



# Overview of Anaerobic Digestion

Nick Elger, U.S. Environmental Protection Agency

# AgSTAR Program



## PARTNERSHIP PROGRAM

Collaborative program sponsored by EPA and USDA.

Established in 1994

### 1 Mission

Advance adoption of livestock manure anaerobic digestion and alternative manure management practices to reduce, capture, and use methane.

### 2 Strong Ties

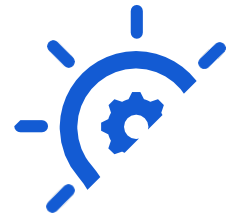
Working with industry, government, NGOs and university stakeholders.

### 3 Helping Hand

Assisting those who enable, purchase, or implement farm anaerobic digestion projects.

# AgSTAR: How the Program Works

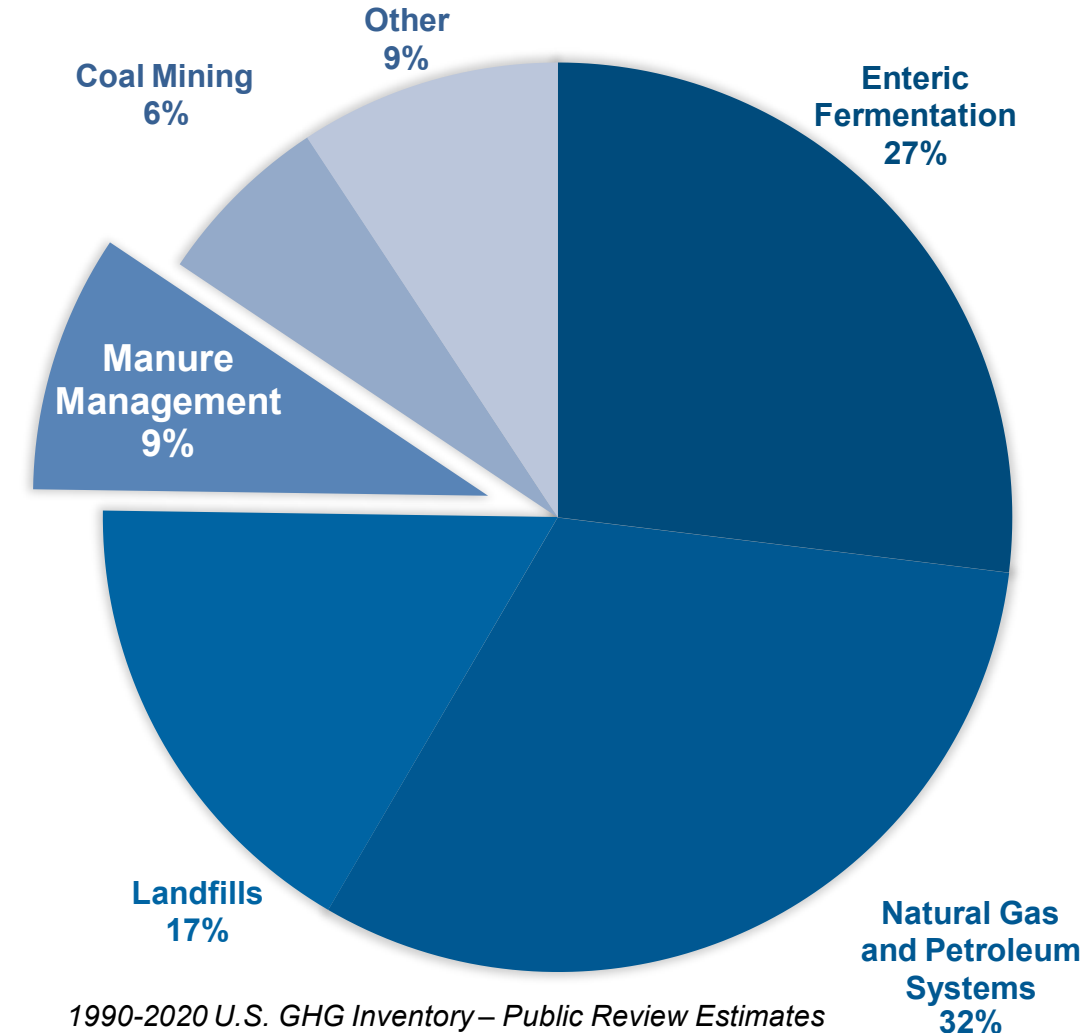
- Knowledge Hub for sustainable manure management practices
- Provide free information and technical assistance to stakeholders on complex aspects of project development
- Collaboration with Department of Agriculture, state agencies, NGOs, universities, and private sector



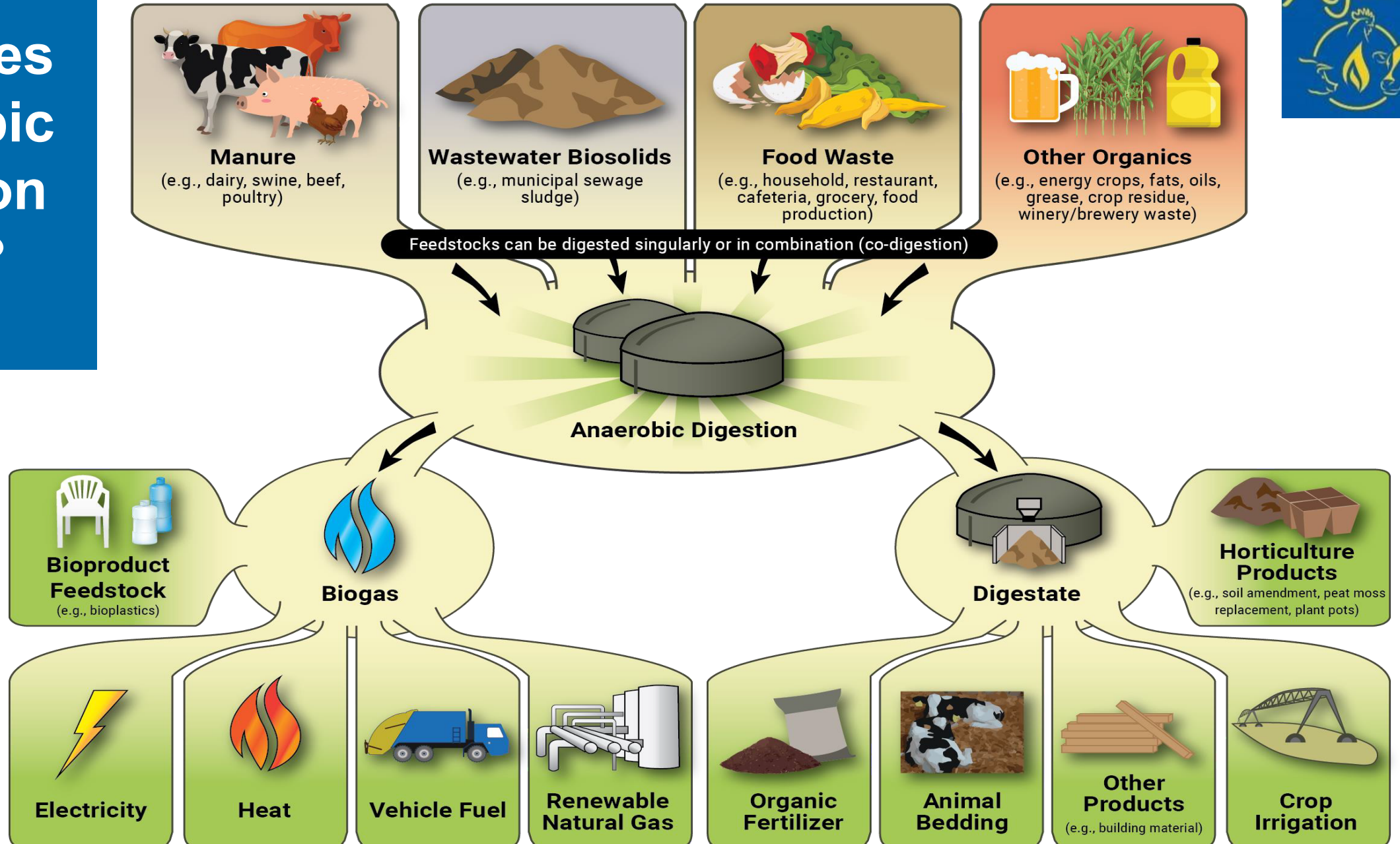
# Why EPA Is Concerned about Manure Management Emissions

- Livestock (dairy, beef, swine, poultry) manure contributes ~9% of US methane emissions, or 59.6 MMTCO<sub>2</sub>e
- US methane emissions from livestock manure increased 71% between 1990 to 2020

U.S. METHANE EMISSIONS 2020, BY SOURCE

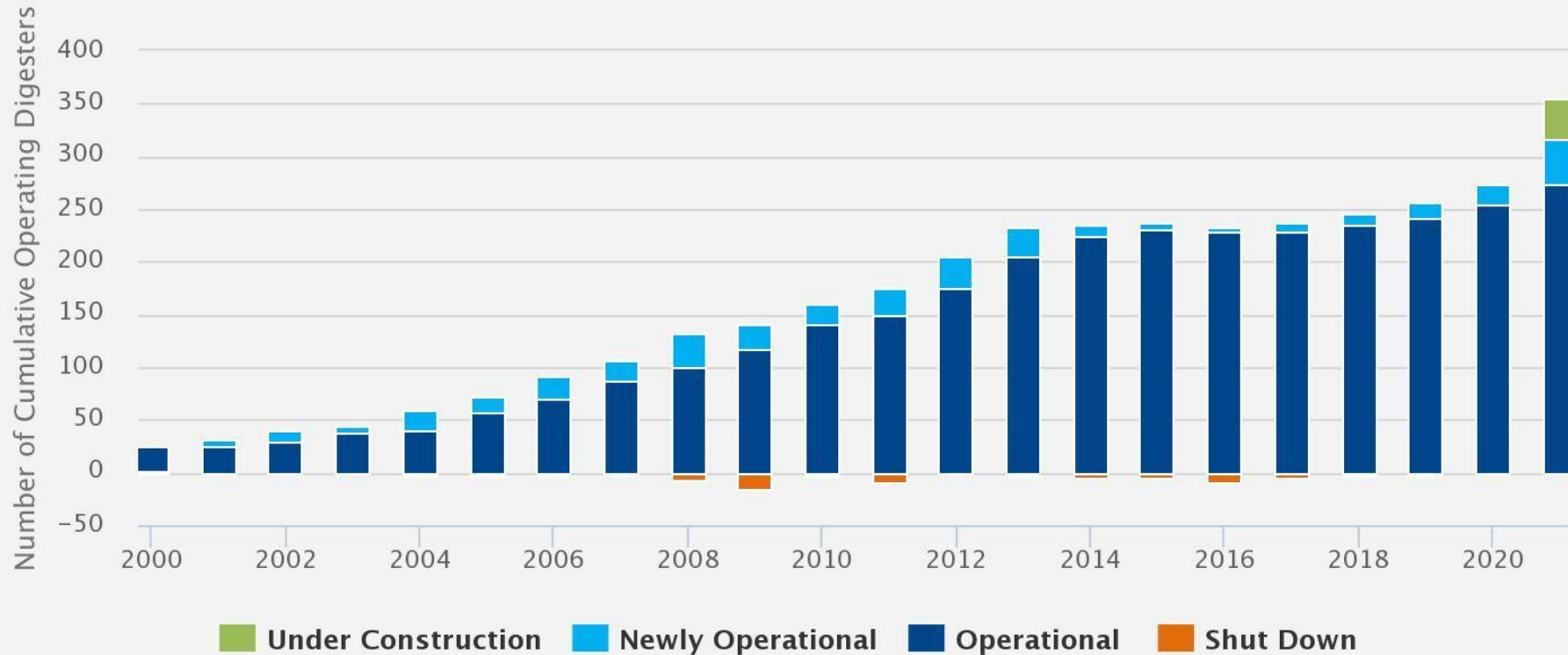


# How does anaerobic digestion work?



# Farm Digester Market Growth

Manure-based Anaerobic Digesters Operating in the U.S.  
(Updated through September 2021)

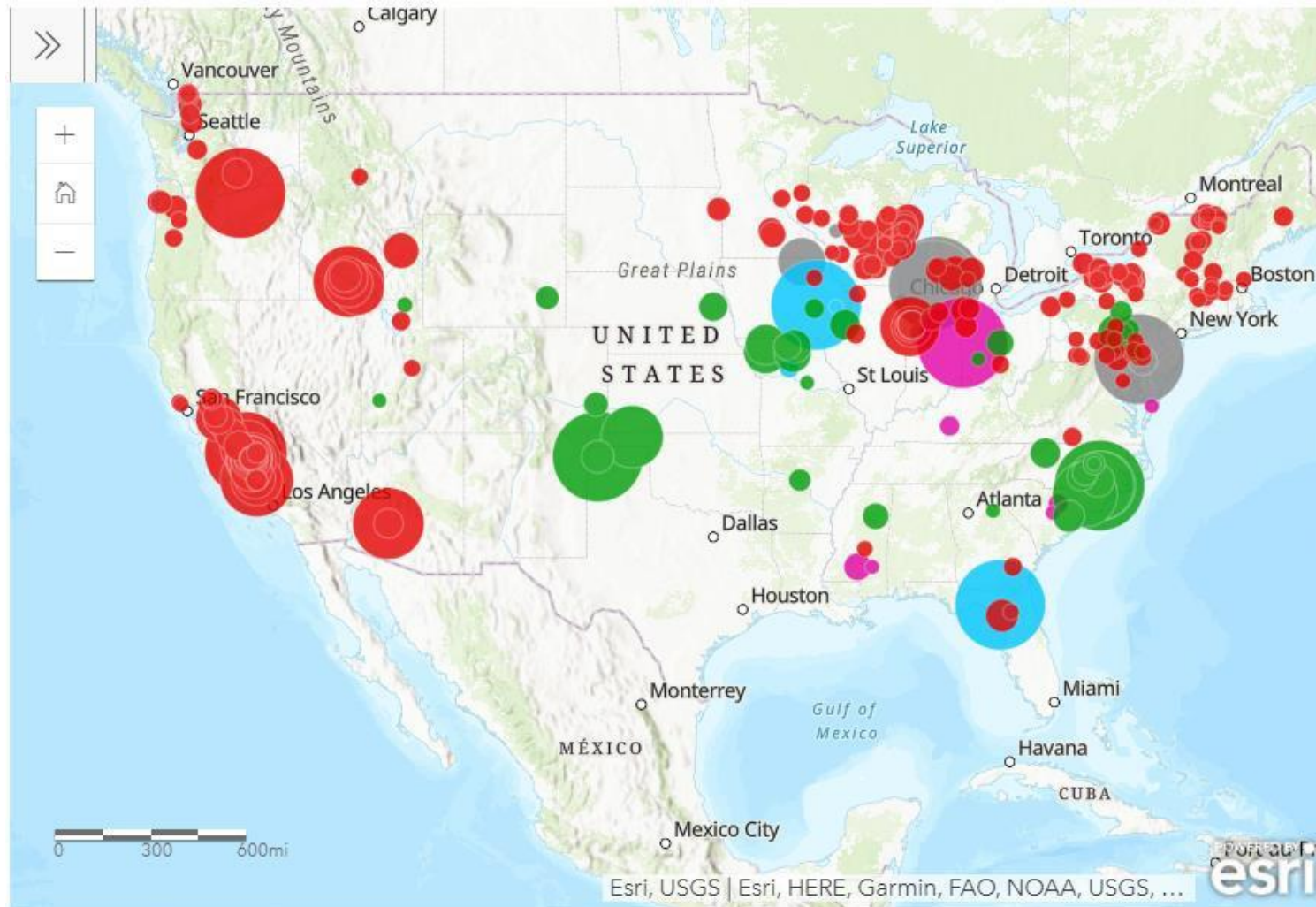


**315**  **Current Digesters**

**Growth projected to exceed 500 digesters in next 5 years**

**Potential for over 8,000\* digesters on farms in U.S.**

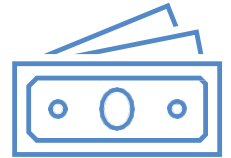
# Where are digesters found?



● Dairy ● Hog ● Poultry ● Beef ● Mixed | [View larger map](#)

# What are barriers to installing AD systems?

1. High up-front costs (feasibility studies, capital costs): Can be intimidating investment for farmers who operate on thin margins
2. Uncertainty associated with market incentives (RFS, RINs, LCFS, environmental credits) and policies (interconnection standards, GHG emissions targets, food waste diversion, nutrient management)
3. Business models and operational set-ups are complex and variable; standardization is challenging
4. Quantifying full environmental and economic benefits is difficult and costly (e.g., air, climate, soil, water, waste management, rural economic growth, impact on EJ communities)





# Benefits of Anaerobic Digester Systems

Anaerobic digesters are a tool agriculture producers can use to manage manure sustainably

- **Environmental**
  - Methane emission reduction and improved local air, water, and soil quality
- **Energy**
  - Energy independence and displacement of fossil fuels
- **Economic**
  - Diversified farm revenue through sale of energy and co-products; local economic impacts

# Environmental Benefits: Air Quality

- **Reduction in methane emissions, a powerful GHG and precursor to ground-level ozone**
  - Collection and use of biogas from U.S. farms reduced methane emissions by 5.27 MMT of CO<sub>2</sub>e in 2020. ([AgSTAR Data and Trends](#))
  - Lower emissions reduce the risk of respiratory illness and reduce climate impacts.
- **Odor Reduction**
  - AD systems can reduce odors, which can benefit farm-community relationships



Patterson Farms, Auburn, New York

- Odor issues related to its newly constructed, 4.5-million-gallon earthen manure storage pond
- Mechanical separation eliminated odor from manure solids, but odors persisted with liquids stored in earthen pond
- Complete mix digester installed in 2005 and has been successfully controlling odor since

# Environmental Benefits:

## Water Quality and Soil Health

- **Improvement of local water quality**
  - AD systems can reduce pathogens and nutrients from leaching into surface and groundwaters.
- **Processed digestate can be used as a soil amendment or organic fertilizer**
  - Returns nutrients to the soil.
  - [Blue Spruce Farm in Vermont](#) dewateres digestate, yielding low-solids irrigation water and a nutrient-rich solid product.
- **Digestate application can increase crop yield**
  - May minimize or offset the use of fertilizers.



# Energy Benefits

- **Produces renewable energy from collected and processed biogas**
  - Manure-based AD projects generated approximately 1.6 [million megawatt-hours in 2020 \(AgSTAR Data and Trends\)](#).
- **Energy Independence**
  - Many digesters can provide all on-farm energy needs.
  - Produces baseload energy or “dispatchable power” for use during peak hours.
  - Excess power can be provided to the local grid.



## [Butler Farms](#) [Lillington, North Carolina](#)

- Produces 540,000 kWh of electricity annually
- On-site microgrid can operate independently and provide power to the farm and surrounding homes, which helps avoid prolonged outages following severe weather events.

# Economic Benefits

- **Diversifies farm revenue through sale of energy and co-products**
- **Opportunity to create new local jobs**
- **Partnerships with local businesses**
- Co-digestion of feedstocks from other businesses
  - [Monument Farms Dairy in Weybridge, Vermont](#) receives waste from Vermont Hard Cider, LLC, offsetting Vermont Hard Cider waste transportation costs.
  - [Noblehurst Farms in Linwood, NY](#) founded [Natural Upcycling](#) to collect food waste and scraps for use in their anaerobic digester.



Barstow's Longview Farm, Hadley, Massachusetts

- Longview Farm, Vanguard Renewables, and Cabot Creamery/Agri-Mark Co-Operative partnered together to create a closed-loop lifecycle.
- Farm waste and wastes from food distributors are used in the anaerobic digestion system which generates energy to the farm, producers, and distributors.





## Contact:

**Nicholas Elger**

[elger.nicholas@epa.gov](mailto:elger.nicholas@epa.gov)

## Connect:

- [www.epa.gov/agstar](http://www.epa.gov/agstar)
- Subscribe to our newsletter
- Technical information and resources

# Appendix

# Digester Types



**Complete Mix**



**Plug Flow**

**Covered Lagoon**

