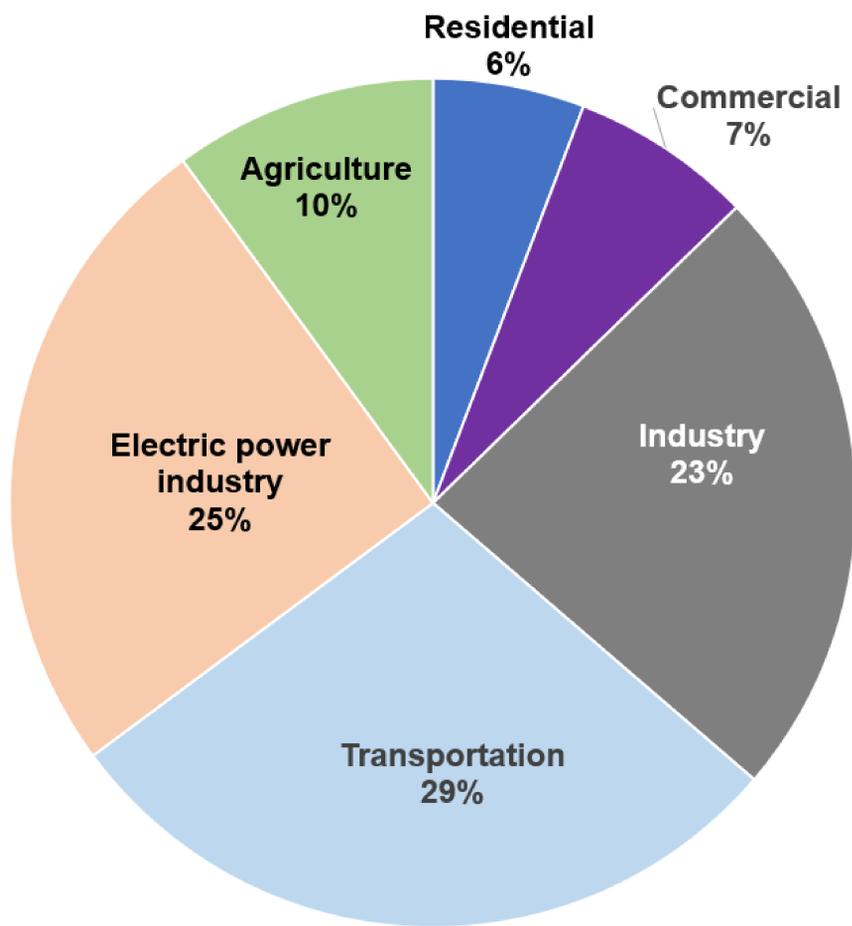
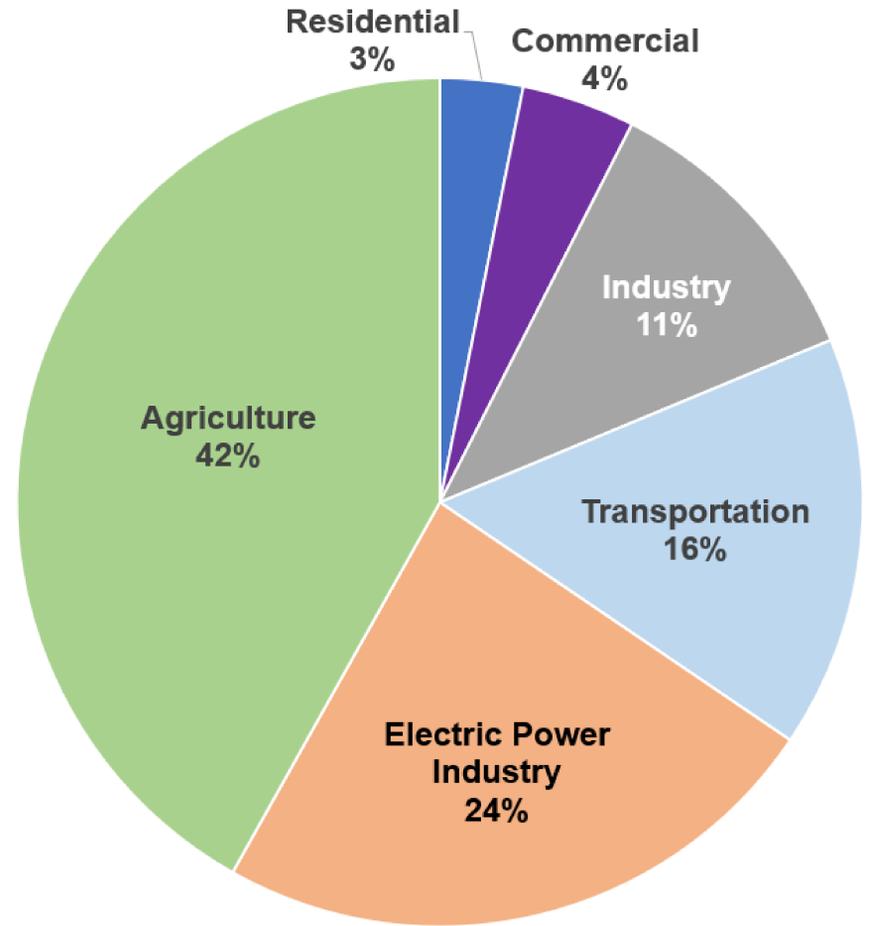


2021 Greenhouse Gas Emissions by Sector

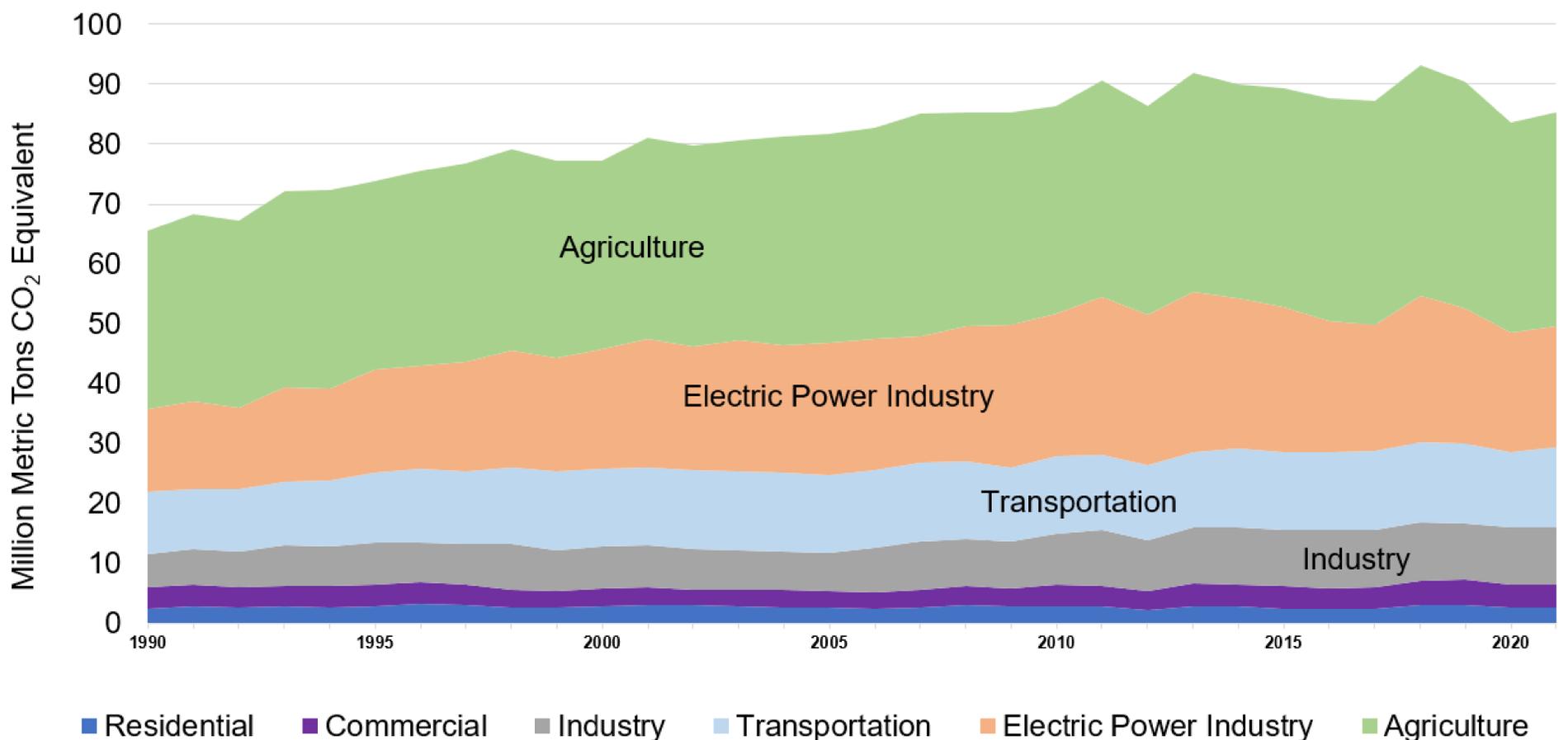
National



Nebraska



Nebraska Greenhouse Gas Emissions 1990-2021



Candidate Priority Measures and Economic Sectors Impacted

Measure	Agriculture	Energy	Industry	Waste & Wastewater	Commercial & Residential Buildings	Transportation
Establish Carbon Intensity score registry and provide per-bushel payment to growers as initial incentive to participate.	✓					
Establish regional hub-and-spoke anaerobic digester/biogas hubs.	✓	✓		✓		
Promote energy efficiency/electrification/weatherization upgrades for agricultural, municipal, industrial, and commercial facilities via funding to utility incentive programs.	✓	✓	✓	✓	✓	
Provide funding to acquire precision agriculture equipment and technology including training to analyze the data for highest impact.	✓					
Funding for infrastructure to facilitate managed grazing (water wells, piping, herding technology).	✓					
Incentives for irrigation well conversion from diesel to electric (expanding Clean Diesel program).	✓	✓				
Funding for solar projects on unused/contaminated land, ag & industrial facilities, and parking lot/feedlot solar canopies, including structural upgrades to allow rooftop solar.	✓	✓	✓			
Funding for solar arrays supporting critical infrastructure (water/wastewater treatment plants, emergency shelters, hospitals).		✓		✓		
Provide incentives to reduce food waste, redistribute unused food, and increase recycling of organics.				✓		
Provide incentives for electric replacements for medium and heavy-duty diesel vehicles (e.g. transit buses, school buses, and airport ground support equipment).						✓
Funding to low-income residents for repairs/upgrades to meet eligibility guidelines for federally-funded weatherization programs.					✓	
Provide incentives for high-efficiency heat pumps and home appliances for low-income households.		✓			✓	
Provide incentives for new public EV fast charging stations, including remote stations powered by ethanol-fueled generators.						✓
Provide incentives for production and use of biochar to reduce organic waste and sequester carbon in soils.	✓			✓		

Carbon Intensity Registry

Establish a Carbon Intensity Score Registry and provide payments to growers per-bushel of crop harvested as an initial incentive to participate.



Regenerative agriculture practices such as no-till and cover crops reduce the greenhouse gas impact of farming by reducing energy and material inputs and by storing carbon as organic matter in soil. A Carbon Intensity Score (CI Score) is a mechanism to measure the impact of these practices.

The CI Score is a standard metric that impacts commodity pricing for farm products and derived products such as ethanol. Wide adoption of CI Scores could allow producers and co-ops to negotiate premium pricing for their crops. This would reward producers who have already adopted sustainable practices, provide an incentive to work toward lower CI Scores, and spur adoption of sustainable practices by other producers.

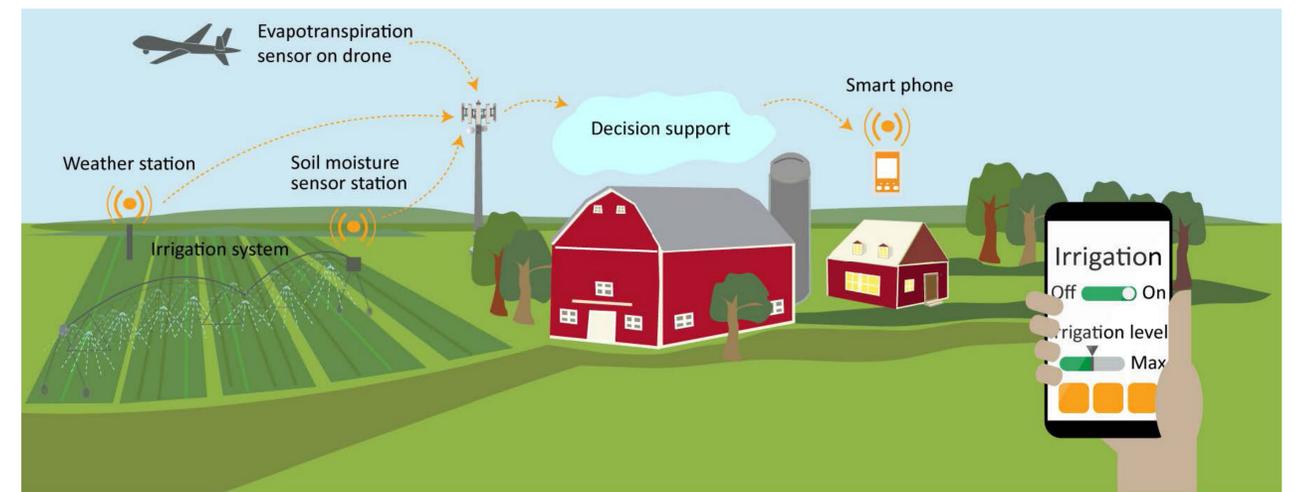
The CI Score incentive is a bridge strategy to encourage growers to become familiar with CI Scores and build participation to a scale that can impact markets.

Future markets and tax credits will then provide sufficient economic incentive to sustain and grow participation.



Precision Agriculture

Provide funding to producers to acquire precision agriculture equipment and technology, and training to analyze the data for highest impact.



Source: GAO. | GAO-20-128SP

Precision agriculture is the use of technology to observe, measure, and respond to field conditions that vary in space and during the growing season. The use of GPS, sensors to determine soil and crop condition, and integration with vehicles allows farmers to precisely control planting, irrigation, and fertilizer applications.

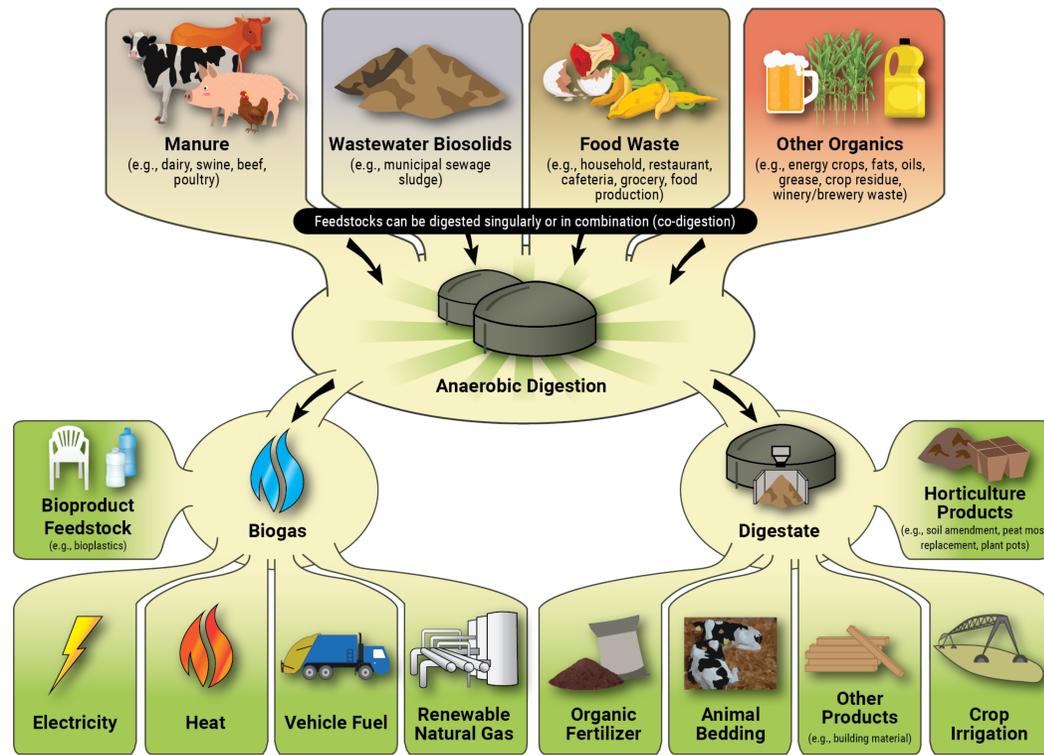
Precision agriculture practices can reduce the cost, energy use, and greenhouse gas impact of farming inputs. However, capital costs to acquire equipment can be high, and training is needed to enable farmers to process and integrate the data to determine the best outcomes.

This incentive program would be designed to encourage further adoption of precision agriculture practices across Nebraska.



Regional Digester Hubs

Establish regional hub-and-spoke anaerobic digester/biogas hubs to process animal manure and generate renewable biogas.



Anaerobic digestion is a process through which bacteria break down organic matter—such as animal manure, wastewater biosolids, and food waste—in the absence of oxygen. Anaerobic digesters contain complex microbial communities that break down (or digest) the waste and produce biogas and residual solids and liquids (digestate).

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.

This program would set up 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. Benefits:

- Additional revenue for participating farms
- Reduced use of fossil fuels
- Rural economic growth
- Improvements in soil health

Electrify Irrigation

Provide incentives to replace diesel irrigation engines with electric motors connected to the grid.



As of May 2022, Nebraska had over 96,000 active agricultural irrigation wells. Although surveys show that about 60% of Nebraska irrigation well pumps are now powered by electricity, that leaves thousands that are powered by engines burning fossil fuels, primarily diesel fuel.

Exhaust from this large number of diesel engines includes not only greenhouse gases, but also particulate matter and nitrogen oxides that contribute to air pollution. Nitrogen oxides also lead to the formation of harmful ground-level ozone, which can be transported readily to nearby populated areas.

Replacing these diesel engines with electric pumps connected to the grid eliminates these harmful emissions at the wellsites. Much of the electricity used to run the new electric pumps is generated from wind and nuclear sources rather than burning fossil fuels, so these replacements result in a net reduction in emissions of greenhouse gases and other air pollutants.



Energy-Efficient Facilities

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



The industrial and commercial sectors contribute about 15% of Nebraska's annual greenhouse gas emissions. Roughly three-quarters of industry emissions are direct emissions originating at the facility level, including fossil fuel combustion for heat and power and process emissions from industrial production. Using electricity instead of fossil fuels to generate heat, in combination with use of waste heat recovery systems, can greatly reduce direct industrial emissions.

Facility systems such as lighting and ventilation are responsible for indirect emissions from generation of electricity off-site. Energy efficiency improvements in these systems carry a range of benefits, including reducing operating expenses and production costs and making other emissions reduction strategies more cost-effective and technically viable.

Nebraska's electric utilities offer energy efficiency incentives, and many facilities in the state have adopted energy efficiency strategies to reduce costs and environmental impacts. A program to provide additional incentives to reach more facilities could include support for:

- Energy audits to identify the most advantageous strategies and upgrades at each facility
- Installation of LED lighting, more efficient ventilation equipment, and insulation.
- Installation of highly-efficient industrial heat pumps to replace boilers producing heat for low- and medium-temperature processes.
- Installation of waste-heat recovery systems
- Structural upgrades to support rooftop solar panels for on-site production of electricity.

Energy-Efficient Homes

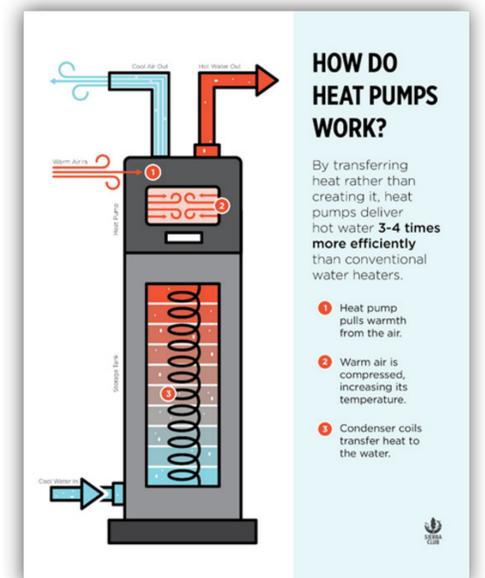
Provide incentives for high-efficiency heat pumps and home appliances for low-income households.

Residential energy use plays a small role in overall greenhouse gas emissions, but residents can save on energy costs and contribute to reducing greenhouse gases by adopting more efficient equipment and appliances while becoming more aware of the economy-wide benefits of energy efficiency. The biggest reductions in home greenhouse gas emissions can be found in replacing systems that burn natural gas and propane (furnaces, water heaters, and stoves) with efficient equipment powered by electricity, especially those using highly-efficient heat pump technology.



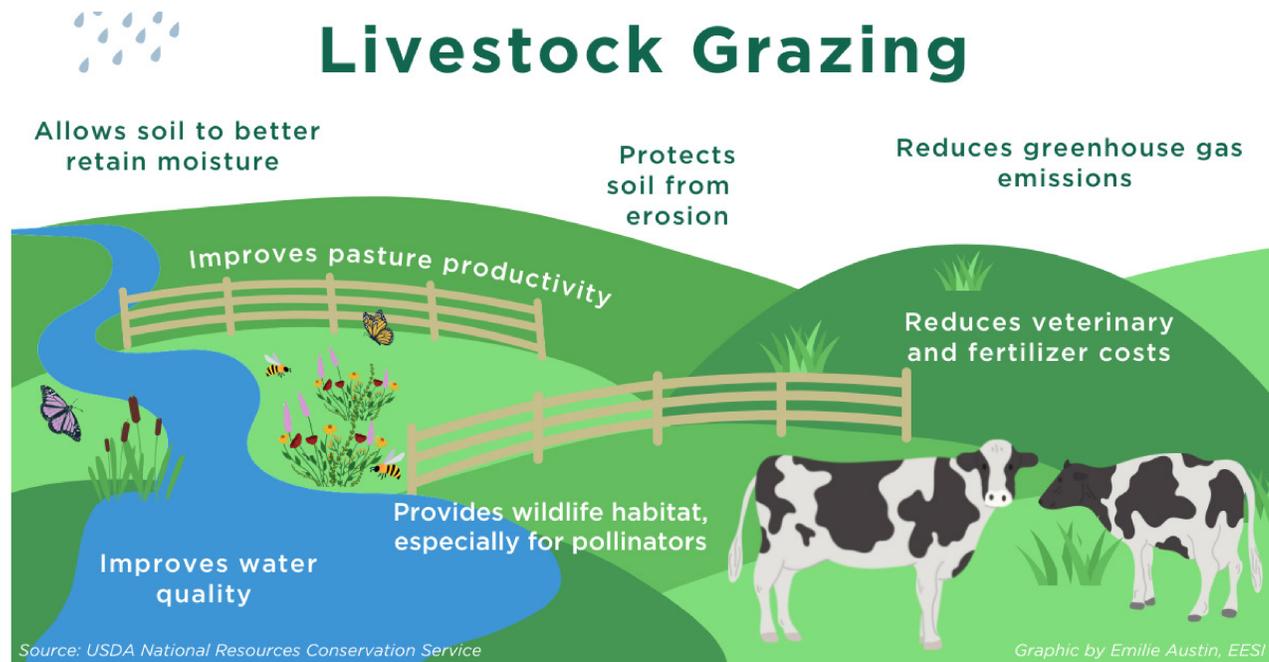
Heat pumps offer an energy-efficient alternative to furnaces and air conditioners for home heating and cooling in all climates. Like a refrigerator, heat pumps use electricity to transfer heat from a cool space to a warm space, making the cool space cooler and the warm space warmer. During the heating season, heat pumps move heat from the cool outdoors or the ground into the warm house. During the cooling season, heat pumps move heat from the house into the outdoors.

In a heat pump, incoming heat causes a liquid refrigerant in the unit to vaporize. The refrigerant vaporizes at a temperature much lower than winter air temperatures, so an air-source heat pump can extract heat from even cold winter air. The gas is then compressed, raising its temperature so that it can be passed through a heat exchanger to heat air or water, so heat can be passed indoors in winter or outdoors in summer. Because they transfer heat rather than generate heat, heat pumps are more efficient than other home heating or water heating systems. Modern heat pumps can efficiently provide comfortable temperatures for homes in all seasons and climates.



Fund Managed Grazing

Provide funding for infrastructure to facilitate managed grazing: water wells, piping, and herding technology.



Managed grazing involves carefully controlling livestock density and the timing and intensity of grazing. Pasture is divided into smaller areas, with one area being grazed at a time, while the remaining areas recover. Compared with conventional pasture practices, managed grazing can increase forage production, improve the structure and health of grassland soils, reduce runoff and erosion, improve water quality, and sequester carbon.

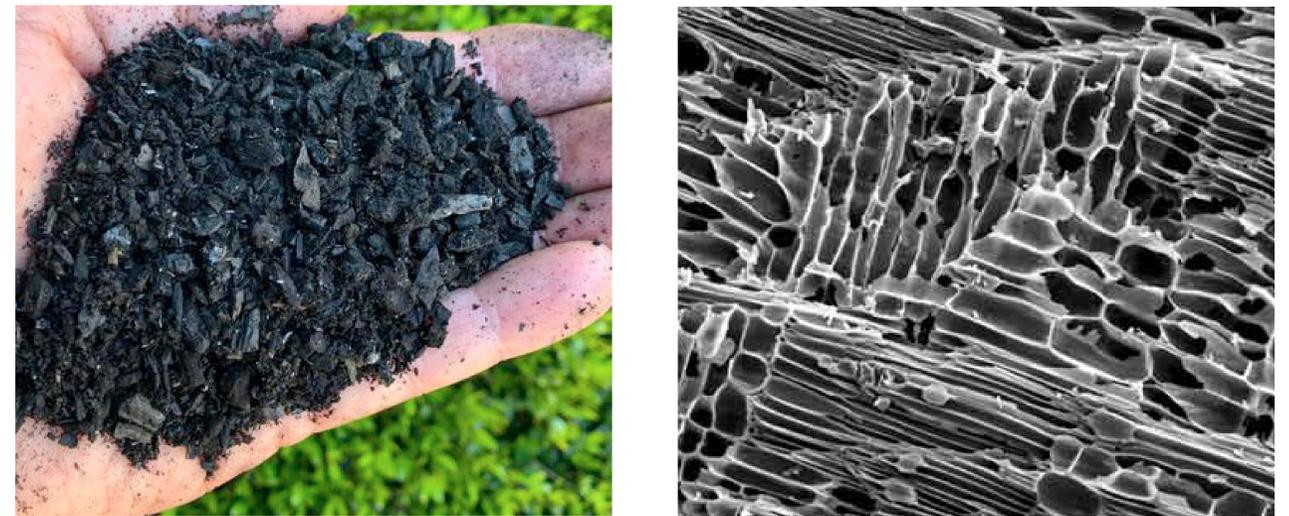
Managed grazing may require additional wells or piping to supply water to the various grazing areas, and permanent or temporary electrified fencing to confine stock in the desired area. New technology options can reduce the labor required to move stock: automated fence lifters to allow stock to move on their own, or virtual fence systems in which animals wear collars equipped with GPS to track their movements and emit sounds and mild electrical shocks when the animals cross a virtual boundary defined in computer software.



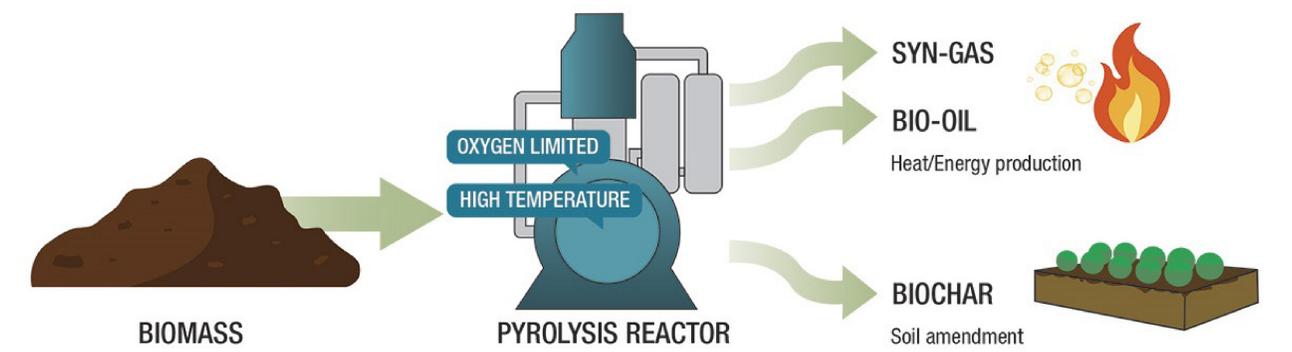
This program would provide funding to ranchers for the capital costs of infrastructure and equipment needed to implement managed grazing.

Biochar Incentives

Provide incentives for production and use of biochar to reduce organic waste and store carbon in soils.



Biochar is a carbon-rich, highly stable soil amendment that improves soil health and can store carbon in soils for long periods of time. Biochar is produced by heating or-organic materials (biomass) to high temperature with little oxygen present, a process called pyrolysis.



Source: Sanford et al., 2022a

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.

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.

Solar for Critical Facilities

Provide funding for solar arrays supporting critical infrastructure facilities (water/wastewater treatment plants, emergency shelters, and health care facilities).



Rooftop solar array being installed at San Benito Clinic in Hollister, CA in 2017

Small solar arrays with battery storage can be designed to be independent of the regional electric grid. Not only do they reduce dependency on fossil fuels, they can continue to supply electricity to critical facilities such as water and wastewater treatment plants, health care facilities, and emergency shelters during emergency situations when electricity may not be available from the regional grid.



Solar on Unused Land

Provide funding for community solar projects on unused or contaminated land such as capped landfills, at agricultural and industrial facilities, and for solar canopies over parking lots and feedlots.



Solar array installed on capped landfill in Tennessee.

Solar arrays can be constructed on unused or contaminated land, such as capped landfills or abandoned industrial sites, in order to avoid replacing other productive land uses. Solar panels can also be installed on canopies over outdoor parking lots or animal feedlots, pairing clean energy production with the benefit of providing shade for vehicles or livestock.



Solar canopy over parking lot at Michigan State University.

Preweatherization Funding

Funding to low-income residents for repairs & upgrades needed to meet eligibility guidelines for the Nebraska Weatherization Assistance Program.



Weatherization programs provide assistance to low-income homeowners to seal air leaks, add insulation, and improve the efficiency of furnaces and water heaters.

Many low-income homes are not eligible for weatherization because of structural problems, electrical and wiring issues, and water leaks. Current funds are not adequate to fix these problems.

A preweatherization program would provide funds to remediate structural deficiencies and home health and safety hazards to allow many more households to receive weatherization assistance.

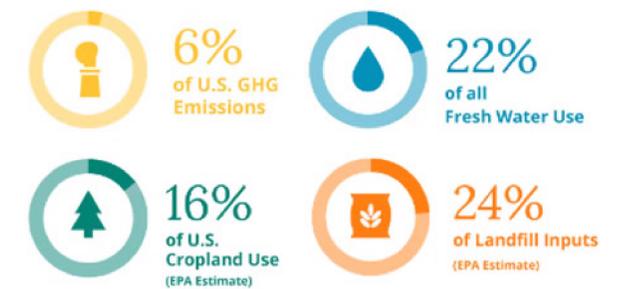


Reduce Food Waste

Provide incentives to reduce food waste, redistribute unused food, and increase recycling of organics.



Uneaten Food Consumes:



Source: ReFED April/May 2023

Unused food causes greenhouse gas emissions in two ways:

- Food production and distribution activities
- Decaying food in landfills generates methane



Farm-to-Kitchen Environmental Footprint of U.S. Food Loss and Waste

(excluding impacts of waste management, such as landfill methane emissions)



FIGURE 4.9. ANNUAL CRADLE-TO-CONSUMER ENVIRONMENTAL FOOTPRINT OF U.S. FLW
This figure depicts the annual environmental footprint of producing, storing, processing, packaging, distributing, and marketing food that is ultimately lost or wasted in the United States. Data Source: U.S. EPA (2021a); USCB (2021); Pagani et al. (2020); Read et al. (2020); U.S. DoE (2020); Vittuari et al. (2020); U.S. EPA (2018); Toth and Dou (2016)



Electric Vehicle Charging

Provide incentives for new public fast-charging stations for electric vehicles, including remote stations powered by ethanol-fueled generators.



Widespread adoption of electric vehicles can greatly reduce greenhouse gas and other pollutant emissions in the transportation sector. Availability of public fast charging is an important factor that will help facilitate the transition to electric vehicles. A network of fast charging stations along highways is needed to support long-distance travel in EVs, and fast charging stations in communities are important to provide access to renters and others who do not have access to charging at home.



Electric Vehicles

Provide incentives for electric replacements for medium and heavy-duty diesel vehicles (transit buses, school buses, delivery trucks, and airport ground support equipment).



Diesel vehicles are a major source of air pollution, emitting not only greenhouse gas-es, but also harmful pollutants such as fine particulates and nitrogen oxides, both of which are detrimental to human health when inhaled. Diesel delivery trucks and buses also commonly operate in populated areas, exposing many people to these pollutants.

Replacing diesel vehicles with electric vehicles completely eliminates these tailpipe emissions. Many locally-operated vehicles such as delivery trucks, school and transit buses, and airport ground support vehicles can recharge overnight and run for a full day. If they require a longer range, they can return to base or to a public charger for a fast partial charge to complete their daily operations.

