has budgeted $57,182,628 for Measure 7 to achieve a cumulative 261,907 metric tons of greenhouse gas reductions (attributed to 70% grant funding). The resulting cost-effectiveness of this measure is therefore $218.33 per metric ton CO_2e reduced.

Budget

In late July, EPA announced its intent to award NDEE $307M to implement eight (8) measures as part of the Climate Pollution Reduction Grant (CPRG). NDEE requested $341,399,719 in the grant application, therefore a deduction of $34,399,719 from the workplan to match the award amount was necessary. Keeping in mind the original application submittal and the need to minimize effects on GHG emission reductions, NDEE shifted the initial reduction of $34,399,719 from the Anaerobic Digester measure. Furthermore, based on cost effectiveness, other factors such as timing, and potential other sources of available funding, NDEE made the following finical shift in the workplan from the Anaerobic Digester measure into the Agricultural Production measure increasing the investment into that measure and leaving $57,182,628 in the Digester measure for one Digester Hub & Spoke project. Overall, this will result in more potential GHG reductions through implementation of all eight (8) funded measures than originally proposed.

Category	Budget	Narrative
Personnel	$670,175	Estimated at 2. 0 FTE per year. Includes portions of salary of full-time staff to perform tasks and assumes decrease in time after initial program set up.
Fringe Benefits	$212,781	Includes taxes, medical insurance, retirement, and other non-salary expenses estimated as a percentage of salary. The current rate for Fringe Benefits is 31.75%.
Travel	4,927	Includes costs for mileage, meals, and lodging necessary to implement the program and to oversee projects. Costs are estimated annually for staff travel to project site visits and community outreach meetings. Costs are estimated for 1000 miles per year of travel to conduct sub-recipient monitoring of activities and project site visits, and 2 overnight stays, 4 travel days for 2 staff per year.
Equipment	$0	EPA definition of equipment is any item over $5,000. There is no anticipated additional equipment needed to implement these activities.
Supplies	$0	Includes usual office and laboratory materials necessary to implement tasks. Office supplies are considered part of this category also and include things such as furniture, staff desk supplies and computers. There are no anticipated additional supplies needed to implement these activities.
Contractual	$56,025,000	Contractual work for a grant management system ($25,000) via subscription service to develop an electronic application database for applicants to submit their application, track their

		project status, submit required reports and track reimbursement. NDEE will also use this system to track expenditures and project metrics. NDEE will utilize a competitive Request for Proposals (RFP) process and solicit interested organizations to construct and operate one hub-and-spoke demonstration AD project near an existing natural gas pipeline. The department will review proposals and evaluate them based on GHG reduction, LIDAC proximity, and long-term viability of the endeavor. This measure will fund 70% of the cost of equipment, installation, and construction activities including AD tanks, pipelines, and cleaning facilities up to $56,000,000.
Other		
Total Direct Charges	$56,912,883	
Indirect Charges	$269,745	40.25% Calculated as a percentage of salary cost (approved FY24 rate)
TOTALS	$57,182,628	
Program Income	$1,200,000	Estimated Program Income generated during the project period.

Budget Narrative:

Contractual: As described in the Administrative Section of the is measure, NDEE intends to issue a competitive Request for Proposals (RFP) process and solicit interested organizations to construct and operate one hub-and-spoke demonstration AD project near an existing natural gas pipeline. This measure will fund 70% of the cost of equipment, installation, and construction activities including AD tanks, pipelines, and cleaning facilities. Estimated ranges for Anaerobic Digestion (Manure pretreatment system, Digester Tanks and Equipment, Digestate Processing Systems, Digestate Storage, and Site Work) is anticipated to be between $ 9-11Million per individual Digester. Gas Collection and Upgrading (pipeline interconnect, Biogas Pipelines to Hubs, Other infrastructure) is estimated to be $12-16 Million. Like the calculated GHG emission reductions for this measure, the $57 million allocated for this measure is based on the average of a model of three regional hub-and-spoke biogas/anaerobic digester clusters of different sizes in different Nebraska counties. NDEE has downsized this measure to one regional hub-and-spoke anaerobic digester cluster. This allocation retains the initial three clusters as the basis for the one-cluster estimate. Because the original three location-specific clusters had different expected numbers of digesters and other components, we calculated average values for cost estimates for the one-cluster from those previously calculated for the three clusters. We view those averages as best estimates for a single cluster.

Program Income: It is anticipated that there will be program income generated from implementation of this measure. The subrecipient will be required to report the amount of program income earned, expended, and a description of how the program income is being used on a semi-annual basis. NDEE will

report this information in each of the required performance reports and submit with the Federal Financial Report.