NEBRASKA
PRIORITY CLIMATE ACTION PLAN

February 2024

NEBRASKA
DEPT. OF ENVIRONMENT AND ENERGY

Acknowledgments

The Nebraska Department of Environment and Energy would like to thank the many individuals and organizations who contributed ideas to help craft Nebraska's first Climate Action Plan. Collaboration with stakeholder experts and leaders in state and local government, agriculture, industry, the electric utilities, and environmental organizations was vital to the process of developing meaningful and practical greenhouse gas reduction measures. The University of Nebraska Public Policy Center ably assisted the outreach efforts by facilitating online stakeholder sessions and compiling session notes and feedback. The Department would also like to thank the many individuals who attended in-person public meetings across the state to discuss and provide comments on these measures. Without this leadership from the citizens of Nebraska, this Priority Climate Action Plan would not have been possible.

Cover photo by Taylor Siebert on Unsplash. Lakeview Park, Henderson, Nebraska, October 2020.

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List of Acronyms

AFLEET Alternative Fuel Life-Cycle Environmental and Economic Transportation tool

AVERT EPA AVoided Emissions and geneRation Tool

B100 Diesel fuel consisting of 100% biodiesel

BTU British Thermal Unit, a measure of heat energy

CCAP Comprehensive Climate Action Plan

CEJST Climate and Economic Justice Screening Tool

CH_4 Methane (a greenhouse gas)

CNG Compressed Natural Gas

CO_2 Carbon Dioxide

CO_2e Carbon Dioxide Equivalent, used to measure and compare greenhouse gas emissions based on how much they contribute to global warming

CPRG Climate Pollution Reduction Grant

DOE U.S. Department of Energy

eGRID EPA Emissions and Generation Resource Integrated Database

EPA U.S. Environmental Protection Agency

EV Electric Vehicle

EVSE Electric Vehicle Supply Equipment (charging equipment)

FDA U.S. Food and Drug Administration

g Gram

GHG Greenhouse Gas

HEEHRA U.S. DOE High-Efficiency Electric Home Rebate Allocation Program

HFC Hydrofluorocarbons (greenhouse gases)

HOMES U.S. DOE Home Energy Performance-Based, Whole-House Rebate

IRA Inflation Reduction Act

kW Kilowatt = 1,000,000 watts (unit of electrical power)

LIDAC Low-income and disadvantaged community

LULUCF Land-Use, Land-Use Change, and Forestry (emissions inventory category)

MJ Megajoule: unit of energy equal to one million joules

MMT Million Metric Tons

MSA Metropolitan Statistical Area

MT Metric Ton (1,000 kg)

MW Megawatt = 1,000,000 watts (unit of electrical power)

NeWAP Nebraska Weatherization Assistance Program

NDEE Nebraska Department of Environment and Energy

List of Acronyms Continued

NDOT	Nebraska Department of Transportation
NF_3	Nitrogen trifluoride (a greenhouse gas)
N_2O	Nitrous Oxide (a greenhouse gas)
NOx	Nitrogen Oxides (air pollutants)
NRCS	Natural Resources Conservation Service
PCAP	Priority Climate Action Plan
PFC	Perfluorocarbons (greenhouse gases)
PHEV	Plug-in Hybrid Electric Vehicle
$PM_{2.5}$	Fine Particulate Matter, smaller than 2.5 micrometers
PV	Photo-voltaic (converting sunlight to electricity)
RNG	Renewable Natural Gas
SF_6	Sulfur hexafluoride (synthetic compound and greenhouse gas)
SO_2	Sulfur Dioxide an (air pollutant)
USDA	U.S. Department of Agriculture
VOC	Volatile Organic Compounds (air pollutants)
WAP	U.S. Department of Energy Weatherization Assistance Program
WARM	WAste Reduction Model tool

Introduction

The Nebraska Department of Environment and Energy (NDEE) received a Climate Pollution Reduction Grant (CPRG) from the U.S. Environmental Protection Agency (EPA) to develop Nebraska's first state-wide climate action plans to reduce greenhouse gas (GHG) emissions and other harmful air pollutants in the state. The CPRG planning grant enables Nebraska to develop a Priority Climate Action Plan (PCAP) followed by a Comprehensive Climate Action Plan (CCAP) over a 4-year period. The PCAP focuses on priority measures to reduce GHG and other air pollutant emissions in the six economic sectors identified by EPA (Agriculture, Energy Production, Industry, Waste & Wastewater, Commercial & Residential Buildings, and Transportation). The CCAP will focus on long-term emission reductions in these sectors going forward. This PCAP allows the state to compete for federal grant funding to implement measures identified in the plan. These funds would spur investment in Nebraska communities to reduce air pollution, stimulate economic growth, create high-quality jobs, and enhance the quality of life for all Nebraskans.

In developing this PCAP, NDEE coordinated with subject matter experts in the six economic sectors identified by EPA as well as with Nebraska citizens, universities, other state agencies, local governments, nonprofits, utilities, industries, and many other stakeholders across the state to collect GHG emission reduction project ideas for inclusion in this plan. The purpose of this plan is to identify voluntary, incentive-based measures to reduce greenhouse gas emissions throughout the State of Nebraska. This plan summarizes the results of this process and highlights the selected priority projects that can be readily scaled-up for implementation.

In addition to the state-wide plan, the Omaha metropolitan area received its own CPRG planning grant. Omaha has been a key collaborator in the development of the Nebraska PCAP. The emission reduction measures in this PCAP are considered applicable to the Omaha metropolitan area as well.

Some tables in this Climate Action Plan may have rows that alternate between white and gray for readability purposes only. This highlighting should not be construed to emphasize priority of any item included in this document.

Approach to Developing Nebraska's PCAP

Overview

Nebraska comprises both urban and rural areas, with the most densely populated areas in the eastern third of the state, as well as along the Interstate 80 corridor. In all, there are 581 communities in the state. Omaha and Lincoln are the only cities with populations over 250,000. Fifteen communities have populations between 10,000 and 75,000, 98 between 1,000 and 10,000 and the remaining 466 below 1,000. Federally designated low-income and disadvantaged communities include rural and urban areas widely distributed across Nebraska.

NDEE's outreach included a combination of virtual stakeholder meetings and in-person public events, a website with current information on the CPRG planning process, virtual information portals, listserv email updates, press releases, and social media posts. NDEE also had a designated email address and physical mailing address to collect public input. These tools helped NDEE gather as much public feedback as possible in a short amount of time. NDEE intends to continue these efforts while formulating Nebraska's Comprehensive Climate Action Plan.

Information Sharing

NDEE established a CPRG webpage (http://dee.ne.gov/ndeqprog.nsf/onweb/cprg); a link to this page was featured prominently on NDEE's home page so the public could find the information easily. Since its inception, the website has evolved and changed on a regular basis to engage with the public and provide the most current information. On this webpage, NDEE provided:

- A link to its CPRG kickoff webinar
- The schedule for the virtual stakeholder workgroup meetings
- The schedule for in-person public participation meetings
- The proposed list of GHG reduction measures
- Al ink to a virtual comment form

The department also developed a CPRG archive page (http://dee.ne.gov/ndeqprog.nsf/onweb/cprg2). Once outreach events had concluded, corresponding information was moved to the archive page as a record of the work completed. The archive also contains links to past presentations and meeting notes for public review.

NDEE utilized a CPRG listserv to allow coordinating entities, stakeholders, and the public to receive update messages during outreach and PCAP development. The listserv announced each of the outreach activities. AClimate Pollution Reduction Program email was created to allow coordinating entities, stakeholders, and the public to submit ideas and message the team during outreach and PCAP development. Hundreds of emails were received via the climate pollution email box.

Multiple press releases and social media campaigns were issued throughout the process to promote awareness.

Stakeholder Engagement

Following submission of NDEE's CPRG workplan to EPA on April 27, 2023, NDEE sent letters and an email to 15 coordinating entities, state and local agencies, municipalities, tribes, and over 63 stakeholders describing the CPRG program, deadlines, transparency and inclusivity goals, and the need for coordination and support. Many of these letters and the email included a copy of the workplan for reference.

On Tuesday, Oct. 17, 2023, NDEE presented an hour-long public webinar to provide an overview of the program, current Nebraska greenhouse gas emissions, the elements the plans are required to cover, and information about implementation grants. As starting points for public discussion in later stakeholder working group sessions, the presentation proposed several potential GHG reduction measures that could be implemented in each sector. Links to the webinar recording and presentation slides were available to view and download on NDEE's website following the live webinar. The webinar was announced through the NDEE website, listserv, press release, social media, and email to coordinating entities and stakeholders.

Development of Measures

In November and December of 2023, 10 working group sessions were conducted online via Zoom to facilitate participation across the state. Two sessions were held for each working group. Working groups included the following economic sectors:

- Transportation
- Agriculture / Natural and Working Lands
- Industry / Waste and Wastewater (sectors combined for sessions)
- Buildings / Housing / Communities
- Energy Production

With the assistance of the University of Nebraska Public Policy Center, an online portal was developed to allow stakeholders and the public to easily sign up for one or multiple sessions. NDEE encouraged stakeholders in each working group to attend both sessions to assist the department in developing effective and practical greenhouse gas reduction measures. The first session presented example measures and provided stakeholders the opportunity to discuss these and propose alternate measures. The second session aimed to refine the scope and scale of individual measures and finalize a list of potential measures for the sector.

In January and February 2024, in-person public meetings took place across the state to consider greenhouse gas emission reduction measures. The meetings included a short presentation about the CPRG, the measures suggested to NDEE and discussed in virtual workgroup sessions, and the priority measures identified thus far. Priority measures, including a brief description, were printed on 11 large posters for the public to review. NDEE staff members were in attendance to interact and answer questions the public had.

Meetings were held in Alliance, North Platte, Grand Island, Norfolk, and Lincoln in order to reach residents in different geographic regions of the state. The Lincoln meeting was a combined effort with the City of Lincoln and was well attended.

In addition to the virtual and in person meetings, NDEE solicited ideas and feedback through online portals. With the assistance of the University of Nebraska Public Policy Center, an online portal was developed to allow the public to easily submit ideas to the NDEE. The portal was open through January 31, 2024. NDEE received 124 ideas through the portal. A second online portal was developed to allow the public to review the priority measures that were discussed and ranked during the Stakeholder meetings and further refine NDEE's thinking on the measures. NDEE received 18 ranking submissions via the portal.

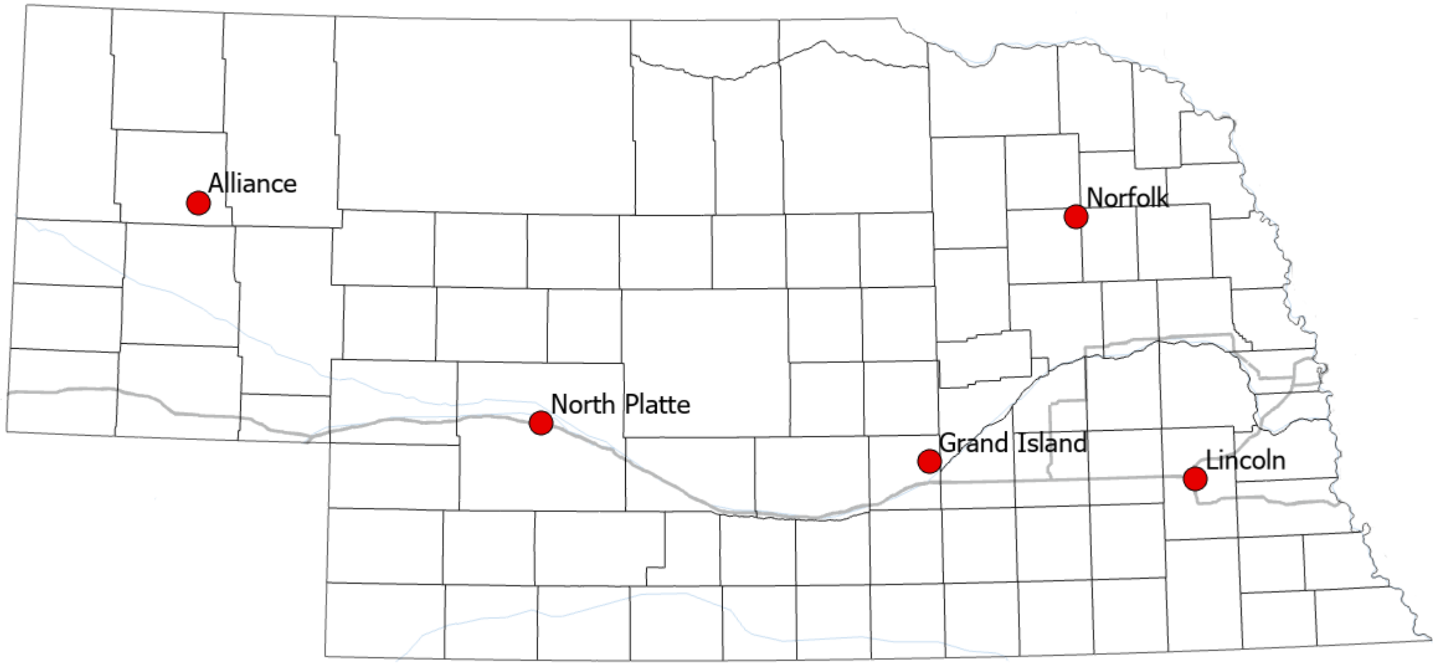

Figure 1. Locations of In-Person Public Meetings Held in Nebraska

Nebraska Greenhouse Gas (GHG) Inventory

Nebraska facilities that emit large amounts of greenhouse gases are subject to the federal Greenhouse Gas Reporting Rule. The Environmental Protection Agency (EPA) requires these facilities to submit annual inventories of all greenhouse gas emissions. In 2021 and 2022, a total of 87 facilities in Nebraska submitted the required greenhouse gas inventory.

The State of Nebraska collects air pollutant emission data from approximately 700 facilities each year. Facilities subject to air permitting requirements submit emission inventories annually, while smaller, lower-emitting sources submit inventories once every three years. The submitted inventories report actual emissions of regulated and hazardous air pollutants based on levels of production, consumption, and combustion, along with associated emission rates. However, these inventories do not include all greenhouse gases, and many smaller facilities that are potential greenhouse gas emission sources are not required to report emissions. Moreover, the State of Nebraska is not required to collect or model emissions from mobile or biogenic sources.

In order to present a complete inventory of Nebraska greenhouse gas emissions across all sectors, the state elected to use the state-level estimates compiled by the EPA for 2021.[1] These estimates reference 100-year Global Warming Potentials (GWP) from Intergovernmental Panel on Climate Change's Fifth Assessment Report,[2] as required in reporting annual national GHG inventories to the United Nations Framework Convention on Climate Change.

The Nebraska inventory includes the sectors and gases shown in Table 1 below. Complete inventories for 2021 by sector and by gas are presented in Appendix A.

Greenhouse Gases

As noted in Table 1, the major greenhouse gases are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The main source of anthropogenic carbon dioxide emissions is the burning of fossil fuels. Methane is produced by the breakdown of organic materials in landfills, breakdown of manure at animal feeding operations, and by fermentation in the digestive tracts of cattle (enteric fermentation). It is also a component of natural gas and may leak into the air from oil and gas operations, but this source is not significant in Nebraska. Nitrous oxide is another byproduct of burning fossil fuels, but a much larger source is the breakdown of nitro-

Sectors
1. Transportation
2. Electric Power Industry
3. Industry
4. Agriculture
5. Commercial
6. Residential
7. Land-Use, Land-Use Change, and Forestry

Greenhouse Gases (across all sectors)
Carbon dioxide (CO_2)
Methane (CH_4)
Nitrous oxide (N_2O)
Fluorinated gases (F-gases) including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3)

Table 1. Economic Sectors and Greenhouse Gases Included in Nebraska's Inventory

gen fertilizer applied to cropland. Although methane and nitrous oxide are less persistent in the atmosphere than carbon dioxide, they trap heat more effectively. Methane and nitrous oxide have 100-year global warming potentials that are 28 and 265 times that of carbon dioxide, respectively.

The fluorine-bearing gases listed in Table 1 are emitted in small quantities from industrial operations, but they are the longest-lasting and most potent greenhouse gases produced by human activities.

Emissions of all greenhouse gases in the inventory are expressed in terms of millions of metric tons of carbon-dioxide equivalent, taking into account the differing global warming potential of each gas.

Nebraska's 2021 Greenhouse Gas Inventory

In 2021 Nebraska's estimated net greenhouse gas emissions were 80.9 million metric tons of carbon dioxide equivalent, which ranks 26th highest among the 50 states. However, Nebraska's per capita emissions of 41.19 metric tons of carbon dioxide equivalent per person rank sixth highest. The distribution of these emissions by economic sector is shown graphically in Figure 2, and by greenhouse gas in Figure 3.

The agriculture sector accounted for 42% of Nebraska's greenhouse gas emissions in 2021, followed by the electric power sector at 24%, transportation at 16%, and industry at 11%. Commercial and residential buildings were minor contributors, at 4% and 3%, respectively. Carbon dioxide was the dominant greenhouse gas at 54.8%. Nitrous oxide was the next most abundant gas at 23.3%, followed closely by methane at 20.7%. Fluorinated gases accounted for only 1.2% of Nebraska's greenhouse gas emissions.

Agriculture

Nebraska consistently ranks as one of the top cattle producing states in the country and also is in the top 10 annually in hog production. In 2021 Nebraska also produced the nation's third largest corn crop and fourth largest soybean crop, according to the USDA National Agricultural Statistics Service. Both animal agriculture and row crop production contribute to greenhouse gas emissions, constituting 42% of the state's total emissions in 2021. Those agricultural emissions rank as fifth-highest among states in recent years, behind Texas, Iowa, California, and Kansas.

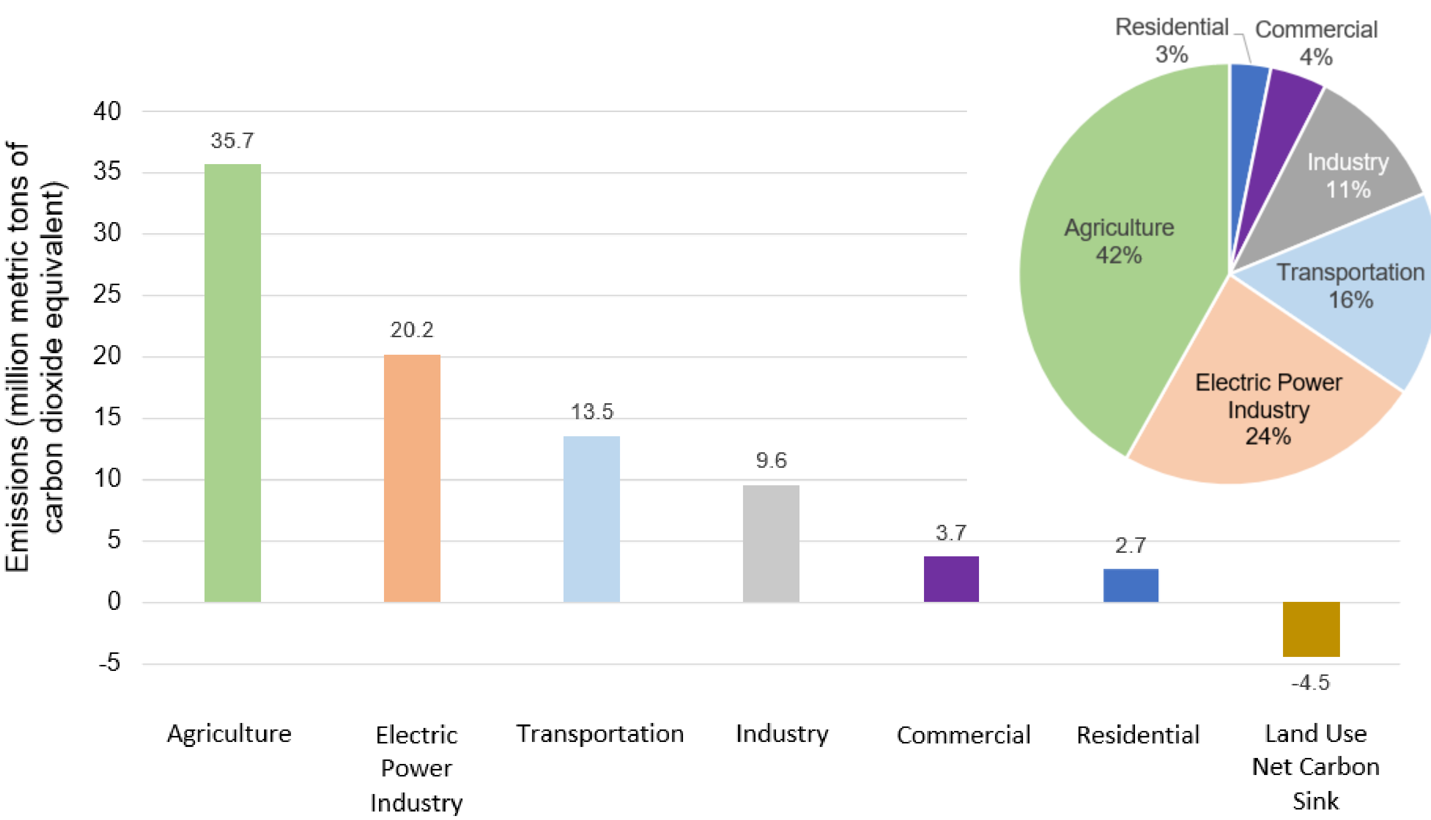

Figure 2. Nebraska Greenhouse Gas Emissions by Sector in 2021

Nitrous oxide from nitrogen fertilizer applications to row crops and from manure management accounts for the largest portion of greenhouse gas emissions from this sector, followed by methane from enteric fermentation and manure management. Carbon dioxide from fossil fuel combustion is a much smaller component, in contrast to most other sectors where it makes up the largest portion of greenhouse gas emissions. The detailed breakdown of agricultural emissions by gas and source is shown in Figure 4.

Electric Power Generation

Electricity generation produces the second largest share of greenhouse gas emissions in Nebraska (24% in 2021), nearly all of which is carbon dioxide from combustion of coal and natural gas. Nebraska benefits from the supply of low-carbon electricity from Cooper Nuclear Station in Brownville and several hydroelectric facilities. Many renewable generation facilities (wind and solar) have also been added to Nebraska's energy portfolio over the last 15 years. In 2021, 44.1% of the electricity used in Nebraska was generated from sources other than fossil fuels.[3]

The state's four largest public electric utilities have all set net zero carbon emission goals. The Lincoln Electric System has set a target date of 2040, while the Nebraska Public Power District, Omaha Public Power District, and the Municipal Energy Agency of Nebraska are working toward net zero carbon emissions by 2050.

Transportation

The transportation sector contributes the third largest share of greenhouse gas emissions in Nebraska (16% in 2021). These emissions are primarily carbon dioxide from burning of fuels in cars, trucks, trains, and airplanes. Gasoline and diesel fuel account for over 90% of the energy consumed by vehicles in Nebraska annually. Although Nebraska is the nation's second largest producer of fuel ethanol (primarily from corn), in 2021 ethanol accounted for only 3.4% of the energy consumed by vehicles in the state.[4] At the end of 2021, electric and hybrid-electric models made up only 1.2% of the state's on-road vehicles.[5]

Industry

Nebraska's industrial sector includes meat packing, agricultural and food processing facilities, pharmaceutical and fertilizer production, and machinery manufacturing. These industrial facilities contributed 11% of Nebraska's greenhouse gas emissions in 2021, primarily carbon dioxide from burning fossil fuels for process heat. Other sources include chemical processing in the production of cement and fertilizer along with methane from natural gas and petroleum systems.

Commercial and Residential Sources

The commercial and residential sectors include all homes and commercial businesses, along with municipal landfills and wastewater treatment facilities. Greenhouse gases are produced by combustion of fossil fuels for heating and cooking, from landfills and wastewater treatment (primarily methane), and from refrigerant leaks (fluorinated gases). These sectors constituted 7% of Nebraska's greenhouse gas emissions in 2021.

Nebraska's Long-term Trends in Greenhouse Gas Emissions

Long-term trends in emissions from 1990 to 2021 are shown by economic sector in Table 2 and Figure 5, and by greenhouse gas in Table 3 and Figure 6. Nebraska's greenhouse gas emissions increased steadily from 1990 to 2010, with growth in population fueling increasing emissions in all sectors, but most prominently from electricity generation. That trend changed beginning around 2011. Despite large annual fluctuations, total greenhouse gas emissions in the state have leveled off or decreased slightly. The most noticeable sector change is electricity generation, where the addition of renewable generation has significantly decreased greenhouse gas emissions from this sector.

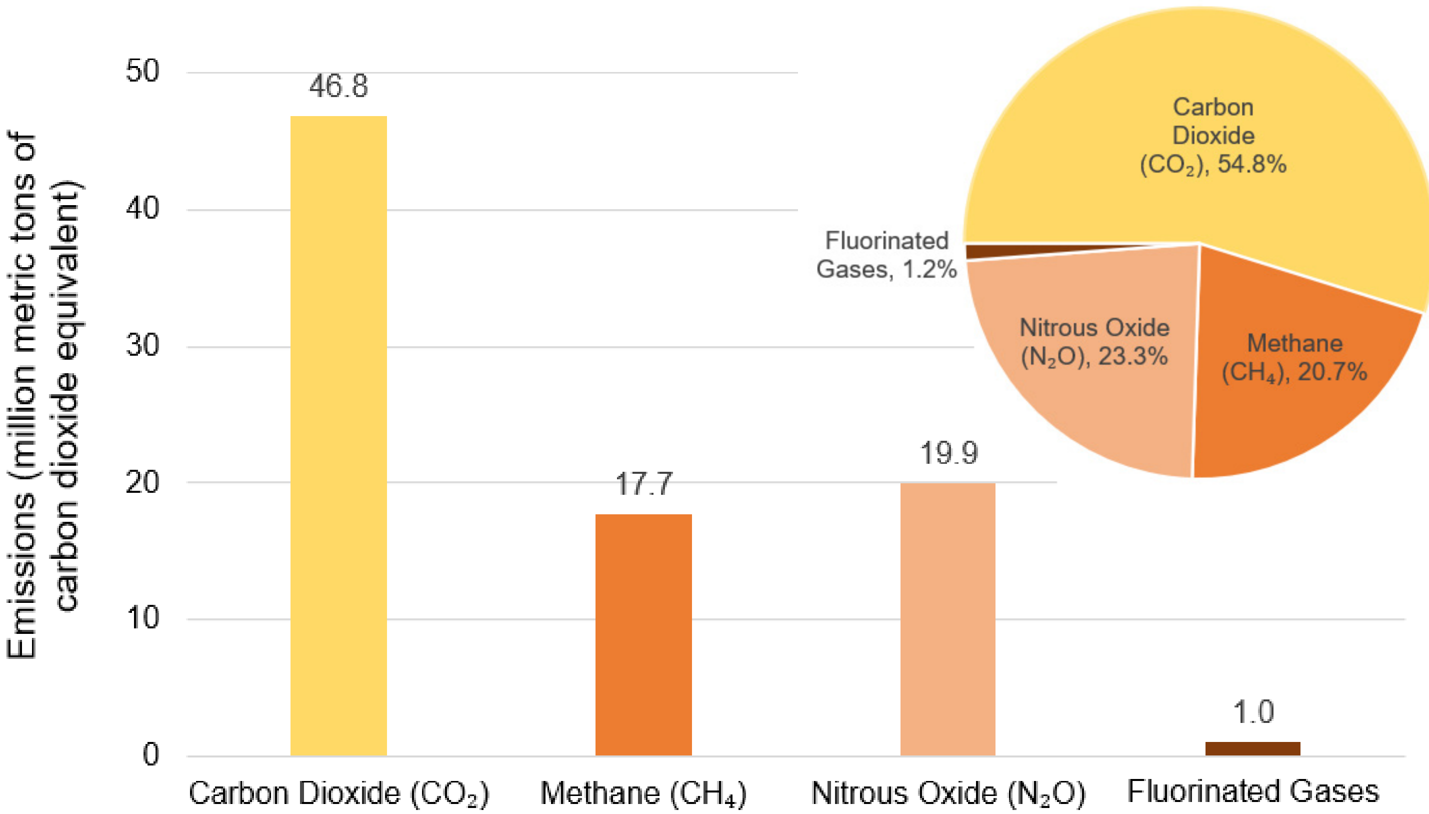

Figure 3. Nebraska's Greenhouse Gas Emissions by Gas in 2021

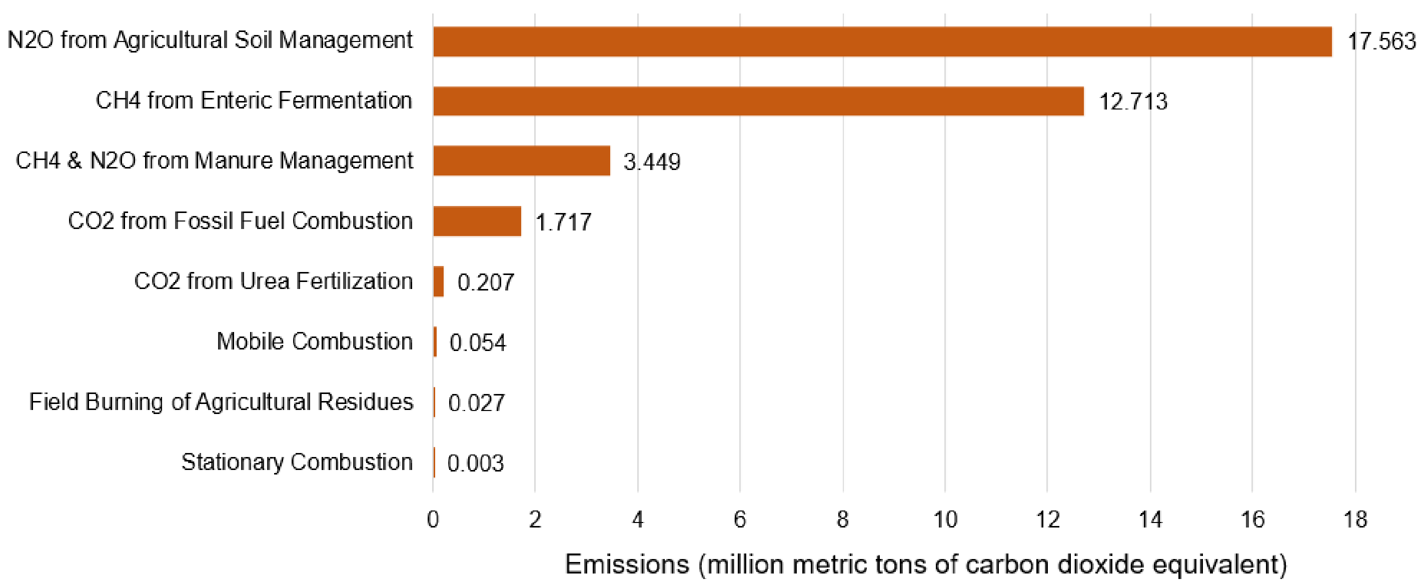

Figure 4. Nebraska's Greenhouse Gas Emissions from Agricultural Activities in 2021

Sectors	(million metric tons of carbon dioxide equivalent)							
	1990	1995	2000	2005	2010	2015	2020	2021
Agriculture	29.8	31.5	31.5	34.9	34.6	36.5	35.1	35.7
Electric Power Industry	13.9	17.2	19.8	22.1	23.8	24.2	20.1	20.2
Transportation	10.4	11.8	13.1	12.9	13	12.9	12.5	13.5
Industry	5.4	7	7	6.5	8.5	9.4	9.6	9.6
Commercial	3.6	3.6	2.9	2.7	3.6	3.8	3.7	3.7
Residential	2.5	2.8	2.9	2.6	2.8	2.5	2.7	2.7
TOTAL EMISSIONS (sources)	**65.6**	**73.9**	**77.2**	**81.7**	**86.3**	**89.3**	**83.7**	**85.4**
Land Use Net Carbon Sink	-3.8	-3.5	-5.8	-2.6	-3.7	-3.5	-4.7	-4.5
NET EMISSIONS	**61.8**	**70.4**	**71.4**	**79.1**	**82.6**	**85.8**	**79**	**80.9**

Table 2. Nebraska Trends in Greenhouse Gas Emissions and Sinks by Economic Sector

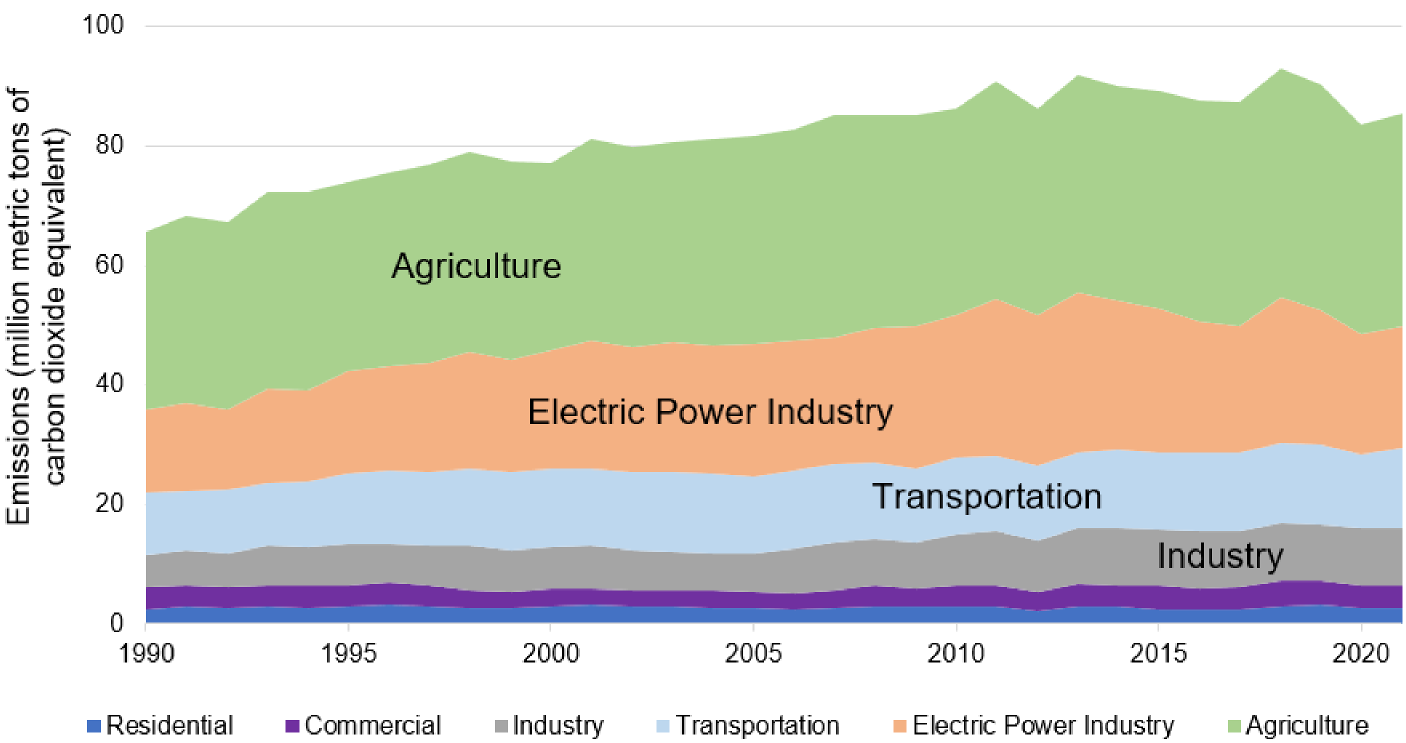

Figure 5. Graph of Trends in Nebraska Greenhouse Gas Emissions by Economic Sector from 1990-2021

Gas/Source	(million metric tons of carbon dioxide equivalent)							
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2021**
Carbon Dioxide (CO_2)	33.12	39.34	42.86	45.07	48.93	50.14	45.9	46.8
Methane (CH_4)	15.97	16.74	16.7	15.88	16.52	16.87	17.73	17.68
Nitrous Oxide (N_2O)	16.16	17.19	16.78	19.87	19.68	21.17	19.02	19.92
Hydrofluorocarbons (HFCs)	0	0.21	0.52	0.68	0.98	1.02	0.86	0.88
Perfluorinated Compounds (PFCs)	0	0	+	+	+	+	+	+
Sulfur Exafluoride (SF_6)	0.46	0.36	0.25	0.21	0.14	0.1	0.11	0.12
Nitrogen Trifluoride (NF_3)	0	0	0	0	0	0	0	0
TOTAL SOURCE EMISSIONS	**65.71**	**73.84**	**77.12**	**81.71**	**86.25**	**89.3**	**83.62**	**85.39**
Land Use Net Carbon Sink	-3.75	-3.55	-5.78	-2.65	-3.67	-3.48	-4.67	-4.47
NET EMISSIONS (Sources and Sinks)	**61.96**	**70.29**	**71.33**	**79.07**	**82.58**	**85.82**	**78.95**	**80.92**

+ Does not exceed 0.001 million metric ton carbon dioxide equivalent.

Table 3. Nebraska Trends in Greenhouse Gas Emissions (by Gas) and Sinks

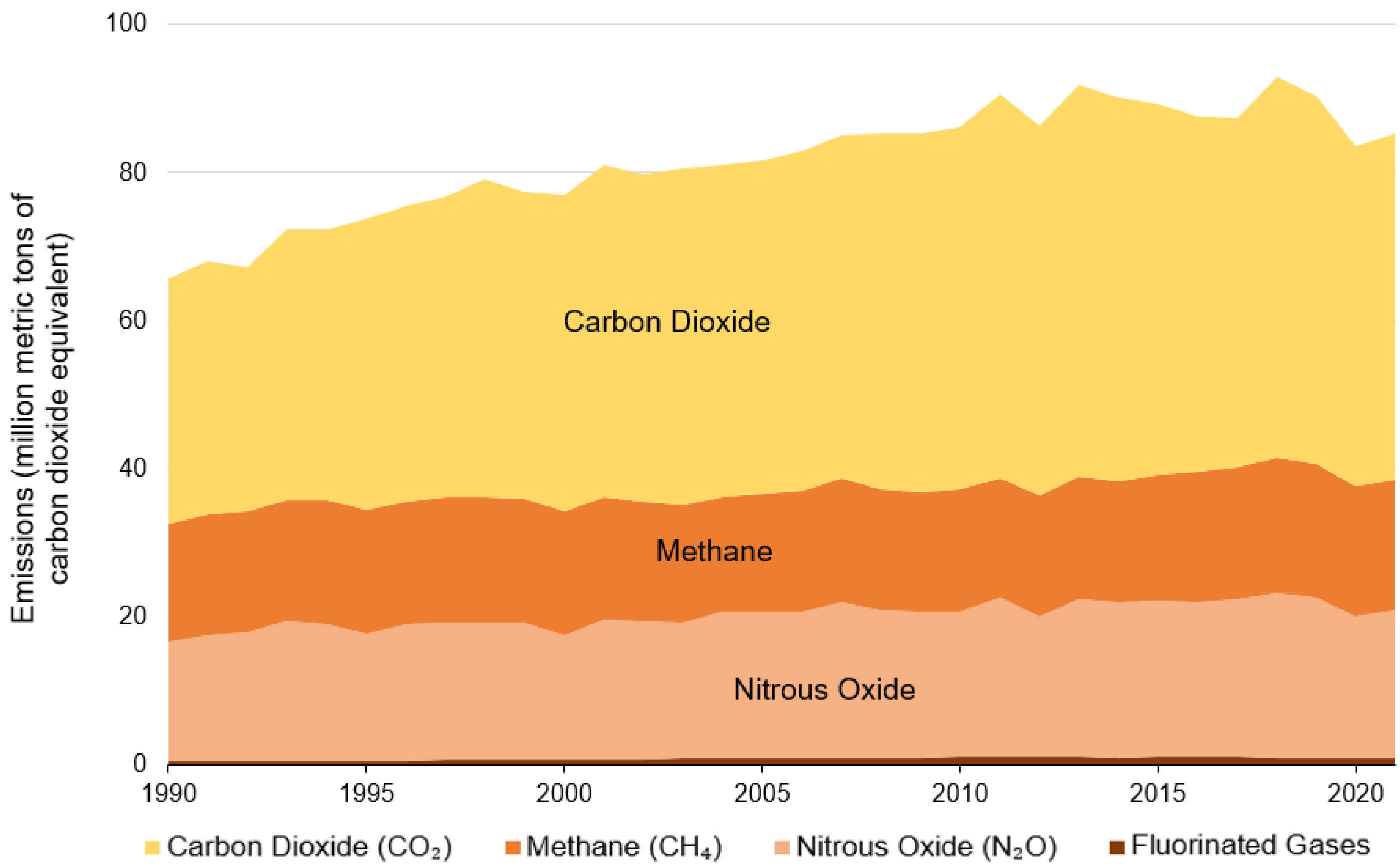

Figure 6. Graph of Trends in Nebraska Greenhouse Gas Emissions from 1990-2021

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2 IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp. https://www.ipcc.ch/report/ar5/wg1.

3 https://neo.ne.gov/programs/stats/inf/52.html

4 https://neo.ne.gov/programs/stats/inf/18.html

5 https://neo.ne.gov/programs/stats/inf/196.htm

Priority Greenhouse Gas Reduction measures

Nebraska's Priority Climate Action Plan proposes greenhouse gas reduction measures that touch all economic sectors, providing opportunities for participation and benefits across the state. The table below summarizes the proposed measures and the economic sectors affected.

	Agriculture	Energy Production	Industry	Waste & Wastewater	Commercial & Residential Buildings	Transportation
Energy Efficiency and Electrification						
Promote Energy Efficiency and Electrification Upgrades for Non-Residential Facilities	✓	✓	✓	✓	✓	
Incentives for Home Energy Efficiency Upgrades for Low- and Middle-Income Homeowners					✓	
Residential Pre-Weatherization Program					✓	
Incentives for Irrigation Well Conversion from Diesel to Electric	✓					
Solar Projects						
Incentives for Micro-Solar Arrays for Critical Infrastructure in Low-Income Rural Communities		✓		✓		
Funding for Solar Projects on Unused/Contaminated Land, Ag & Industrial Facilities, and Parking Lot/Feedlot Solar Canopies	✓	✓	✓		✓	
Agriculture						
Measures to Reduce Emissions In Agriculture Production: • Establish a Carbon Intensity Score Registry • Provide Incentives for a Regenerative Agriculture Practices • Provide Incentives for Precision Agriculture Equipment	✓					
Transportation						
Incentives for Alternative-Fuel and Electric Replacement of Diesel Vehicles	✓					✓
Incentives for New Public Electric Vehicle Charging Stations						✓
Waste Management						
Establish Hub-and-Spoke Anaerobic Digester/Biogas Hubs for Agricultural Waste	✓	✓		✓		
Incentives to Reduce Food Waste				✓		
Incentives for Production and Use of Biochar to Reduce Organic Waste and Sequester Carbon in Soil	✓			✓		

Table 4. Proposed Greenhouse Gas Reduction Measures and Affected Economic Sectors

NDEE has estimated the cumulative greenhouse gas emissions reductions through 2030 for each of the proposed measures if implemented, as shown in the table below. The assumptions for these estimates are provided in the following sections on individual measures and in more detail in Appendix C.

Measure	Cumulative GHG Emissions Reductions through 2030 (MMT CO_2e)
Energy Efficiency and Electrification	**1.085**
Promote Energy Efficiency and Electrification Upgrades for Non-Residential Facilities	0.989
Incentives for Home Energy Efficiency Equipment Upgrades for Low- and Middle-Income Homeowners	0.074
Residential Pre-Weatherization Program	0.007
Incentives for Irrigation Well Conversion from Diesel to Electric	0.015
Solar Projects	**0.398**
Incentives for Micro-Solar Arrays for Critical Infrastructure in Low-Income Rural Communities	0.008
Funding for Solar Projects on Unused/Contaminated Land, Ag & Industrial Facilities, and Parking Lot/Feedlot Solar Canopies	0.390
Agriculture	**22.13**
Measures to Reduce Emissions in Agricultural Production: • Establish a Carbon Intensity Score Registry • Provide Incentives for Regenerative Agriculture Practices • Provide Incentives for Precision Agriculture Equipment	22.13
Transportation	**0.096**
Incentives for Alternative-Fuel and Electric Replacement of Diesel Vehicles	0.096
Incentives for New Public Electric Vehicle Charging Stations	Not determined.
Waste Management	**1.996**
Establish Hub-and-Spoke Anaerobic Digester/Biogas Hubs for Agricultural Waste	1.037
Incentives to Reduce Food Waste	0.946
Incentives for Production and Use of Biochar to Reduce Organic Waste and Sequester Carbon in Soil	0.013
Total	**25.705**

Table 5. Proposed Greenhouse Gas Reduction Measures and their Estimated Cumulative Greenhouse Gas Emissions Reductions through 2030

Energy Efficiency and Electrification

Promote Energy Efficiency and Electrification Upgrades for Non-Residential Facilities

Measure Concept

Provide incentives for energy efficiency, electrification, and weatherization upgrades for industrial, commercial, agricultural, public, and nonprofit buildings and facilities.

Applicable Sector(s)

Agriculture, Energy Production, Industry, Waste & Wastewater, and Commercial & Residential Buildings

Background and Description

Nonresidential buildings and facilities present considerable opportunities for saving energy and reducing greenhouse gas emissions. All such facilities require heating, cooling, and lighting. In addition, the over 1,600 manufacturing facilities in Nebraska[1] also utilize energy for process heating and machine drive (motors). A recent energy savings analysis[2] of small- and medium-sized industrial facilities in the United States concluded that motors, electrical demand management, and process heat recovery provide the largest opportunity for energy savings.

Nebraska's larger public electric utilities offer financial incentives to commercial and industrial customers to undertake energy efficiency upgrades to reduce electricity consumption and save on annual energy costs. The Nebraska Industrial Assessment Center at the University of Nebraska-Lincoln performs energy audits for industrial facilities and recommends energy-saving actions and upgrades. This measure will build on these activities by providing additional funding to expand their reach across the state.

Emissions Reductions and Methodology

The Nebraska Public Power District, Lincoln Electric System, and the Nebraska Industrial Assessment Center provided data on recent energy efficiency programs and measures, including calculated annual energy reductions. From the large number of available measures, NDEE selected a group of more cost-effective measures, estimated the number of annual projects that could likely be carried out in each category, and estimated the potential greenhouse gas reductions for each.

For measures that reduce electricity consumption, the annual reductions in emissions of CO_2, SO_2, and NOx from reduced electricity generation were calculated for each measure using the EPA AVERT tool.[3] These calculations were performed using the central region data file to represent generation resources available in all but four low-population counties in western Nebraska. For measures that reduce natural gas consumption, a CO_2 emission factor for natural gas fuel use from the U.S. Department of Energy MEASUR on-line assessment tool[4] was used to calculate annual greenhouse gas emission reductions.

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)	Co-pollutant Reductions (tons)	
		NOx	SO_2
Measures reducing electricity consumption	0.415	320	350
Measures reducing natural gas consumption	0.574	-	-
TOTAL	**0.989**	**320**	**350**

Another potential component of this measure could be incentives for installation of electric heat pumps to replace fossil fuel boilers at industrial facilities with low to medium process-heat requirements. NDEE does not have data on current industrial heat pump projects in Nebraska. However, research indicates[5] that installation of heat pumps at food-processing and other facilities can reduce energy needs for heat generation by 26 to 32%, which would result in significant reductions in greenhouse gas emissions.

Transformative Impact

Addressing energy use in non-residential buildings, and especially in industrial facilities, is one of the highest impact measures that can be implemented to reduce greenhouse gas emissions. While emissions from electricity use are declining, thermal energy needs in industry for process heating are a significant challenge for efforts to reduce climate pollution. A recent report[6] analyzed industrial electrification opportunities in selected states, including Iowa, which houses some of the same types of industrial facilities as Nebraska. The report concluded that electrifying wet corn milling, ammonia, and soybean oil production facilities can significantly reduce emissions. This program aims to address similar opportunities in Nebraska.

Benefits

The energy-saving actions proposed in this measure would reduce local emissions of greenhouse gases and other air pollutants from industrial facilities. As many such facilities are located in low-income and disadvantaged areas, air quality could be improved in those areas as a result. Reduction in electrical generation from fossil-fuel resources would produce reductions in SO_2 and NOx emissions near those facilities as well.

Authority and Administration

Funds would be administered by the Nebraska Department of Environment and Energy, which has current authority to receive and administer federal grant funds. Funds would also be subawarded to the Nebraska Public Power District, Municipal Energy Agency of Nebraska, Omaha Public Power District, Lincoln Electric System, and other public electric utilities to expand current commercial, industrial, and agricultural electrical energy efficiency programs. Projects to upgrade natural gas equipment could be administered by NDEE or through agreements with natural gas utilities in the state.

Milestones and Metrics for Tracking Progress

During the first year of the program NDEE would negotiate subaward agreements with the public electric utilities to provide annual allocations to their energy efficiency programs. The utilities currently track energy efficiency projects annually and would provide these annual reports to NDEE to document energy and cost savings.

Other Funding Sources

This program would supplement utility energy efficiency programs that are funded by the utilities. Other potential funding sources include the U.S. Department of Agriculture Rural Energy for America Program for agricultural facilities, Industrial Research and Assessment Center Implementation Grants, and the expanded Qualifying Advanced Energy Project Credit (48C) program, which can rebate as much as 30% of a qualified energy efficiency investment.

References

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Incentives for Home Energy Efficiency Equipment Upgrades for Low- and Middle-Income Homeowners

Measure Concept

Provide incentives (rebates) to low- and middle-income residents for purchase and installation of high-efficiency home heat pumps and/or heat pump water heaters to replace equipment fueled by natural gas.

Applicable Sector(s)

Commercial & Residential Buildings

Background and Description

According to the U.S. Energy Information Administration's 2020 Residential Energy Consumption Survey,[1] space heating and water heating make up two-thirds of residential household energy usage in Nebraska, where 69% of households use natural gas as the main space heating fuel. Replacing natural gas furnaces and water heaters with electric heat-pump equipment eliminates local emissions of greenhouse gases and provides more efficient and less expensive heating.

This measure proposes to provide rebates for purchase and installation of 8,000 whole-home air-source heat pumps and 5,000 heat pump water heaters by 2030. Low-income and middle-income households would be eligible for these incentives.

Emissions Reductions and Methodology

Greenhouse gas emissions reductions were calculated as the difference between installation of new, high-efficiency natural gas-fueled equipment and air-source heat pump equipment with similar capacity. The methodology is described in Appendix C.

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)
Install 8,000 air-source heat pumps by 2030	0.060
Install 5,000 heat pump water heaters by 2030	0.014
TOTAL	**0.074**

Transformative Impact

Heat pumps offer an energy-efficient alternative to gas furnaces, gas or electric water heaters, and electric air conditioners. Rather than burning fuel or using electrical resistance to create heat, a heat pump uses electricity to transfer heat from a cool space to a warm space, delivering two to four times more heating energy than the electricity consumed.[2] Modern heat pumps can provide reliable space heating even in cold climates. Widespread adoption of whole home heat pumps and heat pump water heaters in Nebraska would reduce greenhouse gas emissions and lower energy costs for residents.

Benefits

In addition to reducing greenhouse gas emissions, adoption of heat pump technology would lower energy costs for low-income and middle-income residents due to the low cost of electricity in the state. Heat pump replacements of natural gas equipment would also eliminate indoor air pollutants created by incomplete combustion, including methane, NOx, and volatile organic compounds.

Authority and Administration

This program would be implemented by NDEE under its existing authority to administer federal grant funds.

Milestones and Metrics for Tracking Progress

NDEE would implement an annual program soliciting applications and awarding projects to applicants to meet the annual program goals. Quarterly or semi-annual reports would track the progress of each project, the number of projects completed, total project costs, and program expenditures.

Other Funding Sources

U.S. Department of Energy Grant Programs, including Home Energy Performance-Based, Whole-House Rebate Allocation (HOMES) and High-Efficiency Electric Home Rebate Allocation (HEEHRA).

References

1 U.S. Energy Information Administration 2020 Residential Energy Consumption Survey: https://www.eia.gov/consumption/residential

2 Now is the Time to Go All In on Heat Pumps: https://rmi.org/now-is-the-time-to-go-all-in-on-heat-pumps

Residential Pre-Weatherization Program

Measure Concept

Provide financial incentives for a Pre-Weatherization Program for low-income residents. This program would be an expansion of Nebraska's Weatherization Assistance Program (NeWAP) to address critical home repairs in low-income homes that would cause a home to be deferred from the Weatherization Assistance Program (WAP). The program will result in enhanced energy efficiency, greenhouse gas reduction, lower utility bills, and improved health.

Applicable Sector(s)

Commercial & Residential Buildings

Background and Description

Energy expenses comprise an economic drain on low-income communities. Often, energy bills account for more than 20% of a family's gross income. Typically, more than 80% of this expense leaves the community. The WAP is an energy efficiency program that helps low-income households manage the increasingly high cost of energy, while helping to ensure their health and safety. This program funds upgrades such as adding insulation, sealing air leaks, and performing efficiency inspections and tune-ups of furnaces, boilers, and water heaters. Weatherization reduces this financial drain and keeps investments circulating in local economies. For individual families the gain is immediate — up to 18.7% in Nebraska, and an average annual savings on utility bills of $161.[1]

Funds are allocated for administration of the Weatherization Program at the state level. NeWAP is administered by the NDEE. Services are offered at no cost to eligible households by the U.S. Department of Energy (DOE) and the U.S. Department of Health and Human Services. In addition, there are utility ratepayer funded programs.

However, homes that have health and safety issues, such as structural damage and electrical wiring not up to current code, are "deferred" from the program pending rectification of these issues. Many low-income homeowners cannot afford the cost of these pre-weatherization upgrades, so their homes remain ineligible for weatherization. It is estimated that 150 homes were deferred from services from the NeWAP in 2023.

Emissions Reductions and Methodology

Emission reductions were calculated using the assumption that 75 homes would be pre-weatherized and then weatherized per year. Calculations were carried out using the assumed 75 homes over the course of a 5 year cycle. Corresponding annual reductions in emissions from weatherization services were calculated using software developed by the University of Nebraska for NeWAP. Data from this model were used to generate average per home GHG reductions. Average values were derived using 6,378 previous weatherization projects.

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)	Co-pollutant Reductions (tons)	
		NOx	SO_2
Allow an additional 75 homes per year to become eligible for weatherization assistance services through NDEE	0.007	10.54	10.09

Transformative Impact

This program is estimated to allow an additional 75 homes per year to become eligible for weatherization assistance services through NDEE. Energy efficiency and other improvements to the buildings where Nebraskans live, work, and play has the potential to significantly improve residents' safety and well-being. The weatherization program includes home energy and health and safety audits. The program will result in energy efficiency, greenhouse gas reduction, lower utility bills, and improved health for residents.

Weatherization of homes leads to reduced demand on the electrical grid. Reduced energy demands will affect the entire community indirectly by helping to ensure energy infrastructure remains sufficient and reliable for all homeowners.

Benefits

The NeWAP is targeted to low-income households and assists those facing challenges in affording home improvements. Preference is given to persons over 60, persons with disabilities, and families with children under six. Eligibility is limited to households with incomes at or below 200 percent of the federal poverty level. Eligibility income levels rise based on the number of persons living in the home. Income guidelines are listed on the NeWAP webpage.[2] Households containing a member who is receiving either Aid to Dependent Children or Supplemental Security Income are automatically eligible to receive services.[3] To ensure equal distribution across the state, NDEE will distribute the Pre-Weatherization funds among the state's existing subgrantees utilizing the formula allocation for the Annual Weatherization Funding, which is a weighted average based on population. This ensures that the positive impacts of weatherization reach those who need them the most, addressing both economic and environmental considerations. Weatherization is viewed as a long-term investment with benefits such as energy savings and increased property value.

Additionally, the comfort improvements brought about by proper insulation and sealing of air leaks enhance the indoor environment. Residents can experience improved thermal comfort with fewer drafts and temperature fluctuations. These weatherization measures also contribute to better indoor air quality by sealing gaps and addressing insulation issues, reducing the likelihood of pollutants and outdoor allergens entering homes.

Weatherization investments in housing stock aid upkeep and increase the value of housing in these communities. By reducing long-term energy costs, weatherization makes these housing units more affordable.

Weatherization can also have an impact on low-income communities by stimulating the local home energy efficiency industry. The mainstay of this industry consists of the local service providers — mostly nonprofit organizations in Nebraska — that make the improvements in the homes. These jobs represent a significant source of economic development through what economists call the "multiplier effect." This effect describes the phenomenon whereby money circulates in local economies and is used to measure local economic development. The U.S. Department of Energy estimates conservatively an economic multiplier of three from the investment in weatherization services in the homes of low-income Americans.

Authority and Administration

Funds would be administered by NDEE, which has current authority to receive federal grant funds and administers the Weatherization Assistance Program. NDEE plans to subaward to Community Action Partnership Agencies in Nebraska and other non-profit programs that have current authority to receive federal weatherization assistance funds through NDEE and would be responsible for the home weatherization improvements.

Milestones and Metrics for Tracking Progress

NDEE will work with Community Action Partnership Agencies in Nebraska and other non-profit programs through the existing NeWAP to rectify homes in deferral status allowing the homes to be eligible for NeWAP, with a goal of adding 75 homes per year through 2030. NDEE and the subgrantees will track the completion of projects, including co-benefits of emission reductions, economic, and energy impacts during the program period.

Other Funding Sources

Nebraska already receives federal funding for weatherization assistance, but gaps exist in funding critical home repairs, which are often necessary before weatherization can occur. In addition, the HOMES and HEEHRA programs will provide Nebraska with new funding that could involve weatherization. The NDEE will administer these programs and intends to braid funding to ensure that homes with high energy burden receive additional funding to improve the building envelope.

References

1 NDEE Nebraska Weatherization Assistance Program

2 https://neo.ne.gov/programs/wx/wx.html#item-04

3 NDEE Nebraska Weatherization Assistance Program

Incentives for Irrigation Well Conversion from Diesel to Electric

Measure Concept

Provide financial incentives (rebates) to farmers to replace diesel engines powering irrigation well pumps with electric motors/pumps connected to the electric grid, with a goal of funding 50 engine replacements per year from 2025 through 2030. The incentives would cover a percentage of the costs of new electrical equipment, wiring and installation, and utility upgrade and connection charges.

Applicable Sector(s)

Agriculture and Energy Production

Background and Description

Nebraska has a vibrant agricultural economy that is highly dependent on groundwater to irrigate crops such as corn, soybeans, and edible beans. As of November 2023, the groundwater well registry maintained by the Nebraska Department of Natural Resources listed over 96,000 active irrigation wells in the state[1]. A survey of irrigators conducted by the U.S. Department of Agriculture in 2018 gathered data on over 72,500 well pumps, of which 24.3% (17,664) were powered by diesel engines.[2] Between 2017 and 2022 NDEE replaced 140 diesel irrigation engines through the EPA-funded DERA (Clean Diesel) Program. Of those diesel engines, 42% had model years ranging from 1970 to 1996 and lacked any emissions controls. Another 39% were Tier 1 engines with minimal emission controls.

Emissions Reductions

Estimated cumulative net reductions in emissions through target year 2030 are shown in the table below, assuming 2026 is the first full year of operation. Direct emission reductions at the well site resulting from the elimination of diesel engines were calculated using the EPA on-line Diesel Emissions Quantifier.[3] These gross emission reductions are partially offset by emissions from the generation of electricity needed to power the replacement equipment (including transmission losses). These offsets were calculated using emission rates in the EPA Emissions & Generation Resource Integrated Database (eGRID)[4] for the Midwest Reliability Organization (MRO) West subregion.

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)	Co-pollutant Reductions (tons)	
		NOx	$PM_{2.5}$
Replace 50 diesel irrigation engines per year with electric motors	0.015	307.1	18.4

Benefits

In addition to greenhouse gas reductions, all-electric replacements of older diesel irrigation engines will result in significant reductions in emissions of NOx and $PM_{2.5}$. When inhaled, these pollutants can cause adverse respiratory and other health effects, and emissions of NOx during warmer months contribute to the production of ground-level ozone, which has even higher adverse effects on respiratory health. Ozone levels at rural monitoring sites in and around Nebraska have ranged from 80% to 96% of the National Ambient Air Quality Standard in recent years, showing that ozone levels are elevated throughout the region, not just in metropolitan areas. Reduction in NOx, $PM_{2.5}$, and ozone through this measure provide public health benefits across the state.

Irrigation engine replacement projects require the services of electrical contractors, irrigation service companies, and rural electrical utilities. The funding provided through this measure will therefore contribute to economic activity in rural areas across the state.

Based on mapping of 140 previous irrigation engine replacement projects carried out by NDEE, the agency expects that 30% of the projects funded by this measure will be located in low-income and disadvantaged rural areas as defined by CEJST and EJScreen. These areas will experience the local benefit of reduced diesel emissions, reduced health impacts, and benefits from the associated economic activity.

Authority and Administration

This program would be implemented by NDEE under its existing authority to administer federal grant funds.

Milestones and Metrics for Tracking Progress

NDEE would implement an annual program soliciting applications and awarding projects to applicants, with a goal of awarding funds for at least 50 engine replacement projects to be completed within each program year. Quarterly reports would track the progress of each project, the number of projects completed, total project costs, and program expenditures.

Other Funding Sources

EPA State DERA Program and DERA National Grants and USDA Rural Energy for America Program (REAP).

References

1 *2023 Nebraska Groundwater Quality Monitoring Report*: http://dee.ne.gov/publica.nsf/pages/23-022

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4 Emissions & Generation Resource Integrated Database (eGRID): https://www.epa.gov/egrid

Incentives for Micro-Solar Arrays for Critical Infrastructure in Low-Income Rural Communities

Measure Concept

Provide financial incentives (rebates) to rural low-income and disadvantaged communities to install solar arrays at water and wastewater treatment facilities. The solar arrays are expected to range in size from 50 to 500 kW, with a goal of adding total new capacity of 2 MW by 2030.

Applicable Sector(s)

Waste & Wastewater and Energy Production

Background and Description

Many rural communities in Nebraska have a struggling economy. The Nebraska Public Power District has identified approximately 75 rural communities in its service area that have been designated as low-income and disadvantaged and that operate drinking water and/or wastewater treatment facilities. Other such communities are found in the 13-county service area of the Omaha Public Power District. Operation of these facilities places an economic burden on low-income communities. Solar photovoltaic arrays generating electricity at these facilities would reduce energy costs for their communities and residents while reducing fossil-fuel generation of grid electricity.

Emissions Reductions and Methodology

Emissions reductions were calculated by first assuming the addition of 500 kW of solar capacity (one to three projects depending on size) annually over a four-year period by 2030. The corresponding annual reductions in emissions from grid electricity generation were calculated using the EPA AVERT tool[1] with the central region data file used to represent generation resources available in all but four low-population counties in western Nebraska.

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)	Co-pollutant Reductions (tons)	
		NOx	SO_2
Install 500 kW of solar capacity per year at water/ wastewater facilities in low-income rural communities over a four-year period	0.008	7	6.65

Transformative Impact

This program would provide four to 10 low-income rural communities with access to low-cost solar energy for their critical infrastructure facilities while reducing greenhouse gas emissions from the regional electric grid. Each solar facility would be fully funded by the program if the community provides access to the land and commits to maintenance of the facility. The solar facility could be owned by the utility or the community, but in either case energy costs would be reduced for the host community. The program proposes to focus funds on ground-mounted solar projects to provide the maximum financial benefits to the low-income disadvantaged communities. Ground-mounted solar projects benefit from lower capital costs per installed kW capacity in comparison to rooftop solar due to less complex installation. In addition, sites for ground-mounted solar arrays can be carefully selected for favorable sun exposure and minimal utility upgrades.

Benefits

Low-income and disadvantaged rural areas as defined by CEJST and EJScreen will be targeted and prioritized for solar projects as part of this program. The electricity generated by the solar arrays will reduce energy costs for these communities, and the construction of the arrays will contribute to economic activity in rural areas across the state. Reductions in CO_2, NOx, and SO_2 will directly benefit five Nebraska counties (Adams, Douglas, Lancaster, Lincoln, and Otoe) that host coal-fired generating stations as well as surrounding areas.

Authority and Administration

Funds would be administered by the Nebraska Department of Environment and Energy, which has current authority to receive federal grant funds. Funds would also be subawarded to Nebraska public electric utilities including Omaha Public Power District and the Nebraska Public Power District, which have current authority to receive federal grant funds, construct and operate solar photovoltaic generation facilities, and operate energy efficiency incentive programs.

Milestones and Metrics for Tracking Progress

The public electric utilities will work with the low-income and disadvantaged communities in their service areas to identify potential projects to be completed by 2030, with a goal of adding 500 kW (0.5 MW) of capacity per year over a four-year period. NDEE and the utilities will track the completion of projects during the program period.

Other Funding Sources

The small solar systems proposed in this measure could be eligible for a 30% Investment Tax Credit if they meet labor requirements issued by the Treasury Department. The EPA Solar for All Program is another potential source of funding.

References

1 EPA Avoided Emissions and geneRation tool (AVERT): https://www.epa.gov/avert.

Funding for Solar Projects on Unused/ Contaminated Land, Ag & Industrial Facilities, and Parking Lot/Feedlot Solar Canopies

Measure Concept

Provide incentives for solar panels and solar canopies on unused/contaminated land and at agricultural and industrial facilities and for rooftop solar on both commercial and residential properties including parking lots and feedlots.

Applicable Sector(s)

Agriculture, Energy Production, Industry, Commercial & Residential Buildings

Background and Description

Nebraska has enormous potential for capturing solar resources. Solar plays a role in Nebraska ranking first for power grid reliability.[1] By early 2023, Nebraska had nearly 70 megawatts of solar photovoltaic (PV) capacity, including about 28 megawatts of customer-sited, small-scale (less than 1-megawatt) capacity.[2] Since 2010, consumer-owned solar PV systems of rated capacity of 25 kW or less have increased from 45 consumer-owned units to 2,526 units in 2023. Newly installed solar is notable statewide, from small western rural towns to large eastern urban cities. From 2022 to 2023, the number of units increased by 993, or 65%, and the estimated rated capacity increased 7,830 kW, or 47%.

Community feedback has shown that some residents are concerned about solar competing with other land uses such as agriculture. Solar development projects located at unused/contaminated lands, agricultural and industrial facilities, and commercial and residential properties can be a means of generating electricity locally and saving on electricity costs while avoiding development in greenfield areas.

This program would focus on providing incentives for solar projects in non-greenfield areas, including solar at pivot corners, solar above parking lots and on commercial and residential rooftops, and solar above cattle feedlot pens. Parking lots and rooftops of commercial buildings are abundant, largely untapped for solar power generation, and located on land that has already been converted from its natural environment. Irrigation is one of largest energy uses in row crop agriculture in Nebraska.[3] Providing incentives for installing solar at corner pivots can reduce energy use and energy costs. Solar arrays installed as shade structures over open feedlots provide added benefits such as reducing heat stress. The arrays being evaluated could be used to offset the electricity costs of pumping water, lighting, ventilation, and other agricultural uses.

Nebraska's larger public electric utilities offer financial incentives for eligible customers to install solar. This measure will build on these activities by providing additional funding to expand their reach across the state.

Emissions Reductions and Methodology

A number of public utility partners provided data on recent and potential solar project programs and measures, including pilot programs for solar above parking lots (carport solar) and solar above cattle feedlot pens. Emission reductions were calculated by first assuming the addition of 76.6 MW of solar capacity over a five-year period by 2030. The corresponding annual reductions in emissions from grid electricity generation were calculated using the EPA AVERT tool[4] with the central region data file used to represent generation resources available in all but four low-population counties in western Nebraska.

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)	Co-pollutant Reductions (tons)		
		NOx	SO_2	$PM_{2.5}$
Install 76.6 MW of solar capacity in various solar projects over a five-year period	0.39	325.5	306.4	18.6

Transformative Impact

All Nebraskans can benefit from reliable and more affordable electric energy. Sources for dependable, economical electric power include renewable solar energy. Efforts to reduce air pollution, decrease dependence on fossil fuels, and lower greenhouse gas emissions have led utilities, businesses, communities, and homeowners to integrate renewable solar power into their plans to meet energy requirements and save money. This program has an opportunity to impact multiple sectors throughout the State of Nebraska.

Benefits

The electricity generated by the solar arrays will reduce energy costs for the recipients, and the construction of the arrays will contribute to economic activity in areas across the state. By generating renewable electricity, this measure reduces gaseous and particulate emissions associated with electricity generation, including criteria pollutants such as NOx, SO_2, $PM_{2.5}$, and VOCs.

There are numerous co-benefits for the installation of solar. For example, covering parking lots with solar panels could help shade the vehicle beneath. Installing solar above cattle feedlot pens offers additional shade for livestock, and installing solar on the tops and sides of buildings that go largely unutilized would help shade the actual structure from direct sunlight creating less need to cool the building in warmer months.

Authority and Administration

Funds would be administered by the Nebraska Department of Environment and Energy, which has current authority to receive and administer federal grant funds. Funds would be subawarded to the Nebraska Public Power District, Municipal Energy Agency of Nebraska, Omaha Public Power District, and Lincoln Electric System and other eligible entities to expand current and pilot solar project programs.

Milestones and Metrics for Tracking Progress

During the first year of the program NDEE would negotiate subaward agreements with the public utilities to provide annual allocations to their solar project programs. The utilities currently track these projects annually and would provide these annual reports to NDEE to document energy and cost savings.

Other Funding Sources

This program would supplement programs that are funded by the utilities. Other potential funding sources include the U.S. Department of Agriculture Rural Energy for America Program for agricultural facilities, Industrial Research and Assessment Center Implementation Grants, and the expanded Qualifying Advanced Energy Project Credit (48C) program, which can rebate as much as 30% of a qualified energy efficiency investment. The EPA Solar for All Program is another potential source of funding.

References

1 States With the Greatest Power Grid Reliability | US News Best States

2 U.S. Energy Information Administration - EIA - Independent Statistics and Analysis

3 Solar Power and Center Pivots - Part 1: Challenges, Introduction and Definitions | CropWatch | University of Nebraska–Lincoln (unl.edu)

4 EPA Avoided Emissions and geneRation tool (AVERT): https://www.epa.gov/avert.

Agriculture

Measures to Reduce Emissions in Agricultural Production:

- Establish a Carbon Intensity Score Registry
- Provide Incentives for Regenerative Agricultural Practices
- Provide Incentives for Precision Agriculture Equipment

Measure Concept

Provide incentives for a carbon intensity (CI) scores registry that fosters the wide-spread adoption of CI scores as a key performance metric for crops and land usage. In parallel, initiate community-based programs to encourage adoption of regenerative agriculture practices, and provide incentives to farmers to acquire precision agriculture technology. The increased availability of CI scores in agribusiness, coupled with these programs and incentives, will lead producers towards regenerative agriculture and precision agricultural technologies that minimize nitrous oxide and nitrate emissions, restore soil fertility and moisture levels, and increase carbon dioxide sequestration.

Applicable Sector(s)

Agriculture

Background and Description

Nebraska has an extensive and diverse cropland base of nearly 22 million acres, ranking sixth nationally in total cropland acres and first in irrigated cropland acres. In addition, Nebraska has over 23 million acres of grazing land, ranking first with 6.5 million head of cattle and calves. According to the EPA, the agricultural sector accounts for 42% of Nebraska's greenhouse gas (GHG) emissions in 2020, ranking fifth highest among states. If fully healthy, U.S. agricultural soils could store up to 250 million metric tons of carbon annually.[1] Three agricultural sectors account for the largest sources of GHG emissions in agriculture production: enteric and manure emissions of livestock, nitrous oxide emissions from fertilization of row crops, and fossil fuels for operations and transportation.

For the past 100 years, Nebraska's crop and livestock growers' laser focus on increasing yields and lowering inputs has demonstrated producers' commitment to preserving the state's natural resources and productive capacity. At the state-wide level, these efficiencies generate more food and fuel stock by the fewest producers on the least land in the history of agriculture.

A consensus has emerged that the cornerstones of regenerative agriculture overlap with the farming practices critical to reducing GHG emissions in crop production: reduced tillage, cover crops, and nitrogen management. Precision agriculture gives farmers the technical tools needed to track the nutrient needs of crops and provides technology to optimize growth while minimizing the use of fertilizers and pesticides.

Nebraska's Carbon Intensity Registry will aggregate the impact of these practices at county and regional levels to help all of the communities in which farms operate, and on which they rely, to quickly shift towards a new, low carbon paradigm for crop production.

Carbon Intensity Score Registry

As a general principle, "carbon intensity" typically refers to carbon dioxide emissions per joule of energy generated during the production of a raw material within the lifecycle assessment of a finished product. The estimation of CI scores for corn and soybeans has steadily moved towards standardization as a result of the alternative fuels industry. Companies that optimize crop production through precision and regenerative agriculture track and account for the values critical to CI estimates.

The Inflation Reduction Act creates a number of incentives to reduce the carbon intensity of corn and soybeans as feedstocks for alternative fuels. The ability to produce valid CI estimates is converging with the clear evidence that regenerative and precision agriculture directly reduce carbon intensity in row crops while simultaneously improving soil health and reducing co-pollutants.

Nebraska's Carbon Intensity Registry and its incentive for registering CI scores for corn and soybeans (and potentially other crops) will accelerate producers' adoption of carbon intensity as a performance metric for crops and fields. In exchange for logging a CI score in the registry from a third-party provider, growers will receive a small incentive payment. The CI Registry:

- Enables producers to gain familiarity and comfort with CI scores as a performance attribute
- Provides a revenue bridge for producers to work on CI scores until market premiums mature
- Provides agribusiness, precision agriculture, and regenerative agriculture companies reason to supply growers with CI forecasts during the growing season to drive crop management decisions
- Creates a source of localized CI estimates on which growers and their producer groups can rely to understand emissions reduction in corn and soybeans
- Motivates producers to seek out regenerative and precision agriculture opportunities that reduce CI scores at the farm and field level

Nebraska's CI Registry will emphasize small incentives, data privacy, and governance by agricultural leadership to win producer confidence and participation. Local estimates of carbon intensity will support both existing and new outreach efforts from trade groups, governmental agencies, and higher education intended to boost productivity, reduce emissions, and improve producers' profitability.

Regenerative Agriculture

To accelerate the rate of adoption of regenerative agriculture practices, the social, technical, and complex economic barriers, and required solutions, must all be addressed. NDEE's proposed program will focus on one of the gaps in many other projects' designs, which is the lack of community engagement, support, and partnership. It is critical to remember that farmers are part of the food production system and also the local community in which they live. The success and health of the producer, the ecosystem, and their community are intertwined. It is imperative that the community is a partner with the producer in the successful transition to regenerative agriculture.

This program will begin with a community-based pilot project in south-central Nebraska, followed by expansion to other areas in Nebraska. In addition to the site-specific efforts, technical assistance and education about reduced tillage, cover crops and the reduced use of chemical fertilizers will be provided to all farmers.

The innovative pilot project will cover a multi-county area including several low-income disadvantaged community areas. The pilot is based on a three-prong integrated approach that involves the establishment of connections between a stakeholder visioning group, producer-to-producer learning groups, and local educational and demonstration sites relevant to regional producers. This cohesive community-based collaboration will focus on producers, landowners, financial lenders, water providers, health care, urban-rural consumers, policy-makers, K-12 education, and other key influencers of sustainability. Representatives of these groups will form a stakeholder visioning group to guide local activities and build a concentric network of change. These relationships will help build and sustain change as the greater municipality/rural community partnership fosters supportive systems in the transition. This group will foster a landscape in which the more typical producer-to-producer learning groups and educational sites will be successful.

The program will address focus areas integral to the success of the community group:

- Economic risk analysis and information
- Credible soil health benchmarking tools and methods that align with the proposed Carbon Intensity Score Registry
- Facilitating solutions to barriers for the necessary mentoring and group learning for socio-behavioral change
- Facilitate the development and implementation of a communication plan

Following the completion of the pilot project, the model will be expanded to multiple regional locations across Nebraska. The first hubs would likely be 12 counties centered around North Platte, and 10 counties centered around Columbus and Fremont. These new hubs will encompass up to 10 additional underserved communities, addressing grasslands as well as irrigated and rainfed agriculture, helping them reduce costs and maximize benefits. Activities will build upon key learnings from the pilot project and will focus on awareness, education, assistance, and sharing of information on implementation of soil health practices that will reduce GHG emissions as well as improve water quality and quantity concerns, including the effects on human health. It is also critical to understand that this effort will build on, amplify, and complement other ongoing projects conducted by groups who are striving to increase the number of acres transitioning to regenerative agriculture practices.

Within each area, producers, local agribusinesses, representatives of municipalities, various local governmental and civic groups, and other non-agricultural stakeholders will be brought together as a Stakeholder Advisory Group. They will discuss best practices for addressing soil health and water quality and will guide the activities within the area to best serve the needs of the community, each with their own unique conditions and concerns. Local involvement that bolsters municipal/rural partnership always helps with the adoption of new practices and helps ensure that activities will continue and change as the local needs change. Likewise, the members of this Stakeholder Advisory Group will change as needs and expertise change.

A key education and demonstration site will be established in each area to show the soil health practices in use and for field days and other educational activities. When possible, data will be collected to show the benefits of soil health practices and to help analyze the cost/benefit ratio of adopting the practices. Similar data collection and analysis may be done with cooperating producers as they are implementing soil health practices.

Precision Agriculture

"Precision Agriculture" refers to the application of water, nutrients, and pest control according to the specific needs of a plant given its genetics and the environment in which it is being cultivated. More formally, precision agriculture can be described as "a farming management strategy based on observing, measuring and responding to temporal and spatial variability to improve agricultural production sustainability."[2]

In practical terms, precision agriculture utilizes soil sampling, satellite imagery, and real-time sensors to track growing conditions. From these data, growers deploy an arsenal of GPS-programmed technologies, advanced equipment designs, and chemically engineered interventions that meet the individualized needs of particular crops and their specific conditions.

More than field technologies, though, precision agriculture includes farmers' growing reliance on digital field/crop management systems. These information management systems incorporate machine learning and artificial intelligence to convert environmental data and plant performance into specific interventions that improve crop yields balanced against the need to preserve and build the productive capacity of a field and its supporting resources. This program proposes to provide financial incentives to farmers to acquire precision farming equipment and crop management technologies.

Carbon intensity scores can be readily calculated from the data streams running through precision agriculture. CI scores reflect both the emissions generated during crop production as well as the carbon dioxide sequestered. In this way, precision agriculture becomes a critical pathway by which producers can create the best of both worlds: 1) strong, sustained yields over time, and 2) emissions approaching net-zero.

Emissions Reductions and Methodology

In "Climate Neutrality for Nebraska Agriculture: Benchmarking Current Emissions," Blonk Consultants NL conducted a lifecycle assessment of greenhouse gas emissions for production agriculture in Nebraska.[3] Of the estimated 42.3 MMT CO_2e Blonk, et al., attributed to circa 2020 agriculture, three primary sources accounted for 83% and were identified as:

- Enteric and manure emissions of livestock, 19 MMT CO_2e
- Nitrous Oxide emissions related to crops, 9 MMT CO_2e
- Fossil fuels for operations and transportation, 7 MMT CO_2e

The evidence from Blonk's life-cycle assessments shows that increasing the intensive use of regenerative and precision agriculture lowers the carbon intensity of crops as feedstock for both livestock and alternative fuels. For the purpose of these estimations, the GHG emissions reductions reported here are limited to the emissions directly associated with crop production and do not reflect the downstream reductions anticipated in livestock or alternative fuels.

The cumulative net reductions in crop production can be seen in the table below. While crop production occurs year-round, each new year represents a complete reboot of growing practices for corn, soybeans, and other significant row crops. Nebraska agriculture is uniquely organized to support rapid, wide-spread adoption of emission reduction strategies within 2-3 years of implementation. Market dynamics flowing from the IRA's 45(z) ethanol tax credits beginning in 2025 are expected to accelerate and reinforce the use of CI scores and regenerative and precision agriculture to decarbonize crop production.

In their life-cycle assessment of production agriculture in Nebraska, Blonk and associates investigated the potential for crop production to reduce its carbon emissions. For corn, the report found that improved nitrogen efficiency, reduced N_2O emissions, reduced diesel usage, and solar irrigation could lower GHG as much as 4.09 MMT CO_2e per year. Those same measures applied to soybeans would eliminate 1.07 MMT CO_2e annually. As the two largest crops produced each year, these calculations reflect realistic, but conservative, estimates for Nebraska's potential to reduce GHG for all crop production.

The modest financial benefits from participating in the CI Score registry and shifting market dynamics in favor of decarbonized crops will combine with education, technical assistance, and proven technologies to rapidly reduce crop emissions. We expect rapid, widespread adoption of the key strategies in the first two years followed by four years of substantial reductions in GHG between 2026 and 2030 that reflect the gross estimates from Blonk, et al.

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)	NOx emission reductions (tons)
Establish CI Score Registry, initiate community-based regenerative agriculture program, and provide incentives for farmers to acquire precision agriculture technology.	22.13	4,150 — 12,040

Transformative Impact

The wide-spread adoption and implementation of regenerative and precision agriculture have been constrained by technology costs, broad-band and power limits, uncertain impact on yields relative to cost, and a lack of technical support. Until recently, emission reductions in commercial agriculture were collateral benefits realized from the primary purpose of driving down input costs through lower fertilizer rates, more efficient production practices, and deep-seated commitments to better stewardship.

In the last decade, and the last five years in particular, many of the technical and infrastructure constraints have been mitigated. Market dynamics have been slow to shift, however, and continue to push Nebraska farmers to compete almost exclusively on the yield and quality attributes of their crops and livestock.

The Inflation Reduction Act's tax credits for low carbon alternative fuels as well as regulatory actions in other states and export markets have created an impetus for pricing the carbon intensity of fuel stocks into sales contracts. This change drives an unprecedented interest among producers and agribusiness to better understand CI scores as a crop attribute and the means by which it can be lowered.

The three related measures discussed here mutually reinforce broad efforts across government agencies, higher education, and producer trade groups to put regenerative and precision agriculture into practice across as many acres and operations as possible. The CI Score Registry and incentive supports for regenerative and precision agriculture arrive at the best possible time to realize sector-wide transitions in emissions reductions in one of the largest and most influential agricultural states in the country.

Benefits

The CI Score Registry will provide direct evidence of emissions management for hundreds of millions of bushels of corn, beans, and other crops across the state. Regenerative agriculture practices will drive improvements in nitrogen management and boost carbon sequestration rates through cover crops, no-till, and reduced reliance on chemical fertilizer. Precision agriculture supplies the tools to track crop performance across the growing season and synchronize nutrient and pesticide applications with plant needs.

In addition to reducing greenhouse gas emissions, these measures will enable producers to diversify nutrient and pest management practices and lower their reliance on chemical mitigation. Direct and immediate benefits include reductions in nitrate saturation from excess fertilization, increased soil fertility, and higher levels of moisture retention. Nebraska's groundwater and croplands are its greatest natural resource, and these efforts will ensure that it continues to sustainably feed and fuel the world.

Nebraska's crops and farmers occupy nearly every corner of every county in the state, including LIDAC areas. Without the financial incentives of a CI Score Registry, many of these lower income, disadvantaged producers simply cannot bear the risk from shifting production practices. The three-pronged approach proposed here provides a complete solution set, at scale, that enables all farm operations, regardless of size and location, to adopt and adapt to production practices which will preserve their land and livelihood.

Administration and Authority

It is anticipated that NDEE will direct these three measures through a sub-award to a governing coalition of agriculture leadership charged with building, maintaining, and securing the CI Score Registry. Incentive funds for technical assistance in regenerative agriculture and the implementation of precision agriculture technology will be administered like most small programs through NDEE in partnership with the agriculture leadership.

Metrics for Tracking Progress

Progress for the CI Score Registry will be assessed on the bushels and acres of crop for which growers register. For example, Nebraska grows roughly 1.6 billion bushels of corn per year. It is anticipated that between all crops and across all years, approximately 1 billion bushels of corn, soybeans and grains will be registered cumulatively and reflect 10-25% of all cropland.

In the surge to increase precision agriculture and adopt regenerative agricultural practices, progress will be reflected in applications for and awards of those incentive funds. Awards will include several performance metrics such as acres impacted and changes in CI scores prior to and after award.

Other Funding Sources

A number of agriculture and conservation programs exist that provide limited support to a small number of producers for regenerative and precision agriculture. Nebraska's Precision Agriculture Infrastructure Grant Program[4] is an example of the scattershot sampling of alternate funding sources. The program had $1 million to award for FY2023, but it has not been renewed or funded into the future. A federal bill, the Precision Agriculture Loan (PAL),[5] was introduced in the Senate, but has not advanced out of committee and does not appear to be under serious consideration at this time.

The USDA NRCS Environmental Quality Incentives Program[6] (EQIP) funds regenerative agriculture practices like cover crops, but the program focuses on a small group of producers over several years. Similar NRCS programs offer funding in support of some regenerative and precision agriculture practices.

Some of these funding programs might be leveraged in support of the agricultural measures proposed here, but none are specifically designed as emissions reduction strategies tied to a comprehensive method of assessment like the CI Score Registry.

References

1 Regenerative Agriculture: Farm Policy for the 21st Century. NRDC, 2022. https://www.nrdc.org/sites/default/files/regenerative-agriculture-farm-policy-21st-century-report.pdf

2 International Society of Precision Agriculture, https://www.ispag.org/about/definition, Retrieved 20 December 2021.

3 Climate Neutrality for Nebraska Agriculture: Benchmarking Current Emissions, 2022. Blonk Sustainability and Resilience Services, PLLC. https://aksarben.org/full-value-ag

4 Nebraska Precision Agriculture Infrastructure Grant Program: https://psc.nebraska.gov/precision-agriculture

5 https://www.fischer.senate.gov/public/index.cfm/2023/3/fischer-klobuchar-reintroduce-bills-to-expand-farmers-access-to-precision-agriculture-equipment-climate-friendly-technologies

6 https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives/nebraska/nebraska-environmental-quality

Transportation

Incentives for Alternative-Fuel and Electric Replacements of Diesel Vehicles

Measure Concept

Provide incentives for replacement of medium- and heavy-duty diesel vehicles with electric or alternative fuel vehicles or conversion of such diesel vehicles to use 100% biodiesel. Eligibility would be restricted to vehicles that operate entirely within the state of Nebraska.

Applicable Sector(s)

Agriculture and Transportation

Background and Description

The Nebraska greenhouse gas inventory for 2021 reports 13.45 million metric tons CO_2e emitted by the transportation sector, representing 16% of the state's total annual emissions. At end of 2023 Nebraska had 159,272 registered diesel and biodiesel vehicles[1], most of which are medium- and heavy-duty trucks and buses. EPA's report on the 2021 U.S. greenhouse gas inventory shows that emissions from medium- and heavy-duty trucks and buses are responsible for 24.5% of greenhouse gas emissions from the transportation sector.[2] These vehicles are also significant sources of ozone-forming nitrogen oxide (NOx) emissions, totaling 16,181 tons annually in Nebraska in the 2020 National Emissions Inventory.[3] Both NOx and ozone pose significant public health risks, especially for children, senior citizens, and people with asthma and other respiratory diseases.

This measure proposes to provide financial incentives to reduce harmful diesel emissions by replacing medium- and heavy-duty diesel vehicles with alternative-fuel vehicles (burning cleaner compressed natural gas or propane) or with electric vehicles. Another cost-effective option is retrofitting existing diesel vehicles to use higher blends of biodiesel, including 100% biodiesel (B100).

Emissions Reductions and Methodology

NDEE has long participated in programs to replace older diesel trucks and school buses with newer, cleaner equivalents. These efforts include the EPA Clean Diesel Program and the Nebraska Diesel Emission Mitigation Program, which is funded through the Volkswagen Diesel Emissions Environmental Mitigation Trust. Data from these Nebraska programs was used to provide the inputs needed to calculate emissions reductions for representative diesel emission reduction strategies. These inputs include average annual miles, annual diesel fuel use, and vehicle model year.

The strategies modeled were electric replacements of diesel school buses, compressed natural gas (CNG) replacements of diesel trucks, and retrofits of diesel trucks to use B100 biodiesel fuel. Emissions reductions were computed using the On-Road Fleet Footprint calculator in Argonne National Laboratory's Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) spreadsheet tool.[4] For each strategy both old and new vehicle parameters are entered, and the tool computes the emissions for each, with the difference being the emissions reductions for carrying out that action. Details of the results and the calculation of cumulative reductions are presented in Appendix C.

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)	NOx emission reduction (tons)
20 electric replacements of diesel school buses annually by 2030	0.003	10.755
20 CNG replacements of medium- and heavy-duty local diesel trucks annually by 2030	0.016	26.21
50 conversions of local diesel trucks to B100 bio-diesel annually by 2030	0.077	0
TOTAL	**0.096**	**36.96**

Benefits

Transitioning fleets from diesel vehicles to cleaner alternative-fueled or electric vehicles will reduce greenhouse gas emissions, reduce emissions of other harmful diesel pollutants, and result in significant cost savings to vehicle owners due to the lower cost of electricity and alternative fuels compared to diesel. Reducing emissions will provide a significant public health benefit to populations currently exposed to diesel exhaust, including school children. NDEE may structure the program so that higher incentives would be provided to projects in low-income and disadvantaged areas to ensure that a significant portion of these changes benefit those areas.

Authority and Administration

This program would be implemented by NDEE under its existing authority to administer federal grant funds.

Milestones and Metrics for Tracking Progress

NDEE would implement an annual program soliciting applications and awarding projects to applicants to meet the annual program goals. Quarterly or semi-annual reports would track the progress of each project, the number of projects completed, total project costs, and program expenditures.

Other Funding Sources

Potential funding sources include the EPA DERA (Clean Diesel) State Program and the Clean School Bus Program and the U.S. Department of Transportation Low or No Emission Grant Program.

References

1 https://neo.ne.gov/programs/stats/inf/196.htm.

2 Table 2-13, Transportation-Related Greenhouse Gas Emissions, in I*nventory of U.S. Greenhouse Gas Emissions and Sinks*: 1990-2021. U.S. Environmental Protection Agency, EPA 430-R-23-002. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021

3 https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-data

4 https://afleet.es.anl.gov/home

Incentives for New Public Electric Vehicle Charging Stations

Measure Concept

Provide financial incentives for the installation of new public electric vehicle charging stations, including fast charging stations and Level 2 charging stations.

Applicable Sector(s)

Transportation

Background and Description

The transportation sector is responsible for 16% of Nebraska's annual greenhouse gas emissions. Transitioning public and private vehicle fleets to plug-in hybrid electric vehicles (PHEVs) and fully-electric vehicles (EVs) would result in significant reductions in greenhouse gas emissions from this sector. Providing increased access to public charging would accelerate this transition.

As of February 2024, Nebraska has 62 public fast charging locations with a total of 155 charging ports, and 200 public Level 2 charging locations with a total of 392 charging ports.[1] However, most of the fast-charging locations are along Interstate 80, with clusters in Omaha and Lincoln, the state's two largest cities. Most stations outside the Interstate 80 corridor are in the eastern quarter of the state; only three public fast charging stations are currently located in the western three-fourths of the state outside of the Interstate 80 corridor. Public Level 2 charging locations are more widely distributed but are also concentrated in the eastern part of the state. Electric vehicle travel north or south across the state and east or west across northern Nebraska are particularly difficult due to the long distances between charging stations.

This measure proposes to double the number of fast charging locations in Nebraska by 2030, with priority given to smaller cities and rural communities along federal and state highways. Incentives can also be provided for installation of public Level 2 chargers at workplaces, retail locations, hotels, and state parks.

Emissions Reductions and Methodology

Adding electric vehicle supply equipment (EVSE, also known as charging stations) will reduce the "range anxiety" of EV drivers and promote increased adoption of electric vehicles.

Although doubling the number of public EV charging locations is expected to increase sale and use of electric vehicles, it is not possible to quantify that effect sufficiently to estimate the amount of greenhouse gas emissions reductions to be achieved by this measure. However, the average Nebraska gasoline vehicle emits 12,594 pounds of CO_2e annually, while the average all-electric vehicle emits only 3,860 pounds annually.[2] Use of an EV in place of a gasoline vehicle in Nebraska therefore reduces annual greenhouse gas emissions by 8,734 pounds of CO_2e. Expanding opportunities for EV charging will facilitate increased use of EVs and multiply these emissions reductions.

Transformative Impact

The majority of electric vehicle charging currently takes place at home. However, having more public charging locations available would encourage increased adoption of EVs by facilitating long-distance travel across the state and by making EV charging available to renters, who do not have access to home-based charging. Fast chargers in smaller communities along federal and state highways can serve both of these purposes.

Benefits

Providing more public charging to facilitate the use of electric vehicles instead of vehicles with internal combustion engines would reduce emissions of pollutants such as NOx, $PM_{2.5}$, and volatile organic compounds in addition to carbon dioxide. Providing public fast charging in smaller communities would provide access to lower-income drivers who live in rental housing where home-based charging may not be available. Installation and maintenance of the charging equipment would provide jobs and increase economic activity in smaller rural communities.

Authority and Administration

Programs described in this measure could be implemented by the Nebraska Department of Transportation (NDOT) and NDEE under existing authority to administer federal grant funds.

Milestones and Metrics for Tracking Progress

The government entities administering these programs would set the timelines for allocating funds and would monitor the progress and completion of individual projects.

Other Funding Sources

U.S. Department of Transportation National Electric Vehicle Infrastructure Program includes formula funds allocated to NDOT and competitive grants open to government entities for community charging. Several Nebraska public utilities also provide incentives for installation of public charging stations.

References

1 U.S. Department of Energy, Alternative Fuels Data Center, Electric Vehicle Charging Station Locations: https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC, accessed 2/18/2024.

2 U.S. Department of Energy, Alternative Fuels Data Center, Emissions from Electric Vehicles: https://afdc.energy.gov/vehicles/electric_emissions.html

Waste Management

Establish Hub-and-Spoke Anaerobic Digester/Biogas Hubs for Agricultural Waste

Measure Concept

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

Applicable Sector(s)

Agriculture, Waste & Wastewater

Background and Description

Generally speaking, 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.[1] 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.

Emissions Reductions and Methodology

The emission reductions from the establishment of hub-and-spoke anaerobic digester systems 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. The reductions were calculated assuming six hubs across the state of Nebraska. Operation-scale data was input into the joint EPA and Global Methane Initiative's Anaerobic Digestion Screening Tool, Version 2.3.[2]

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)
Digesters utilizing waste from feeder cattle, swine, and dairy cattle	1.037

Transformative Impact

Ordinarily, several factors hamper the use of AD as an emissions and manure management practice:

- Large, consistent volumes of manure are required or else the digester investment is underutilized
- While the digester tanks are not especially cost prohibitive, the cleaner and injection site costs and licensing fees can only be justified for very large operations
- Beef cattle feedlots can provide ample volumes of manure, but dirt mixed into the manure adds costs for cleaning the manure or significantly reduces digester efficiency

The hub-and-spoke model envisioned here leverages a central cleaning and injection site to the benefit of multiple producers. Operations with fewer head of cattle, hogs, or dairy need only size their digester tanks to the volume of feedstock they expect to regularly produce. Distributing the feedstock sourcing for the cleaner and injection facility across multiple livestock operations reduces the risk of production stoppages due to factors at any one operation. Recent engineering practices, such as the use of roller-compacted concrete in beef cattle feedlots improves animal health and well-being as well as producing good manure without dirt and sand contaminants.

Hub-and-spoke anaerobic digester systems can improve multiple media in heavy agricultural producing areas, many of which exist in rural or LIDAC communities. Improvements to air and water quality will provide benefits to all members of these communities. The introduction of additional renewable energy, using existing waste, both improves manure management and increases rural energy resiliency.

While this proposal has focused on the most common uses of AD to produce RNG, AD can also be configured to produce a wide variety of alternative fuel precursors and chemicals.[3] If during the pendency of this proposal, additional bio-economic opportunities emerge in addition to RNG, all of the attendant advantages of a hub-and-spoke system will apply equally to other possibilities.

Benefits

There are many direct and indirect benefits of anaerobic digester systems, including methane emission reduction, renewable energy generation, and decreased synthetic nitrogen fertilizer application. Indirect environmental benefits include: improved soil health, improved local water quality, decrease nuisance odors, and improved manure management. Digester systems also provide producers with diversified income streams from selling biogas to utilities, as well as decreasing their own energy bills by utilizing gas on site.

Hub-and-spoke projects could be located entirely or in some part in LIDAC areas of the state. These projects can help LIDAC communities with rural energy resiliency. Building these facilities will generate economic benefits to the surrounding communities with the need for construction materials, engineers, and labor. Operations will generate jobs through maintenance and facility staff, as well. Furthermore, land-applied digestate can introduce valuable nutrients to the soil which can improve soil health. Diverting the manure from leaching or running off in current practices can greatly decrease local water pollution.

A final benefit of the hub-and-spoke model rests with its scale of operations and production. As a biogas aggregator from multiple operations, large hub and spoke AD delivers a sufficient volume of gas to sustain professional oversight, maintenance, and security. Even on large farms, digester operations are simply one of many infrastructure responsibilities. A hub-and-spoke AD system is essentially a utility company that relies on specialized management to ensure that all parts of the system—from tanks to gas collection and transport and processing—operate at capacity and remain secure from accident or failures.

Authority and Administration

This program would be implemented by NDEE under its existing authority to administer federal grant funds.

Milestones and Metrics for Tracking Progress

NDEE would implement a program soliciting applications and awarding projects to applicants to meet the program goals. Quarterly or semi-annual reports would track the progress of each project, the number of projects completed, total project costs, and program expenditures.

Other Funding Sources

Other funding sources include the United States Department of Agriculture's Rural Energy for America Program (REAP), the American Recovery and Reinvestment Act of 2009, USDA's Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program, and USDA Value-Added Producer Grants.

References

1 USDA/NASS 2022 State Agriculture Overview for Nebraska

2 *Climate Neutrality for Nebraska Agriculture: Benchmarking Current Emissions*, 2022. Blonk Sustainability and Resilience Services, PLLC. https://aksarben.org/full-value-ag

3 SAF in Action: Carbon Negative Jet Fuel Made from Manure and More | Department of Energy

Incentives to Reduce Food Waste

Measure Concept

Provide incentives to reduce food waste and recycle organics. Because food waste is a complex challenge, this concept incorporates a multipronged approach.

1. Fund a marketing company to build a campaign for Nebraska and provide the materials to schools, NGOs, the public, as well as food handling entities such as growers, distributors, and restaurants regarding food waste and the circular economy.

2. Develop a statewide composting program to divert organics, including food waste, from entering Nebraska's 22 landfills.

3. Fund university research into food rescue (waste prevention) and redistribution. Research would involve a multidiscipline analysis of all facets of the challenge.

Applicable Sector(s)

Waste & Wastewater

Background and Description

Since 1980, food waste has doubled in the U.S. Because food waste contributes to the majority of GHG from landfills and requires considerable energy to produce, reducing food waste by any means will have significant GHG reduction potentials.

NDEE's Waste Program estimates Nebraska produces approximately 3,000,000 tons of municipal solid waste (MSW) per year. The department also believes Nebraska follows the national average for MSW characterization with 61.3% (1,839,000 tons) being organic material. Approximately 24% of this organic material is food waste, making up approximately 14.3% (438,000 tons) of all MSW.

EPA studies have shown that approximately 60% of all landfill GHG's are produced by decomposition of food waste due to its rapid decomposition prior to gas recovery system operation.

According to the USDA, Nebraska has a food insecurity rate of 12.1% which is above the national average while all our neighboring states except Wyoming have lower rates.[1] As a strong agricultural state, Nebraska has the opportunity to improve management of food systems in the state.

Emissions Reductions and Methodology

Calculations were performed using EPA's WARM v16[2] using the following assumptions:

1. The food reduction marketing campaign would target schools, public media, cultural centers, urban farming organizations, NGOs, and others who would help drive the campaign to success. Through education the public would be made more aware of the challenges associated with food waste and want to do something about it. The intended outcome of the five-year plan would be to reduce overall food wasted in Nebraska by 12.5% (54,700 tons) by 2030 through a reduction in purchasing, donation, food rescue or other similar strategy.

2. By providing funding opportunities to all 22 Nebraska landfills for all necessary equipment to operate a reliable commercial composting operation as well as funding for individual composting bins for the public to utilize, organic waste can be diverted from the landfill. The goal would be to divert 25% of all organic waste materials (459,760 tons) to the composting operation. Landfills would benefit additionally by not paying a tipping fee for composted material, helping sustain the operation as well as the potential marketability of the compost. The goal would be for all 22 landfills to have operational and successful composting operations by 2030.
3. Support University led multidisciplinary research and analysis of the challenge of food waste in Nebraska. Utilizing the departments of sociology, psychology, business, engineering, and others to research and provide recommendations that would reduce food waste in Nebraska by 50%, which is a USDA, EPA, and FDA national goal.

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)
Educational campaign to reduce food wasted in Nebraska by 12.5% by 2030	0.570
Statewide composting program (25% overall reduction in organics)	0.377
TOTAL	**0.946**

Transformative Impact

Through a 12.5% reduction of food wastd and the diversion of 25% of all organic waste from the landfill, 28% less organic waste would enter the Nebraska landfill system, extending the life of existing landfills.

Using a multi-year statewide educational campaign to educate the public about our food network and the circular economy as well as the needs of fellow Nebraskans enables Nebraskans to make deliberate and conscious decisions to use less, waste less, and donate more.

Benefits

Building out a food waste reduction and recovery program will help to reduce methane emissions from landfills by reducing food waste and increasing food waste recovery. Other benefits include business opportunities, support for sustainable material management initiatives, job creation, household and business cost savings, and increased food security.

Organic waste recovery and diversion from MSWs can significantly increase the life of Nebraska landfills, saving taxpayer dollars and utilizing fewer agricultural acres for waste disposal. Landfill compost operations can market their compost end products providing an additional revenue stream to their operation and saving additional taxpayer dollars. Creating compost for Nebraska's growers can improve soil health resulting in better growing conditions with potential higher yields and higher quality products. In addition, compost operations may provide job creation opportunities for Nebraskans. Education to encourage donations of unused food to food banks and other such operations in a timely manner can help support low-income Nebraskans needing assistance.

Authority and Administration

Programs described in this measure could be implemented by NDEE under existing authority to administer federal grant funds.

Milestones and Metrics for Tracking Progress

NDEE would implement an annual program soliciting applications and awarding projects to applicants, to meet the program goals. Quarterly or semi-annual reports would track the progress of each project, the number of projects completed, total project costs, and program expenditures.

Other Funding Sources

Potential funding sources include the NDEE's Waste Reduction and Recycling Grant Program.

References

1 USDA Economic Research Service, https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/key-statistics-graphics/

2 EPA WARM version 16, https://www.epa.gov/warm

Incentives for Production and Use of Biochar to Reduce Organic Waste and Sequester Carbon in Soil

Measure Concept

Provide financial incentives to aid entities to purchase biochar processing equipment to reduce organic waste and sequester carbon in soils. The incentives would cover a percentage of the costs of material handling equipment, pyrolysis unit, wiring and installation, and utility upgrade and connection charges.

Applicable Sector(s)

Waste & Wastewater and Agriculture

Background and Description

As plants and trees grow, they absorb atmospheric carbon dioxide. Natural decomposition and deforestation release the stored carbon back into the atmosphere. The creation of biochar from plant material sequesters carbon, preventing it from being released back into the environment for at least 100 years.[1] Biochar is created by a chemical process called pyrolysis, in which biomass is heated in an oxygen-limited environment and turned into a charcoal-like substance.

The carbon in biochar is highly resistant to chemical breakdown in soil. Biochar can be produced from waste wood, manure, or other organic materials that might otherwise have been burned or left to decompose, releasing greenhouse gases. Adding biochar produced from these sources to soil results in a net reduction in greenhouse gas emissions and long-term storage of carbon in soil. Biochar can also be integrated into other materials such as concrete and asphalt.

Interest in biochar was heard from stakeholders and the public at nearly every virtual and in-person meeting held. Encroachment by species like eastern red cedar is a threat to Great Plains grasslands and can reduce forage production by up to 75% in heavily invaded locations. In 2019, Nebraska rangelands lost over 419,000 tons of plant biomass production due to woody plant encroachment.[2] Mechanical removal is one method for controlling red cedar. Producing biochar from the resulting wood waste would add an economic benefit to this strategy.

The City of Lincoln, Nebraska, recently purchased a pyrolysis unit to process Emerald Ash Borer tree waste in addition to storm-generated biomass waste. Lincoln is seeking funding to install and begin operation of this unit as plans to market biochar products become viable.

Emissions Reductions

Estimated net reductions in emissions through target year 2030 are shown in the table. Emissions reductions assume the addition of one new biochar production project annually from 2025 through 2029, with an estimated 16,000 cubic yards of biomass processed annually per project. Details of the emissions reduction methodology are provided in Appendix C.

Cumulative Net Emissions Reductions through 2030

Priority Output	GHG emissions reductions (MMT CO_2e)
Estimated 16,000 cubic yards of new cedar/biomass annually per project with one new project added each year	0.013

Benefits

Biochar is a carbon-rich, highly stable soil amendment that improves soil health and can store carbon in soils for long periods of time. The granular character of biochar improves soil structure, and it has a complex, highly porous structure that attracts and holds moisture, nutrients such as nitrogen and phosphorus, and agrochemicals. The intricate pores also provide a secure habitat for beneficial soil microbes and fungi. Because of these properties, biochar can improve soil moisture, improve fertility, improve crop yield, and reduce nitrogen fertilizer runoff and groundwater contamination.

Biochar can drastically reduce wood waste through conversion into a beneficial material, and help with sustainable agricultural practices (increase crop yields, decrease synthetic fertilizer use, and improve water retention of soils). Additionally, it can help with woody invasive species management for grassland and rangeland.

Authority and Administration

The Nebraska Department of Environment and Energy (NDEE) would administer this program. NDEE has the authority to apply for and administer EPA grant funds.

Milestones and Metrics for Tracking Progress

NDEE would implement an annual program soliciting applications and awarding projects to applicants, with a goal of awarding funds for a total of five projects by 2030. Quarterly reports would track the progress of each project, the number of projects completed, total project costs, and program expenditures.

Other Funding Sources

Other funding sources include USDA Wood Innovations Grant Program, USDA Community Wood Grant Program, and USDA-NRCS EQIP.

References

1 Buss, W., C. Wurzer, D.A.C. Manning, E.J. Rohling, J. Borevitz, and O. Mašek, 2022. Mineral-enriched biochar delivers enhanced nutrient recovery and carbon dioxide removal. *Nature Communications Earth & Environment*, 3:67. https://www.nature.com/articles/s43247-022-00394-w

2 https://beef.unl.edu/beefwatch/2022/science-guide-outlines-new-approach-reducing-eastern-redcedar

Low-Income/Disadvantaged Communities Benefit Analysis

Implementation of the measures in this PCAP are anticipated to provide significant benefits to low-income and disadvantaged communities (LIDACs). Many of the emissions reduction measures included in this plan may have co-benefits localized to the area where the measure is implemented. This section identifies LIDACs in Nebraska, how NDEE meaningfully engaged with LIDACs in the development of this PCAP, and how implementation of the PCAP will benefit LIDACs.

Identification of and Engagement with LIDACs

The priority measures included in this PCAP not only reduce GHG emissions, but also provide opportunities to address public health inequities for those living in areas most impacted by climate change. There is a higher rate of incidence of heart disease, cancer, obesity, and diabetes in LIDACs. By addressing public health through climate policy implementation, the cost of climate mitigation and adaptation efforts are reduced.

The EPA Climate Pollution Reduction Program requires meaningful outreach to LIDACs. NDEE identified LIDACs using the White House Council on Environmental Quality's Climate and Economic Justice Screening Tool (CEJST) along with the EPA Environmental Justice Screening Tool (EJScreen) using criteria set by EPA for this grant program. These tools assess the impacts of various environmental, health, social, and climate factors on low-income areas.

As determined by EPA for the purpose of the CPRG, low-income and disadvantaged communities are defined as any community that is identified as disadvantaged by CEJST. This tool uses datasets as indicators of burden in eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. CEJST uses these factors to identify communities that are overburdened and underserved so they can be prioritized for benefits under the Nebraska climate plan.

These communities are particularly vulnerable to the climate impacts and risks that Nebraska is facing, including drought, wildfire, extreme weather events, flooding, and extreme heat. This PCAP aims to deliver equitable GHG reductions for LIDACs while also improving public health, promoting economic development, creating jobs, building resiliency, increasing energy efficient housing, and helping LIDACs reduce their energy burden.

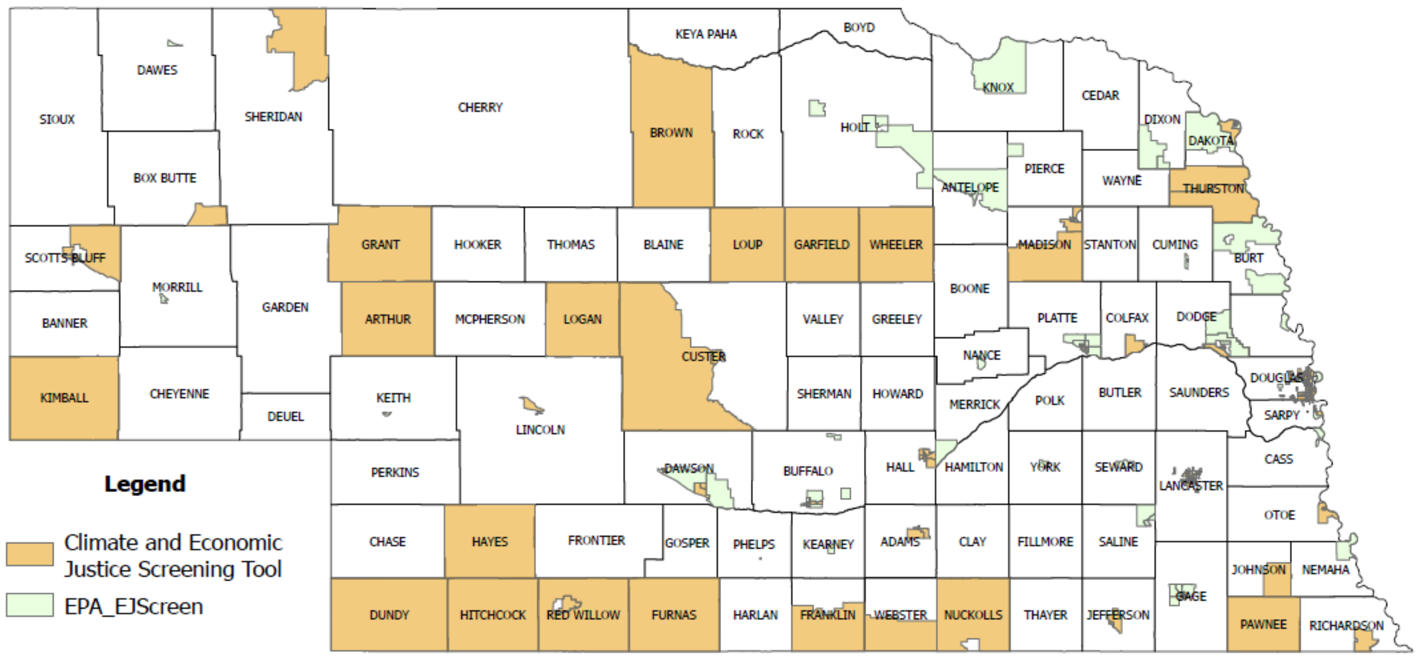
Nebraska's LIDACs include both urban and rural areas:

- 59 of the 93 Nebraska counties include LIDACs
- 14 entire rural counties are designated as disadvantaged
- 100 municipalities in mostly rural counties are designated as LIDAC in their entirety
- 25 additional municipalities are partial LIDAC

These areas cover 21% of the land area of the state and are home to 32.5% of the population. The LIDACs in counties outside of the Omaha-Council Bluffs Metropolitan Statistical Area, which has its own Climate Pollution Reduction Grant, are home to 20.8% of the state's population. Furthermore, Nebraska has 14 entire counties that are considered LIDAC. Those 14 counties are rural and all have experienced population losses from 1980-2020. For example, since 2020, Dundy County in southwest Nebraska has lost 17.6% of its population.

The comprehensive dataset shows a complex landscape of challenges faced by low-income disadvantaged communities in Nebraska. Broken down by race, 56.4% of LIDACs in Nebraska are White, 11% are Black or African American, 11% are Hispanic or Latino, 2.5% are Asian, and 1.7% are American Indian/Other. A statewide map of LIDACs is shown in Figure 7. The complete list of identified LIDACs with Census Tract ID numbers is provided in Appendix B.

The U.S. Census Bureau's American Community Survey defines "low income" as the percent of a census tract's population in households where the household income is at or below 200% of the federal poverty level. The CEJST tool described earlier identifies communities as disadvantaged if they are in census tracts that are at or above the 90th percentile for metrics related to health, housing, and energy as well as communities at or above the 65th percentile for low income.



Entire Counties in Nebraska Designated as Low-Income and Disadvantaged Communities				
Arthur	Furnas	Hayes	Logan	Thurston
Brown	Garfield	Hitchcock	Loup	Wheeler
Dundy	Grant	Kimball	Pawnee	

Figure 7. Nebraska Census Areas Designated as Low-Income and Disadvantaged by the Climate and Economic Justice Screening Tool (CEJST) and EPA Environmental Justice Screening Tool (EJScreen)

Existing Climate Risks, Impacts, and Vulnerabilities among LIDACs

Climate risks, impacts, and vulnerabilities faced by low-income disadvantaged communities in Nebraska include the following:

Climate Risks

- *Extreme weather events*—LIDACs are particularly vulnerable to the increasing frequency and intensity of extreme weather events, including storms, tornadoes, floods, and heatwaves. Low-income communities are at increased risk to be affected by the weather event due to lack of weatherization and resiliency infrastructure available along with a lack of rebuilding capacity.

- *Agricultural Disruptions*—Climate change poses a significant threat to agriculture, affecting the livelihoods of residents in LIDACs. Changes in precipitation patterns and temperature extremes can impact crop yields and livestock. Heat waves, droughts, and other extreme weather events can negatively affect agriculture by decreasing crop yields, killing plants and livestock, and decreasing soil health. Low-income, rural communities that are supported by the agriculture industry are at risk of losing the livelihoods of residents as well as the risks to human health from extreme weather. Furthermore, increases in food prices that result from the effects of extreme seasonal weather on the agricultural industry disproportionately affect low-income Nebraskans.

Climate Impacts

- *Health Concerns*—Higher temperatures and increased frequency of extreme weather events can lead to health risks, especially for vulnerable populations. Heat-related illnesses, vector-borne diseases, and respiratory issues may become more prevalent. According to the Center for Disease Control, 8.2% of Nebraskans already suffer from asthma. And according to the American Heart Association, the leading cause of death in Nebraska is heart disease. As an example, these health issues are often triggered by smoke from wildfires. Nebraska's air quality was impacted by wildfires in 2023. Air quality impacts from wildfire smoke can extend over a large area and impact both rural and urban communities at any time of the year.
- *Water Scarcity*—Like many states in the Midwest, Nebraska faces constant challenges with water scarcity. In early 2023, 100% of the state was under some form of drought, with 84% of the state under a severe, extreme, or exceptional drought.[1] Changes in precipitation patterns and increased temperatures can lead to water scarcity, impacting public health, agriculture, and food security.
- *Economic Strain*—Not surprisingly, agriculture is Nebraska's leading industry. Production agriculture contributes more than $25 billion to Nebraska's economy each year.[2] According to the Nebraska Department of Agriculture, farms and ranches utilize approximately 90% of Nebraska's total land area. Furthermore, one in four jobs in Nebraska are related to agriculture. Agricultural loss due to climate-related factors can further strain the economic conditions of LIDACs. Reduced crop yields and damage to infrastructure can hinder economic opportunities in LIDAC communities.

Climate Vulnerabilities

- *Housing Vulnerability*—The risk of floods can result in housing vulnerability for LIDACs. Many residents may lack the means to rebuild or relocate after climate-related disasters.
- *Limited Adaptive Capacity*—LIDACs may have limited resources and infrastructure to adapt to changing climate conditions. This includes inadequate healthcare facilities in rural areas, emergency response systems, and financial resources. Ongoing shortages in the healthcare workforce exist across rural Nebraska—14 of the state's 93 counties do not have a primary care physician.[3]

Engagement with LIDACs to Understand Community Priorities

Because LIDAC communities are located throughout Nebraska in both rural and urban areas, NDEE's approach for meaningful engagement followed a general outreach strategy. NDEE specifically reached out to municipalities, non-profit groups, other government agencies, Tribes, and directly to residents of the state through press releases to inform communities about the state-wide climate plan and to solicit project ideas to include in the plan. Identified participants include state agencies, city and county staff, regional planning organizations, non-profit organizations, educational institutions, and more.

NDEE's outreach plan included a virtual kick-off meeting open to everyone and announced in a press release and on social media. The kick-off meeting focused on a detailed presentation of the planning process, a review of Nebraska's GHG emissions compared to national emissions, and a broad appeal for input, feedback, and participation. That was followed by first-round virtual meetings for each sector, with Industry and Waste & Wastewater being combined for a total of five meetings. The University of Nebraska-Lincoln Public Policy

Center assisted in planning the meetings as well as providing a moderator and note-takers. The sector meetings included an overview of CPRG along with some possible GHG reduction measures. There was time for discussion of those measures as well as opportunities to propose new measures. NDEE then held a second round of virtual meetings focused on the five working groups to invite additional ideas and to rank the priority of GHG measures. NDEE reached approximately 500 people through the sector meetings.

Following the sector-specific meetings, NDEE's outreach turned to five in-person public meetings across the state in rural and urban areas. The public meetings were designed to gather feedback across the state and to allow the public to identify new measures and prioritize existing measures. The meeting locations are shown in Figure 8. Potential participants were researched and targeted with agency listservs and press announcements. The meeting in Lincoln was a joint meeting with the City of Lincoln to explain and discuss the city's climate plan as well as the state-wide plan.

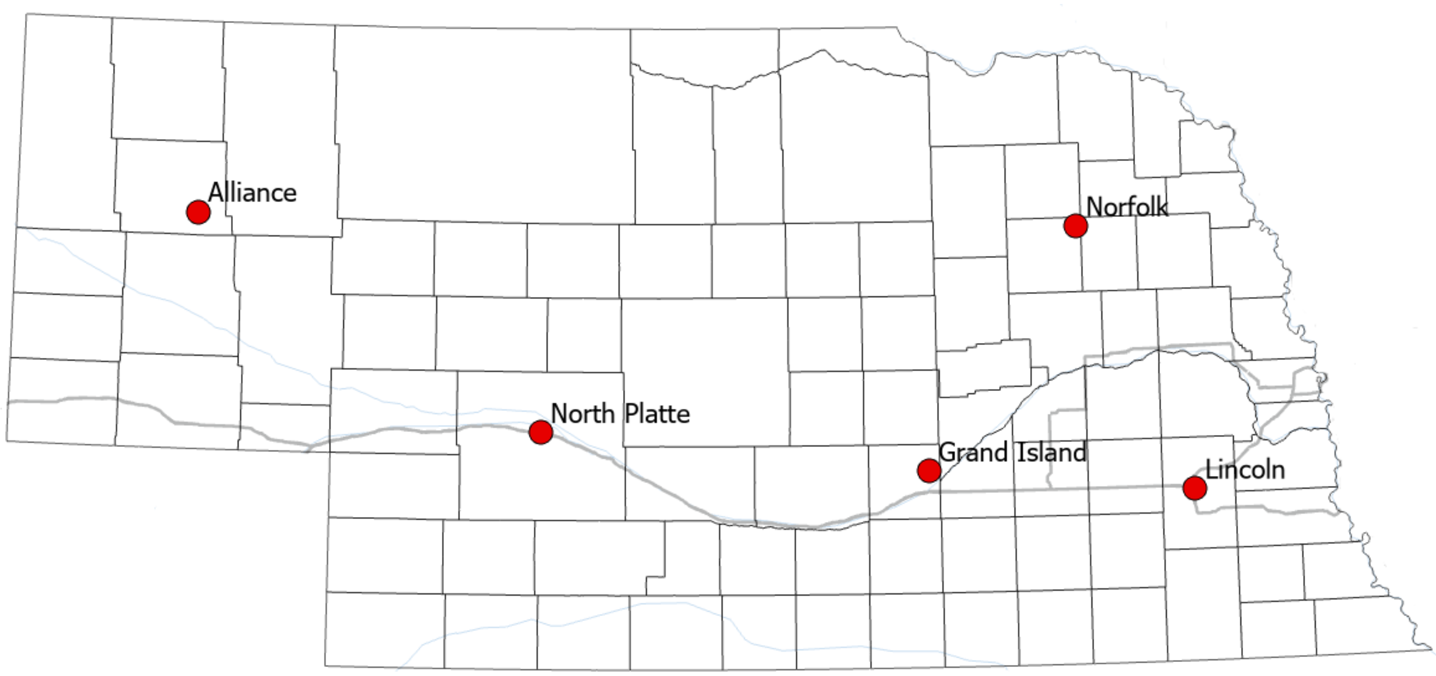


Figure 8. Locations of In-Person Public Meetings Held in Nebraska

The NDEE's strategy for public meetings included a staff presentation that focused on an overview of the CPRG grant, a brief video in support from Nebraska Gov. Jim Pillen, an explanation of the process and deliverables required, and a summary of feedback received so far. The meetings included collaborative brainstorming segments aimed at formulating and prioritizing projects ideas. The meetings included a discussion of each community's specific needs and a question-and-answer session. The public meetings were centered around 11 large posters displayed on easels. These posters included GHG pie charts, visuals and detail for each priority measure, and an opportunity for the community to vote on priorities using colored dots. Agency staff discussed the posters with the public and answered questions one on one. For the public meetings, NDEE translated key documents into Spanish and offered translation, interpreters, and other needed accommodations to make meetings as accessible as possible. Through public meetings, NDEE reached approximately 105 individuals.

Strategies for engagement with LIDACs include the following:

- NDEE CPRG website on main page
- Email lists
- Social Media
- A virtual kick-off meeting
- Press releases for five public meetings
- Forms for submitting ideas
- Forms for prioritizing measures

- Five in-person community meetings across the state
- Holding meetings in trusted, easily accessible locations
- 10 online meetings; two for each working group
- Numerous meetings with interested persons and organizations
- Targeted outreach to community-based organizations
- PowerPoints and flyers made available at meetings
- Key documents translated into Spanish for public meetings
- Public comment on the draft plan

Estimated Potential Benefits of GHG Emissions Reduction Measures to LIDACs

While it's difficult to estimate the associated benefits to LIDACs quantitatively, the following descriptions qualitatively describe expected benefits to LIDACs as a result of grant measures:

- Less pollution in the ambient air due to expected reductions of GHG, criteria air pollutants, and toxic air pollutants at the county level in identified LIDAC communities.

- Financial benefits from residential energy efficiency resulting in decreased energy costs. According to the Energy Information Administration, the average monthly electric bill in Nebraska in 2021 was $108. The expected energy efficiency savings for residential homes is 20%, which saves LIDAC money to be used for groceries and other needs.

- Increased crop yields for producers under some of the Agriculture sector grant measures could result in lower food prices for LIDACs.

- It is anticipated that a number of jobs will be created in identified communities as a result of the grant measures. In Nebraska, unemployment is low, but underemployment is high and rising. According to the U.S. Bureau of Labor Statistics, the unemployment rate for the eligible workforce decreased from 4.4% in 2020 to 2.8% in 2021, while underemployment rose from 2.9% in 2020 to 3.8% in 2021. The unemployment rate has continued to decrease. In August of 2023, the unemployment rate was 2.0%. Nebraska ranked sixth for low employment. Residents are working, but a large segment of the population is underemployed. The grant measures could help acquire a highly trained workforce in energy efficiency and other areas. These measures could help underemployed Nebraskans secure high paying jobs.

- It is anticipated that some of the grant measures will spend funds to train LIDAC residents in clean energy job training programs or apprenticeship programs.

- For the anaerobic digesters, some of which could be located in or near LIDAC areas, local community benefits include protections of animal and human health by reducing pathogens; increasing production of biogas, which lessens the agriculture sector's dependence on fossil fuels; and reducing odors from livestock manure.[4]

- Some of the grant measures will result in energy savings or reductions in fuel use by disadvantaged communities.

Strategies to Overcome Barriers to Participation

Nebraska's CPRG planning funds can be used to help overcome barriers to engagement. Funds are available for translation services, refreshments, and event space rental, as well as participation in community events. A combination of in-person and virtual events helped overcome the barrier of geographic representation, especially in rural areas, ensuring that individuals can attend, even if they cannot physically get to a location. In selecting meeting locations, Nebraska considered places that are trusted by the community, such as local libraries and community colleges, and readily accessible by community members.

Nebraska found that the largest barrier to participation was EPA's aggressive timeline required for delivery of the PCAP by March 1, 2024. For the Comprehensive Action Plan due to EPA in the summer of 2025, NDEE will use as many strategies for engagement as possible, with focused efforts on low-income and disadvantaged communities.

References

1 https://www.nefb.org/01/16/2024/persistent-drought/#:~:text=Figure%205%20compares%20drought%20maps,%2C%20extreme%2C%20or%20exceptional%20drought.

2 https://nebraska.edu/nuforne/martha-mamo

3 https://nebraska.edu/nuforne/nikki-carritt

4 https://www.epa.gov/agstar/benefits-anaerobic-digestion

Review of Authority

NDEE has reviewed its existing statutory and regulatory authority to implement each priority measure contained in Nebraska's Priority Climate Action Plan (PCAP). Nebraska's PCAP focuses on voluntary, incentive-based measures. No new regulatory authority is given to NDEE by the Climate Pollution Reduction Grants (CPRG), nor is new authority necessary for NDEE to implement the CPRG. NDEE has the existing and ongoing authority to apply for, administer, and subaward federal grants to implement CPRG projects in Nebraska communities under the Nebraska Environmental Protection Act, Neb. Rev. Stat. § 81-1504(4)[1]. NDEE has the authority to "accept, expend, or disburse funds, public or private, made available to it for research studies, demonstration projects, or other activities which are related either to energy conservation and efficiency or development." Neb. Rev. Stat. § 81-1504(40). This includes greenhouse gas (GHG) reduction, energy efficiency, renewable energy, methane emission reduction, and other energy conservation and saving measures. NDEE has further authority "To develop and disseminate transparent and objective energy information and analysis" and "To actively seek to maximize federal and other nonstate funding and support to the state for energy planning". Neb. Rev. Stat. § 81-1504(48), (49). Governor Pillen has designated NDEE to be the lead agency for the CPRG. The PCAP measures are consistent with the NDEE's mission to preserve and protect the state's natural resources.

References

1 Neb. Rev. Stat. § 81-1504 (4) authorizes NDEE "To act as the state water pollution, air pollution, and solid waste pollution control agency for all purposes of the Clean Water Act, as amended, 33 U.S.C. 1251 et seq., the Clean Air Act, as amended, 42 U.S.C. 7401 et seq., the Resource Conservation and Recovery Act, as amended, 42 U.S.C. 6901 et seq., and any other federal legislation pertaining to loans or grants for environmental protection and from other sources, public or private, for carrying out any of its functions, which loans and grants shall not be expended for other than the purposes for which provided." [Emphasis added]

Closing and Next Steps

Reducing GHG and co-pollutants is a long-term effort necessary for the health and well-being of Nebraska communities, economies, and natural environments. The priority actions identified here through community and stakeholder engagement are the next steps to support GHG reductions in Nebraska. There is already significant investment happening on many fronts. Looking ahead, Nebraska will use voluntary, incentive-based measures along with grants and other financial resources to promote these incentives. The public health, environmental, and economic values of these investments will be evident near-term and will continue to guide decision-making long term.

This PCAP is the first deliverable under the CPRG planning grant award. The NDEE will continue the next phase and develop a state-wide Comprehensive Climate Action Plan. We will update the state's greenhouse gas emission inventory, continue comprehensive community engagement, and evaluate additional opportunities in all sectors in order to improve air quality and public health, benefit disadvantaged communities, improve access to services and amenities, reduce energy costs, strengthen the state's climate resilience, and develop a workforce with good jobs for Nebraska residents.

Appendix A
Nebraska GHG Inventory

The Nebraska Department of Environment and Energy has adopted for this plan the state-level estimates compiled by the EPA for 2021. In this inventory waste and materials management and wastewater treatment activities are listed as appropriate within the various sectors.

Table 1 details greenhouse gas emissions in million metric tons (MMT) of carbon dioxide equivalents (CO_2e) for sources in all economic sectors. Table 2 details emissions of specific greenhouse gases across all sectors.

The following potential source types listed in the EPA national inventory are not listed in Tables 1 and 2:

1. Sources listed by EPA as not occurring in Nebraska
2. Sources indicated by EPA as not exceeding emissions of 0.005 MMT CO_2e

Sector/Source	Base Year 2021
Transportation	**13.452**
CO_2 from Fossil Fuel Combustion	13.109
Substitution of Ozone Depleting Substances	0.180
Mobile Combustion	0.089
Non-Energy Use of Fuels	0.075
Electric Power Industry	**20.248**
CO_2 from Fossil Fuel Combustion	19.790
Stationary Combustion	0.326
Electrical Equipment	0.116
Other Process Uses of Carbonates	0.016
Industry	**9.591**
CO_2 from Fossil Fuel Combustion	6.508
Natural Gas Systems	1.136
Non-Energy Use of Fuels	0.099
Petroleum Systems	0.086
Cement Production	0.418
Substitution of Ozone Depleting Substances	0.179
Ammonia Production	0.228
Nitric Acid Production	0.018
Abandoned Oil and Gas Wells	0.034
Wastewater Treatment	0.524

Table A-1. Nebraska GHG Emissions in MMT CO_2E by Sector[1]

Sector/Source	Base Year 2021
Industry Continued	
Mobile Combustion	0.063
Urea Consumption for Non-Agricultural Purposes	0.029
Mobile Combustion	0.063
Carbon Dioxide Consumption	0.029
N_2O from Product Uses	0.022
Stationary Combustion	0.016
Other Process Uses of Carbonates	0.016
Landfills (Industrial)	0.151
Agriculture	**35.731**
N_2O from Agricultural Soil Management	17.563
Enteric Fermentation	12.713
Manure Management	3.449
CO_2 from Fossil Fuel Combustion	1.771
Urea Fertilization	0.207
Mobile Combustion	0.054
Field Burning of Agricultural Residues	0.027
Commercial	**3.700**
CO_2 from Fossil Fuel Combustion	2.064
Landfills (Municipal)	1.083
Substitution of Ozone Depleting Substances	0.315
Wastewater Treatment	0.199
Composting	0.028
Stationary Combustion	0.011
Residential	**2.666**
CO_2 from Fossil Fuel Combustion	2.431
Substitution of Ozone Depleting Substances	0.206
Stationary Combustion	0.030
Total Emissions (Sources)	**85.392**
Land-Use, Land-Use Change, and Forestry (LULUCF) Sector Net Total	**(4.474)**
Net Emissions (Sources and Sinks)	**80.919**

Table A-1 continued. Nebraska GHG Emissions in MMT CO_2e by Sector

Gas/Source	Base Year 2021
CO_2	**46.792**
Fossil Fuel Combustion	45.619
Electric Power Sector	*19.790*
Transportation	*13.109*
Industrial	*8.226*
Residential	*2.431*
Commercial	*2.064*
Non-Energy Use of Fuels	0.175
Natural Gas Systems	0.020
Cement Production	0.418
Other Process Uses of Carbonates	0.033
Carbon Dioxide Consumption	0.029
Iron and Steel Production & Metallurgical Coke Production	0.033
Ammonia Production	0.228
Urea Consumption for Non-Agricultural Purposes	0.029
Urea Fertilization	0.207
International Bunker Fuel [1]	0.109
Wood Biomass, Ethanol, and Biodiesel Consumption[2]	1.015
CH_4	**17.573**
Natural Gas Systems	1.115
Petroleum Systems	0.082
Enteric Fermentation	12.713
Manure Management	1.805
Field Burning of Agricultural Residues	0.020
Landfills	1.234
Wastewater Treatment	0.586
Composting	0.016
N_2O	**19.921**
Stationary Combustion	0.338
Mobile Combustion	0.181
Nitric Acid Production	0.018
Manure Management	0.181
Agricultural Soil Management	17.563
Field Burning of Agricultural Residues	0.007
Wastewater Treatment	0.137
N_2O from Product Uses	0.022
Composting	0.012

Table A-2. Nebraska GHG Emissions in MMT CO_2e by Gas[2]

Gas/Source	Base Year 2021
HFCs, PFCs, SF_6 and NF_3	**0.996**
HFCs	**0.879**
Substitution of Ozone Depleting Substances[3]	0.879
PFCs	**<0.005**
Substitution of Ozone Depleting Substances[3]	<0.005
SF_6	**0.116**
Electrical Equipment	0.116
NF_3	**None**
Total (Sources) Emissions	**85.392**
LULUCF Emissions[4]	**0.988**
LULUCF CH_4 Emissions	0.972
LULUCF N_2O Emissions	0.017
LULUCF Carbon Stock Change[5]	**(5.462)**
LULUCF Sector Net Total[6]	**(4.474)**
Net Emissions (Sources and Sinks)[7]	**80.919**

[1] Emissions from international bunker fuels are not included in totals.

[2] Wood biomass, ethanol, and biodiesel consumption emissions are not included in the sum of Energy sector totals. Net carbon fluxes from changes in biogenic carbon reservoirs are accounted for in LULUCF estimates.

[3] Small amounts of PFC emissions also result from this source.

[4] LULUCF emissions of CH_4 and N_2O are reported separately from gross emissions totals.

[5] LULUCF Carbon Stock Change is the net C stock change from the following categories: Forest Land Remaining Forest Land, Land Converted to Forest Land, Cropland Remaining Cropland, Land Converted to Cropland, Grassland Remaining Grassland, Land Converted to Grassland, Wetlands Remaining Wetlands, Land Converted to Wetlands, Settlements Remaining Settlements, and Land Converted to Settlements.

[6] The LULUCF Sector Net Total is the net sum of all CH_4 and N_2O emissions to the atmosphere plus net carbon stock changes.

[7] Net emissions include LULUCF.

Table A-2 continued. Nebraska GHG Emissions in MMT CO_2e by Gas

References

1 Data were obtained from EPA's State-level GHG inventories file State-GHG_Trends_Emissions__Sinks_By_Gas_08312023.xlsx, which was accessed on 1/12/2024. This data set is available at https://www.epa.gov/ghgemissions/state-ghg-emissions-and-removals.

Appendix B
List of Nebraska LIDAC

Census Tracts from the Climate and Economic Justice Screening Tool (CEJST) and Census Block Groups from the EPA Environmental Justice Screening Tool (EJScreen) not included in CEJST tracts.

County	CEJST	EJScreen
Adams	31001966100 31001966000	310019655002 310019657001 310019658001 310019658002 310019658003 310039796001 310039797002
Arthur	31005958300	
Box Butte	31013951300	
Brown	31017975000	
Buffalo	31019969300 31019969500	310199689003 310199691004 310199692031 310199692032 310199692033 310199694001 310199694002 310199694003 310199694004 310199696001 310199696002 310199696004 310199697001 310199697002
Burt		310219634001 310219633002
Cass		310259656003 310259661002 310259661003
Colfax	31037964800	310379648001
Cuming		310399728002 310399728004

Table B-1. List of Nebraska LIDAC

County	CEJST	EJScreen
Custer	31041971800 31041971900	
Dakota	31043010300	310430101011 310430101012 310430101021 310430101022 310430101023 310430102001 310430102002 310430102004 310430104001 310459507004
Dawson	31047968500 31047968400	310430101011 310430101012 310430101021 310430101022 310430101023 310430102001 310430102002 310430102004 310430104001 310459507004
Dixon		310519778002 310519778004
Dodge	31053964000 31053964200 31053964400	310539636002 310539638001 310539638002 310539643003 310539643004

Table B-1 continued. List of Nebraska LIDAC

County	CEJST	EJScreen
Douglas	31055000400 31055002100 31055002500 31055002600 31055007434 31055004200 31055003200 31055005800 31055007003 31055000700 31055005902 31055006303 31055005300 31055005901 31055006505 31055003401 31055004000 31055000200 31055000800 31055002400 31055002700 31055002000 31055000300 31055001200 31055006000 31055005100 31055005200 31055006302 31055007101 31055007312 31055002300 31055002800 31055002900 31055005400 31055006101 31055006202 31055001100 31055004900 31055003000 31055003900 31055005700 31055006102 31055006506 31055007102 31055003800 31055000600 31055003300	310550005001 310550016001 310550016002 310550018004 310550019002 310550022001 310550031001 310550031002 310550031003 310550031004 310550043002 310550048002 310550050001 310550050002 310550050003 310550056002 310550063012 310550064004 310550065043 310550066031 310550066032 310550068062 310550068063 310550070013 310550070022 310550070024 310550073091 310550073112 310550074062 310550074243 310550074361 310550074444 310550074452 310550074552 310550074562 310550074573 310550074581 310550074661 310550074663 310550074672 310550074674 310550074731
Dundy	31057962300	
Franklin	31061964700	
Furnas	31065963900	

Table B-1 continued. List of Nebraska LIDAC

County	CEJST	EJScreen
Gage	31067965000 31067965100	310679648002 310679648003 310679648004 310679649001 310679649002 310679649004
Garfield	31071973200	
Grant	31075956300	
Hall	31079000400 31079000700 31079001000 31079001100 31079000900 31079000200	310790003001 310790003003 310790003004 310790003005
Hayes	31085961500	
Hitchcock	31087962700	
Holt		310899741001 310899742002 310899743001 310899743002 310899743003 310899743004
Jefferson	31095963700 31095963800	
Johnson	31097967600	
Kearney		310999667002
Keith	31101000100	311010002002
Kimball	31105954500	
Knox		311079764002

Table B-1 continued. List of Nebraska LIDAC

County	CEJST	EJScreen
Lancaster	31109003202 31109000300 31109002200 31109001700 31109001800 31109000800 31109003003 31109003104 31109000400 31109002100 31109002001 31109002002 31109003103	311090001002 311090001003 311090002011 311090002021 311090002022 311090002023 311090005001 311090005002 311090006004 311090007001 311090007002 311090009001 311090009003 311090010012 311090010032 311090014001 311090014003 311090015003 311090016002 311090019001 311090019002 311090023002 311090027011 311090027025 311090029002 311090029003 311090030021 311090030023 311090030051 311090033011 311090034022 311090034023 311090037043
Lincoln	31111959900	311119602001 311119602002 311119605003
Logan	31113957500	
Loup	31115972800	

Table B-1 continued. List of Nebraska LIDAC.

County	CEJST	EJScreen
Madison	31119960700 31119960900 31119961000 31119961100 31119961300	311199606002 311199608012
Merrick		311219667001
Morrill		311239525003
Nance		311259661002
Nemaha		311279681001
Nuckolls	31129960000	
Otoe	31131966900 31131967000	
Pawnee	31133967800	
Platte	31141965600	311419653011 311419653012 311419653021 311419653022 311419653023 311419654001 311419654002 311419654003 311419655002 311419655003 311419655004 311419655005 311419657003 311419657004
Red Willow	31145963300 31145963100	
Richardson	31147968600	
Saline		311519606012 311519606021 311519606022

Table B-1 continued. List of Nebraska LIDAC.

County	CEJST	EJScreen
Sarpy	31153010402	311530101052 311530101053 311530101063 311530101081 311530102041 311530103021 311530104011 311530104012 311530105022 311530105032 311530105033 311530105051 311530105052 311530105054 311530106141 311530106143 311530106215
Scotts Bluff	31157952900 31157953300 31157953700 31157953600	311579535003 311579538002 311579539001
Seward		311599602001
Sheridan	31161951600	
Thurston	31173940200 31173940100	
Washington		311770501022
Wayne		311799787004
Webster	31181965100	
Wheeler	31183973600	
York		311859697002

Table B-1 continued. List of Nebraska LIDAC.

Appendix C
GHG Reduction Methodology

Promote Energy Efficiency and Electrification Upgrades for Non-Residential Facilities

To estimate emissions reductions for non-residential energy efficiency projects, NDEE selected a group of cost-effective measures from program data provided by the Nebraska Public Power District, Lincoln Electric System, and the Nebraska Industrial Assessment Center and estimated the number of projects that could be carried out annually for each.

For measures that reduce electricity consumption, the annual reductions in emissions of CO_2, SO_2, and NOx from reduced electricity generation were calculated for each measure using the EPA AVERT tool.[1] These calculations were performed using the central region data file to represent generation resources available in all but four low-population counties in western Nebraska. Emissions reductions for all measures were summed to determine the annual totals, and the same number of each project type were assumed to be undertaken each year for the five-year program period beginning in 2025.

Action	Annual Energy Savings per Unit (kWh)	Modeled Annual Num. of Incentives	Modeled Annual Energy Savings (GWh)	AVERT CO_2 Reductions (metric tons)	AVERT SO_2 Reductions (lbs)	AVERT NOx Reductions (lbs)
Energy Management System	22,481	100	2.248	1,833.2	3,100	2,840
Variable Frequency Drive (VFD)	65,191	25	1.630	1,323.5	2,250	2,040
VFD Air Compressor	47,694	10	0.477	346.0	650	560
Air Compressor Optimization	240,000	10	2.400	1,958.7	3,310	3,030
Prescriptive Ind/Ag Lighting	21,929	100	2.193	1,787.0	3,030	2,760
Corner Pivot VFD	51,529	50	2.576	2,099.4	3,550	3,250
Hog Heat Mat	144,900	20	2.898	2,372.0	4,000	3,660
Automate refrigeration pressure control	674,431	20	13.489	11,118.5	18,610	17,100
Upgrade HVAC Unit	381,677	10	3.817	3,134.3	5,260	4,820
Economizers for Rooftop Air Handlers	210,762	10	2.108	1,719.5	2,910	2,650
TOTAL				**27,692.2**	**46,670.0**	**42,710.0**

Table C-1. Annual Emissions Reductions for Energy Efficiency Actions Reducing Electricity Consumption

Year	Cumulative CO_2 Reductions by Year (metric tons)	Cumulative CO_2 Reductions by Year (MMT)	Cumulative NOx Reductions by Year (tons)	Cumulative SO_2 Reductions by Year (tons)
2026	27,692	0.0277	21.36	23.34
2027	83,077	0.0831	64.07	70.01
2028	166,153	0.1662	128.13	140.01
2029	276,922	0.2769	213.55	233.35
2030	415,383	0.4154	320.33	350.03

Table C-2. Cumulative Net Emissions Reductions by Year Through 2030 for Energy Efficiency Actions Reducing Electricity Consumption

For measures that reduce natural gas consumption, a CO_2 emission factor of 53.06 kg/million BTU (0.005306 metric tons/therm) for natural gas fuel use from the U.S. Department of Energy MEASUR on-line assessment tool[2] was used to calculate annual greenhouse gas emission reductions for each type of action. For emissions reduction through 2030, NDEE assumed that five projects in each category would be carried out each year during a five-year program beginning in 2025, with cumulative emissions computed for 2026 through 2030.

Action	Annual Energy Savings (therms)	Annual GHG Reduction per Unit (metric tons CO_2e)	Annual GHG Reduction for 5 Units (metric tons CO_2e)
Upgrade Boiler Economizer	261,000	1,384.9	6,924.3
Boiler Replacement	188,180	998.5	4,992.4
Replace Boiler with Water Heater	840,000	4,457.0	22,285.2
Economizer for Heat Recovery	153,980	817.0	4,085.1
TOTAL	**1,443,160**	**7,657**	**38,287.0**

Table C-3. Annual Emissions Reductions for Energy Efficiency Actions Reducing Natural Gas Consumption

Year	Cumulative GHG Reductions by Year (metric tons CO_2e)	Cumulative GHG Reductions by Year (MMT CO_2e)
2026	38,287.0	0.038
2027	114,861.1	0.115
2028	229,722.2	0.230
2029	382,870.3	0.383
2030	574,305.5	0.574

Table C-4. Cumulative Net Emissions Reductions by Year Through 2030 for Energy Efficiency Actions Reducing Natural Gas Consumption

Incentives for Home Energy Efficiency Equipment Upgrades for Low- and Middle-Income Homeowners

Greenhouse gas emissions reductions were calculated as the difference between installation of new, high-efficiency natural gas-fueled equipment and air-source heat pump equipment with similar capacity.

Whole-Home Air-Source Heat Pumps

Calculations for whole-home heat pumps were carried out by Resilient Electric Analytics in a study for the City of Lincoln, Nebraska. The study made the following assumptions:

Average Lincoln home: 2,400 sq ft, 20+ yrs old.
Climate Control Sizing Needs - Heating: 50,000 BTU.
Replacement Gas furnace Annual Fuel Utilization Efficiency > 97%.
Replacement Air-Source Heat Pump Heating Seasonal Performance Factor (HSPF2) > 8.5
Climate Control Sizing Needs – Cooling: 25 ton.
Central AC & Air Source Heat Pump Seasonal Energy Efficiency Rating 2 (SEER2) > 15.2.

Using these parameters, the study calculated that use of an air-source heat pump produced an annual reduction in CO_2 emissions of 2.87 tons, or 2.6 metric tons. NDEE used the latter figure to compute the annual emissions reductions for installation of 8,000 whole-house heat pumps over a five-year period (1,600 annually).

Year	Cumulative Number of Units	Annual CO_2 Reduction per Unit (metric tons)	Annual CO_2 Reduction (metric tons)	Annual CO_2 Reduction (MMT)
2026	1,600	2.6	4,160	0.004
2027	3,200	2.6	8,320	0.008
2028	4,800	2.6	12,480	0.012
2029	5,400	2.6	14,040	0.014
2030	8,000	2.6	20,800	0.021
TOTAL			**59,800**	**0.060**

Table C-5. Annual and Total Cumulative Net Emissions Reductions Through 2030 for Installation of Whole-House Heat Pumps

Heat Pump Water Heaters

Calculations for heat pump water heaters were taken from a study by the New Buildings Institute,[3] taking into account natural gas leakage emissions from gas water heaters and refrigerant leakage from heat pump water heaters.

Baseline Natural Gas Tank Water Heater:

269 Annual therms energy use, per EnergyGuide (1 therm = 100,000 BTU)
1.08% Upstream Leakage
53.11 kg CO_2e/million BTU emissions rate for natural gas combustion
13.21 kg CO_2e/million BTU fugitive natural gas emissions rate
Annual CO_2e Emissions: 1,433 kg

Heat Pump Water Heater:

1,219 kWh annual energy use, per EnergyGuide
360 kg CO_2e/MWh long-run marginal emissions rate
12-year lifespan to annualize end-of-life leakage
0.65 kg of R134a refrigerant charge
2% annual operational leakage rate
80% end-of-life leakage rate
Annual CO_2e Emissions: 519 kg

CO_2e Reduction from Heat Pump Water Heater compared to a Natural Gas Tank Water Heater:
913 kg = 0.913 metric ton. NDEE used the latter figure to compute annual emissions reductions for installation of 5,000 heat pump water heaters over a five-year period (1,000 per year).

Year	Cumulative Number of Units	Annual CO_2 Reduction per Unit (metric tons)	Annual CO_2 Reduction (metric tons)	Annual CO_2 Reduction (MMT)
2026	1,000	0.913	913	0.001
2027	2,000	0.913	1,826	0.002
2028	3,000	0.913	2,739	0.003
2029	4,000	0.913	3,652	0.004
2030	5,000	0.913	4,565	0.005
TOTAL			**13,695**	**0.014**

Table C-6. Annual and Total Cumulative Net Emissions Reductions by Year Through 2030 for Installation of Heat Pump Water Heaters

Residential Pre-Weatherization Program

Weatherization Program Reductions

Many states have Weatherization Assistance Programs that enable low-income families to make energy efficiency improvements to their homes. Weatherization reduces the energy use of these homes, resulting in reduced greenhouse gas emissions from on-site energy use and from generation of electricity. However, many homes are deferred from these activities due to structural or electrical issues. Addressing those deficiencies would allow the home to be weatherized.

A research team at the University of Nebraska developed software for Nebraska's Weatherization Assistance Program (NeWAP) to estimate the energy, economic, and environmental impacts associated with those improvements. A simple input screen allows users to enter information for more than 1,000 different weatherization projects. For each project, expenditures are broken into 12 separate categories. Results from an extensive statistical analysis are then applied to the input data to estimate electricity and natural gas savings derived from those improvements. State-specific energy prices convert the energy savings into dollar values and the present discounted value (PDV) of saved energy is estimated.

The software also estimates the economic and environmental impacts related to the weatherization improvements. Economic measures include both direct and multiplied impacts assessed in terms of output, value added, labor income, and job years created. Environmental measures include reductions in CO_2, SO_2, NOx, $PM_{2.5}$, VOC and PM_{10}, as well as the estimated dollar values of many associated environmental benefits. Present discounted values are calculated for all dollar-denominated measures.

Data from this model from 2012 and 2015 were used to generate average per home reductions in greenhouse gases and co-pollutants. Average values were derived using 6,378 previous weatherization projects. On average, approximately 115 homes are deferred from weatherization programs per year in Nebraska. An assumption that 75 homes would be pre-weatherized and then weatherized per year was made in these calculations. Calculations were carried out using the assumed 75 homes per year over the course of a 5 year cycle.

Year	Cumulative GHG Reductions by Year (metric tons CO_2e)	Cumulative GHG Reductions by Year (MMT CO_2e)	Cumulative NOx Reductions by Year (tons)	Cumulative SO_2 Reductions by Year (tons)
2026	494.287	0.0005	0.70	0.67
2027	1,482.861	0.0015	2.11	2.02
2028	2,965.723	0.0030	4.22	4.04
2029	4,942.871	0.0049	7.03	6.73
2030	7,414.306	0.0074	10.54	10.09

Table C-7. Cumulative Emission Reductions vy Year Through 2030 for Pre-Weatherization Projects

Incentives for Irrigation Well Conversion from Diesel to Electric

Replacing (with scrapping) diesel irrigation engines with surface electric motor or electric submersible pumps eliminates direct emission of greenhouse gases and other pollutants at the wellsite. However, these direct emission reductions are partially offset by emissions associated with the generation of electricity to power the new electric equipment, along with transmission and distribution losses.

Direct emission reductions at the well sites for irrigation engine replacements were calculated using the EPA on-line Diesel Emissions Quantifier.[4] The inputs for these calculations were drawn from the data from 138 previous replacement projects from 2018 through 2022 and the percentage of engines in each diesel emissions tier (uncontrolled and Tier 1 through Tier 3) among those projects. The calculations used the average engine model year for each engine tier along with full dataset averages of engine horsepower, annual operating hours, and annual diesel fuel use.

Tier	Average Model Year	Average Engine Horsepower	Annual Operating Hours	Annual Fuel Use (gallons)	Annual CO_2 Reduction (metric tons)*	Annual NOx Reduction (tons)	Annual $PM_{2.5}$ Reduction (tons)
UNC	1996	144.3	968	4754	48.53	0.567	0.032
1	2000					0.382	0.021
2	2005					0.273	0.014
3	2008					0.166	0.017

* CO_2 reductions computed in tons in the Diesel Emissions Quantifier have been converted to metric tons using the conversion factor 1 short ton = 0.907185 metric tons.

Table C-8. Diesel Irrigation Engine Data and Calculated Average Gross Emission Reductions Per Engine by Diesel Engine Tier from Prior NDEE Engine Replacement Projects 2018-2022

Tier	Percent Total	Number in Tier	Annual CO_2 Reduction (metric tons)*	Annual NOx Reduction (tons)	Annual $PM_{2.5}$ Reduction (tons)
UNC	42.0	21	1019.2	11.907	0.672
1	39.1	20	970.7	7.64	0.420
2	12.3	6	291.2	1.638	0.084
3	6.5	3	145.6	0.498	0.051
TOTAL		**50**	**2,426.7**	**21.68**	**1.227**

* CO_2 reductions computed in tons in the Diesel Emissions Quantifier have been converted to metric tons using the conversion factor 1 short ton = 0.907185 metric tons.

Table C-9. Gross Emissions Reductions Per Year by Diesel Emission Tier from Replacement of 50 Diesel Irrigation Engines

The average annual electricity usage for a replacement electric motor was calculated from the average horsepower of the replacement motors in the prior projects and the average annual operating hours:

Average annual operating hours from prior NDEE projects:	968
Average motor horsepower:	85
Average motor power in kilowatts (0.746 kW/hp):	63.41
Single motor annual electricity use in kilowatt hours (63.41 kW x 968 hrs):	61,381
Single motor annual electricity use in megawatt hours:	61.38

The EPA Emissions and Generation Resource Integrated Database (eGRID)[5] was used to calculate emissions associated with the generation and transmission of the electricity consumed by the average irrigation motor. The calculations followed the procedure outlined in the guidance document Using *eGRID for Environmental Footprinting of Electricity Purchase*.[6] The calculations used output emission rates for the Midwest Reliability Organization (MRO) West subregion and transmission loss rates for the Eastern Interconnect (4.5%).

Greenhouse Gas	Emissions (metric tons)	GWP 100	Emissions MT CO_2e
CO_2	29.03	1	29.031
CH_4	0.0031	28	0.087
N_2O	0.0004	265	0.116
			29.235

Co-pollutants	Emissions (tons)
NOx	0.0242
$PM_{2.5}$	0.0014

Table C-10. Annual Emissions Per Electric Motor from Electricity Generation and Transmission and Distribution Losses

	Annual GHG Reductions (metric tons CO_2e)	Annual GHG Reductions (MMT CO_2e)	Annual NOx Emissions Reductions (tons)	Annual $PM_{2.5}$ Emissions Reductions (tons)
Gross reduction at well site	2,426.72	0.0024	21.68	1.23
Emissions from electricity generation & transmission	1,461.73	0.0015	1.21	0
Net annual emissions reduction	964.99	0.0010	20.47	1.23

Table C-11. Net Annual Emissions Reductions for Electric Replacement of 50 Diesel Irrigation Engines

Year	Cumulative GHG Reduction by Year (metric tons CO_2e)	Cumulative GHG Reduction by Year (MMT CO_2e)	Cumulative NOx Reduction by Year (tons)	Cumulative $PM_{2.5}$ Reduction by Year (tons)
2026	964.99	0.0010	20.47	1.23
2027	2,894.97	0.0029	61.41	3.68
2028	5,789.93	0.0058	122.83	7.36
2029	9,649.89	0.0096	204.71	12.27
2030	14,474.84	0.0145	307.07	18.41

Table C-12. Cumulative Net Emissions Reductions by Year Through 2030 for Electric Replacement of 50 Diesel Irrigation Engines Annually

Incentives for Micro-Solar Arrays for Critical Infrastructure in Low-Income Rural Communities

Emissions reductions were calculated by assuming the addition of 500 kW (0.5 MW) of solar capacity (one to three projects depending on size) annually over a four-year period by 2030. The corresponding annual reductions in emissions from grid electricity generation were calculated using the EPA AVERT tool[1] with the central region data file used to represent generation resources available in all but four low-population counties in western Nebraska.

Annual CO_2 Reduction (metric tons)	Annual CO_2 Reduction (MMT)	Annual NOx Reduction (tons)	Annual SO_2 Reduction (tons)
830	0.0008	0.7	0.67

Table C-13. Net Annual Emissions Reductions for Annual Addition of 0.5 MW Solar Photovoltaic Capacity

Year	Cumulative CO_2 Reduction by Year (metric tons)	Cumulative CO_2 Reduction by Year (MMT)	Cumulative NOx Reduction by Year (tons)	Cumulative SO_2 Reduction by Year (tons)
2027	830	0.001	0.7	0.67
2028	2,490	0.002	2.1	2.0
2029	4,980	0.004	4.2	3.99
2030	8,300	0.008	7.0	6.65

Table C-14. Cumulative Net Emissions Reductions by Year Through 2030

Funding for Solar Projects on Unused/Contaminated Land, Ag & Industrial Facilities, and Parking Lot/Feedlot Solar Canopies

Calculations for this measure assumed the addition of a total of 76.6 MW (76,00 kW) of solar capacity over a five-year period by 2030. Public electrical utility partners provided data and proposals for four specific project types, including the number of projects and power ratings. From this data NDEE constructed a schedule of projects to form the basis of computing annual reductions in emissions from grid electricity generation using the EPA AVERT tool[1] with the central region data file, representing generation resources available in all but four low-population counties in western Nebraska.

Project Type	Total Number of Projects	Total Capacity (kW)	Capacity Per Project (kW)	Number of Projects Year 1	Added Capacity Year 1 (kW)	Annual Number of Projects Years 2-5	Added Annual Capacity Years 2-5 (kW)
Solar at Pivot Corners	1,000	75,000	75	200	15,000	200	15,000
Parking lot solar at CGO	1	150	150	1	150		
Parking lot solar statewide	5	250	50	1	50	1	50
Cattle feedlot solar canopies	12	1,200	100	0	0	3	300
TOTAL		**76,600**			**15,200**		**15,350**

Table C-15. Assumed Addition of Solar Capacity by Type Over a Five-Period

Year	Total Program Solar Capacity (MW)	Annual CO_2 Reduction (metric tons)	Annual CO_2 Reduction (MMT)	Annual NOx Reduction (tons)	Annual SO_2 Reduction (tons)	Annual $PM_{2.5}$ Reduction (tons)
2026	15.2	25,817.5	0.026	21.57	20.28	1.23
2027	30.6	51,962.9	0.052	43.38	40.80	2.47
2028	45.9	77,946.0	0.078	65.06	61.21	3.71
2029	61.3	104,114.1	0.104	86.90	81.80	4.95
2030	76.6	130,111.2	0.130	108.58	102.29	6.19
TOTAL		**389,951.8**	**0.390**	**325.48**	**306.36**	**18.55**

Table C-16. Annual and Total Cumulative Emissions Reductions from Addition of Solar Capacity Over a Five-Year Period

Measures to Reduce Emissions in Agricultural Production

- Establish a Carbon Intensity Score Registry
- Provide Incentives for Regenerative Agricultural Practices
- Provide Incentives for Precision Agriculture Equipment

The Blonk report[7] summarized the primary pathways to reducing-crop related emissions in Nebraska agriculture as follows:

- **"Nitrification inhibitors in corn production:** A 38% reduction in direct nitrous oxide emissions, achievable using existing nitrification inhibitors, across all corn production would mean 1.99 MMT CO_2e year less GHGE.
- **Reduce fuel use in crop cultivation:** A 30% reduction in the diesel consumption in both corn and soybeans combined – through efficiency improvements or shifts to renewable fuels – could reduce emissions by 1.18 MMT CO_2e year
- **Improve N use efficiency in corn production:** 20% less nitrogen fertilizer inputs achieving the same corn production levels would reduce emissions by 0.90 MMT CO_2e year."

If fully realized, these reductions total 4.07 MMT CO_2e annually. While these reduction estimates might have been ambitious given the technology and practices assessed for the production years on which their analysis was based (2018-2020), recent changes related to emissions management and market dynamics make these estimates more reasonably achieved.

As Blonk noted, nitrous oxide emissions and the excess application of anhydrous ammonia are the primary drivers of crop-related emissions. In the production seasons since the report period, the means to significantly reduce nitrous oxide emissions have grown alongside the ability to assess the carbon intensity of corn and soybeans.

Global demand for bio-based, alternative fuels has driven unprecedented research and development around inputs and crop management practices with a goal of achieving net-zero emissions in corn and soybean production. Even when the specific conditions of a farming operation cannot reach net-zero, the use of cover crops, no-till, and reduced fertilizer rates are expected to cut carbon intensity by half, or more.[8]

The Inflation Reduction Act provides significant financial incentives for alternative fuel producers to buy corn and soybeans with low/negative carbon intensity. These market demands will most strongly influence the adoption and implementation of field-level emissions management practices for the harvest years of 2025, 2026, and 2027.[9]

The following assumptions were made in calculating GHG emissions reductions from rapid, widespread adoption of regenerative and precision agriculture as a means of reducing the carbon intensity of corns and soybeans in Nebraska:

- Multiple factors are driving corn and soybean producers to immediately shift to cover crops, reduced till, and substantial reductions in the use of chemical fertilizers.
- Just over half of the emissions reductions anticipated in the Blonk report will be realized by 2025 as a result of producers' shifts in practice since 2020.
- The increased use of CI Scores as a performance metric for corn and soybean production as a result of the CI Score Registry incentives will amplify interest in additional emissions reductions beginning in 2025.
    - o Blonk reported approximately 11.7 MMT CO_2e per year for the Nebraska corn crop. Applying the standard assumed carbon intensity score of 29 g CO_2/MJ for that harvest, every 10-point reduction in the carbon intensity score equates to a reduction of nearly 4 MMT CO_2e per year:

CI Score	Total MMT of CO_2e	MMT CO_2e reduced	% Change
29	11.7	--	--
19	7.65	4.05	-35%
9	3.62	8.08	-69%

Table C-17. Greenhouse Gas Emissions Attributed to Different CI Scores

- o Cumulatively, one billion bushels of corn with a CI score of 15 logged with the CI Score Registry represents a 3.2 MMT CO_2e reduction in GHG emissions.

- Confidence in the profitability of farming with regenerative and precision agriculture will grow through 2030 and routinize and preserve the practices after the lapse of tax credits in 2028.

From these assumptions, the cumulative reduction in GHG gas emissions from corn and soybean production is estimated to be 22 MMT CO_2e through 2030.

Year	Greenhouse Gas Emission Reductions (MMT CO_2e)		
	Corn	Soybeans	Annual Total
2025	1.69	0.40	2.1
2026	2.25	0.53	2.8
2027	3.00	0.71	3.7
2028	4.00	0.95	5.0
2029	4.09	1.07	5.2
2030	4.25	1.27	5.5
TOTAL	**17.59**	**4.54**	**22.13**

Table C-18. Cumulative Net Emissions Reductions by Year For Agricultural Practices Through 2030

Incentives for Alternative-Fuel and Electric Replacement of Diesel Vehicles

NDEE modeled three diesel emission mitigation strategies: electric replacements of diesel school buses, compressed natural gas (CNG) replacements of heavy-duty short-haul diesel trucks, and retrofits of diesel trucks to use B100 biodiesel fuel. Data from previous NDEE programs was used to establish average annual mileage, fuel use, and model year for the vehicle types. The energy use ("fuel economy") of an electric school bus was set as 1.5 kWh/mile.[10]

Emissions reductions were computed using the On-Road Fleet Footprint calculator in Argonne National Laboratory's Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) spreadsheet tool.[11] For each strategy both old and new vehicle parameters are entered, and the tool computes the emissions for each, with the difference being the emissions reductions for carrying out that action.

Vehicle Parameters	School Bus		Heavy-Duty Refuse Truck		Conversion to B100	
	Diesel	Electric	Diesel	CNG	Diesel	B100
Annual Miles	9,000	9,000	20,400	20,400	20,400	20,400
Fuel Economy	6.6 mpg	1.5 kWh/mi	1.7 mi/gal	1.9 mi/gal	1.7 mi/gal	1.7 mi/gal
Annual fuel/energy use	1,360 gal	13,500 kWh	12,000	10,800	12,000	12,000
Vehicle Model Year	2009	2024	2009	2024	2009	2009

Table C-19. Vehicle Parameters for Modeling Emissions Reductions

	GHG (tons)	GHG (metric tons)	NOx (lbs)	Cumulative emissions reductions by year for 20 school bus replacements per year			
				Year	GHG (metric tons)	GHG (MMT)	NOx (tons)
Diesel	18.7	17.0	71.7	2026	176.0	0.0002	0.72
Electric	9.0	8.2	0	2027	528.0	0.0005	2.15
Difference	**9.7**	**8.8**	**71.7**	2028	1,056.0	0.0011	4.30
				2029	1,759.9	0.0018	7.17
20 replacements:		**176.0**	**1,434**	2030	2,639.9	0.0026	10.76

Table C-20. AFLEET Emissions Results for Electric Replacements of Diesel School Buses

	GHG (tons)	GHG (metric tons)	NOx (lbs)	Cumulative emissions reductions by year for 20 CNG replacements per year			
				Year	GHG (metric tons)	GHG (MMT)	NOx (tons)
Diesel	165.2	149.9	176.6	2026	1,090.4	0.0011	1.75
CNG	105.1	95.3	1.9	2027	3,271.3	0.0033	5.24
Difference	**60.1**	**54.5**	**174.7**	2028	6,542.6	0.0065	10.48
				2029	10,904.4	0.0109	17.47
20 replacements:		**1,090.4**	**3,494**	2030	16,356.5	0.0163	26.21

Table C-21. AFLEET Emissions Results for CNG Replacements of Heavy-Duty Local Diesel Trucks

	GHG (tons)	GHG (metric tons)	NOx (lbs)	Cumulative emissions reductions for 50 B100 conversions per year		
				Year	GHG (metric tons)	GHG (MMT)
Diesel	165.2	149.9	225.3	2026	5,125.6	0.0051
B100	52.2	47.4	225.3	2027	15,376.8	0.0154
Difference	**113.0**	**102.5**	**0**	2028	30,753.6	0.0308
				2029	51,256.0	0.0513
50 conversions:		**5,125.6**	**0**	2030	76,883.9	0.0769

Table C-22. AFLEET Emissions Results for Conversion of Heavy-Duty Local Diesel Trucks to B100 Biodiesel

Hub-and-Spoke Anaerobic Digester/Biogas Hubs for Agricultural Waste

Greenhouse gas emissions for Anaerobic Digester/Biogas hubs were split into three calculation pathways:

- The first used the joint EPA and Global Methane Initiative's Anaerobic Digestion Screening Tool,[12] Version 2.3 to calculate the emission reductions from the process of capturing biogas and producing renewable natural gas that can reduce the use of fossil-fuel natural gas.
- The second used the USDA NRCS Comet-Planner tool[13] to calculate emissions reductions from replacing synthetic fertilizer with land-applied digestate generated during the anaerobic digestion process.
- The third used the EPA's Greenhouse Gas Equivalencies Calculator[14] to convert the thermal energy of the biogas to emission data.

Due to the construction time and permitting requirements, the measure was projected to be completed incrementally starting with two digester systems becoming operational in 2028. Two more would be added in 2029, and the final two digester systems in 2030, resulting in six total regional hub-and-spoke systems. Parameter estimates for feeder cattle, swine, and dairy cattle manure systems were provided to NDEE. Those data included approximate head, electricity usage, manure nutrient composition, and biogas/digestate generation. GHG calculations were performed on a system-by-system approach using the same tools and methods. These tools require some assumptions to be made on how the systems work, and how aspects of them are managed.

Assumptions made in calculations of GHG reductions from digestion:

- All biogas produced will be transported to the processing facility, no flaring or on-site utilization of biogas will occur.
- A methane loss rate from production to injection is estimated to be 2%.
- Digestate will be dewatered and split into a dry and wet component for land application.

Assumptions made in calculations of GHG reductions from land application:

- The carbon to nitrogen ratio of the digestate will be the same as the influent manure.
- The land-applied digestate will replace the full nutrient load of synthetic fertilizer.
- Digestate will be applied exclusively to irrigated corn fields at established rates depending on manure type.

Using these assumptions and the estimates provided, the three components (land application, anaerobic digestion, and renewable natural gas production) were all calculated and converted into cumulative emission reductions by 2030, resulting in total cumulative emissions reductions of 1.037 MMT CO_2e.

Year	Number of Digester Systems Operating	Greenhouse Gas Emissions Reductions, MMT CO_2E			
		Digestate Land Application	Anaerobic Digestion	Renewable Natural Gas	Total
2028	2	0.1042	0.0153	0.0525	0.1720
2029	4	0.2320	0.0423	0.0961	0.3703
2030	6	0.3126	0.0747	0.1073	0.4946
TOTAL		**0.6488**	**0.1323**	**0.2560**	**1.0370**

Table C-23. Annual and Total Net Greenhouse Gas Emissions Reductions for Anaerobic Digester Systems Through 2030

Incentives to Reduce Food Waste

NDEE's Waste Programs estimate Nebraska produces approximately 3,000,000 tons of municipal solid waste (MSW) per year. NDEE assumes that Nebraska follows the national average for MSW characterization with 61.3% (1,839,000 tons) being organic material. Approximately 24% of this organic material is food waste, making up approximately 14.3% (438,000 tons) of all MSW generated annually in Nebraska.

Estimated reductions in greenhouse gas emissions from organic material in landfills were calculated in two parts:

- Reductions in food waste delivery to landfills resulting from an educational outreach program aiming to reduce food waste in stages, achieving a 12.5% reduction (54,700 tons) by 2030.
- Diversion of 25% of landfill-delivered food waste (459,750 tons) to composting by 2030.

Calculations were performed using EPA's WAste Reduction Model (WARM) v16.[15]

Year	GHG Emissions Reductions (metric tons CO_2e)					Cumulative Total GHG Reductions (MMT CO_2e)
	3.125% Reduction in Food Waste	6.25% Reduction in Food Waste	9.375% Reduction in Food Waste	12.5% Reduction in Food Waste	Cumulative Total	
2027	56,956.5				56,956.5	0.057
2028		113,913.0			113,913	0.114
2029			170,869.5		170,869.5	0.171
2030				227,826.0	227,826.0	0.228
TOTAL					**569,565.0**	**0.570**

Table C-24. Cumulative Greenhouse Gas Emissions Reductions by Year Due to Food Waste Reductions at Landfills Through Educational Outreach

Landfill organic material recycling calculations were based on a subset of Nebraska's 22 landfills requesting funding, purchasing commercial composting equipment, and initiating composting operations each year. The goal would be for all 22 landfills to have operational and successful composting operations by 2030.

Year	GHG Emissions Reductions (metric tons CO_2e)						Cumulative Total GHG Reductions (MMT CO_2e)
	1 Landfill Composting	3 Landfills Composting	7 Landfills Composting	15 Landfills Composting	22 Landfills Composting	Cumulative Total	
2026	7,845.9					7,845.9	0.008
2027		23,537.6				23,537.6	0.024
2028			54,921.0			54,921.0	0.055
2029				117,688.0		117,688.0	0.118
2030					172,609.0	172,609.0	0.173
TOTAL						**376,601.5**	**0.377**

Table C-25. Cumulative Greenhouse Gas Emissions Reductions by Year Due to Commercial Composting at Nebraska Landfills

Incentives for Production and Use of Biochar to Reduce Organic Waste and Sequester Carbon in Soil

Emissions reductions for production of biochar assumed that one new production facility would be introduced annually from 2025 through 2029, with facility designs similar to the pending City of Lincoln biochar facility. Emissions reduction estimates for that facility were calculated by a consultant using the Verra VM0044 Methodology for Biochar Utilization in Soil and Non-Soil Applications, v1.1.[16] This methodology quantifies the carbon dioxide removals resulting from the conversion of waste biomass into biochar at new biochar production facilities.

The calculations assumed that the biochar production process will utilize a high-technology pyrolysis production facility meeting the following conditions:

- Pyrolytic greenhouse gases will be recovered or combusted
- At least 70% of the heat energy produced by pyrolysis will be recovered
- Emissions controls meet local and national standards
- The facility will operate 24 hours per day, 250 days per year
- Electricity consumption at 50 amps, 220 volts, with a power factor of 80%

- 0.22 gallons of diesel fuel consumed per cubic yard of biomass during screening and grinding
- 10,000 cubic yards of biomass annually provided by the City of Lincoln
- 6,000 cubic yards of biomass annually transported 43 miles (round trip) to the facility
- Biomass is transported to the facility using a 100 cubic yard diesel tractor trailer
- A small diesel bulldozer is operated in the facility
- 75% organic content of biochar produced

Using these conditions, the consultant estimated that the Lincoln facility will result in net reduction of 836.87 million metric tons of carbon dioxide equivalent ($MTCO_2e$) annually. This GHG reduction estimate did not account for the transportation of the biochar to its end-use location or the soil or non-soil application. Addition of one such facility annually between 2025 and 2029 will result in cumulative GHG reductions of 12,553.05 metric tons by 2030, as shown in the table below.

Year	GHG Emissions Reductions (metric tons CO_2e)						Greenhouse Gas Reductions (MMT CO_2e)
	Lincoln Project	New Project	New Project	New Project	New Project	Annual Total	
2026	836.87					836.87	0.0008
2027	836.87	836.87				1,673.74	0.0017
2028	836.87	836.87	836.87			2,510.61	0.0025
2029	836.87	836.87	836.87	836.87		3,347.48	0.0033
2030	836.87	836.87	836.87	836.87	836.87	4,184.35	0.0042
	4,184.35	3,347.48	2,510.61	1,673.74	836.87	**12,553.05**	**0.0125**

Table C-26. Annual and Total Net Greenhouse Gas Emissions Reductions for Addition of One Biochar Facility Annually

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15 EPA WAste Reduction Model (WARM) version 16, https://www.epa.gov/warm

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