

# Utilization of Regional Biodigesters to Meet Chesapeake Bay Initiatives



Coalition for Smart Growth  
Smart Growth Summit 2010

October 28, 2010

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# Presentation Overview

- **Introduction to Regional Biodigester Concept**
  - Chesapeake Bay Nutrient Initiatives
  - Regional Biodigester Concept
- **Project Business Structure and Revenue Sources**
  - Nutrient Credit Trading
  - Agricultural Producer Benefits
  - Community Benefits
- **Biodigester Implementation in Lancaster County**
  - Feasibility Study for Site Selection
  - Next Steps

# Chesapeake Bay Nutrient Reduction Goals

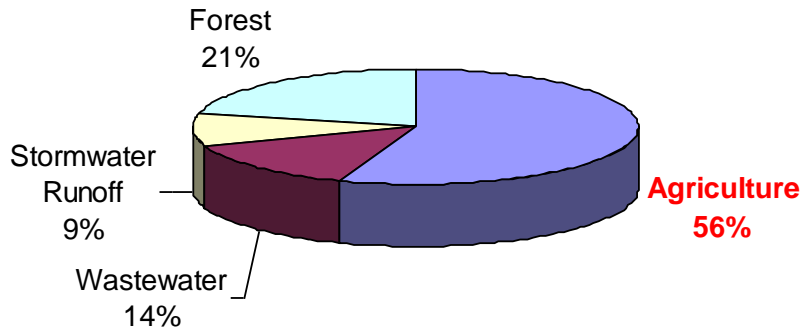
- On July 1, 2010, EPA set draft Bay watershed limits for Nitrogen and Phosphorus
  - Nitrogen: 187.4 million pounds per year (PA: 76.8 million lbs/year)
  - Phosphorus: 12.5 million pounds per year (PA: 2.74 million lbs/year)
  - Sediment: between 6.1 and 6.7 billion pounds per year set on August 13 (PA: 2 billion lbs/year)
  - PA Remaining Reductions (Million Pounds per Year):
    - Nitrogen: 29.5
    - Phosphorus: 1.21
    - Sediment: 472-662

# Chesapeake Bay Nutrient Reduction Goals

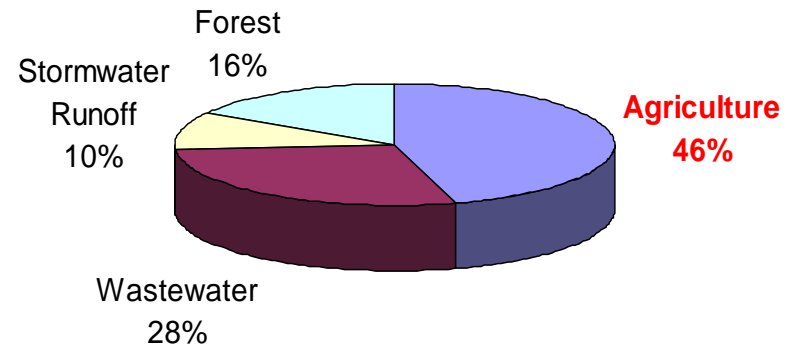
- PA DEP Key Elements for Reduction Goals:
  - Development of 2-year milestones for measuring incremental improvement.
    - As of 2009, 41% of nitrogen reduction credited to agricultural is attributed to PA agriculture from Best Management Practices (BMP).
    - By 2011, 40 WWTPs are scheduled for nutrient reduction upgrades in PA.
  - Implementation of new technologies.
    - DEP is promoting the establishment of **regional digesters**.
    - **According to DEP, “If 42 enhanced digesters were built in 40 counties, about 27 million pounds of nitrogen load could be reduced.”**
    - **14 Enhanced digesters in top 2 counties of Lancaster & Franklin for processing of dairy manure could reduce TN by about 9 million pounds.**

# Source of Nutrient Loads from PA to Chesapeake Bay

Sources of Nitrogen from PA



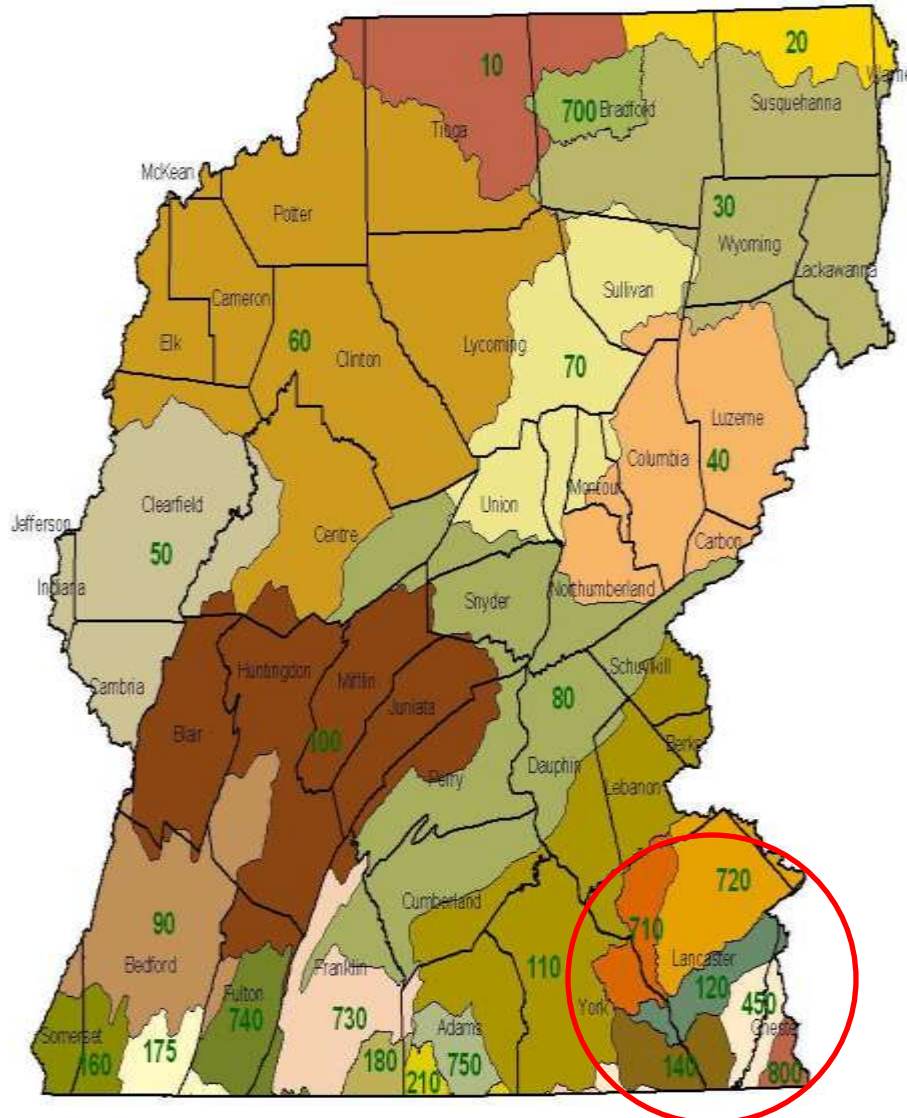
Sources of Phosphorus from PA



Source: Chesapeake Bay draft TMDL

# Delivery of Nutrients to Chesapeake Bay

\* Lancaster County Farming Areas



Source: CBP Watershed Model Phase 4.3

Nitrogen and Phosphorus Delivery Ratios		
Segment	Nitrogen	Phosphorus
10	0.474	0.436
20	0.495	0.436
30	0.733	0.436
40	0.871	0.436
50	0.836	0.436
60	0.930	0.436
70	0.941	0.436
80	0.951	0.436
90	0.897	0.436
100	0.880	0.436
110	0.961	0.436
120*	0.980	0.436
140*	0.990	0.436
160	0.583	0.670
175	0.700	0.670
180	0.819	0.670
210	0.720	0.669
450*	1.000	1.000
470	1.000	1.000
700	0.700	0.436
710*	0.970	0.436
720*	0.891	0.436
730	0.683	0.670
740	0.749	0.670
750	0.627	0.670
800	1.000	1.000

# Chesapeake Bay Total Maximum Daily Load (TMDL)

## TMDL Background:

- The Clean Water Act of 1972 requires jurisdictions to develop list of impaired waterways.
  - TMDL developed for water quality standards.
- Since 2000, seven jurisdictions (DE, MD, NY, PA, VA, WV & D.C.), EPA and Chesapeake Bay Commission have been planning for the TMDL to the Bay.
- In 2005, Maryland finalized new water quality standards (WQS) based on three criteria:
  - Dissolved Oxygen, Chlorophyll-a & water clarity.
    - Bay jurisdictions expected to incorporate criteria into their WQS.
- In October 2007, EPA agreed to establish the TMDL.
- Since 2008, EPA established expectations and evaluation criteria for jurisdictions to meet the TMDL pollution limits.
- May 12, 2009, President Obama issued Executive Order 13508.
  - Restore and protect the Chesapeake Bay.
- September 1, 2010, draft Phase I Watershed Implementation Plan (WIP) submittal deadline.
- **September 24, 2010, release of draft Chesapeake Bay TMDL.**

Source: Chesapeake Bay TMDL – Draft September 24, 2010

# DRAFT Chesapeake Bay TMDL

- **Draft TMDL is largest ever developed by EPA and was prompted by insufficient restoration progress over the last several decades.**
  - Designed to ensure that control measures in place by 2025 with 60% of actions to be completed by 2017.
- **EPA evaluated draft Phase I Watershed Implementation Plan (WIP) submitted by jurisdictions.**
- **“Serious deficiencies” in five states WIP, including PA DEP WIP phosphorus and sediment allocations.**
  - Programs not identified or implemented to reduce pollution to meet TMDL allocations by 2017 or 2025.
  - Jurisdictions required to revise WIPs for final submittal on November 29, 2010.
- **EPA provided stringent “backstop allocations” to substitute jurisdiction’s proposed Point Source allocations.**
  - Three levels: Minor, Moderate, High

Source: Chesapeake Bay TMDL – Draft September 24, 2010

# DRAFT Chesapeake Bay TMDL (cont.)

- **PA: High-level backstop allocations**
  - **WWTPs:**
    - Point Source Load Reductions – Limit of Technology as defined by TMDL (3 mg/L TN and 0.1 mg/L TP) for significant municipal plants
    - MD: 4 mg/L TN and 0.3 mg/L TP for significant municipal plants
    - Delivery ratios not considered in these allocations
  - **Stormwater:**
    - Construction: 100% E&S Control
    - Municipal Separate Storm Sewer System (MS4) Controls:
      - 50% urban MS4 meet standards through retrofit/redevelopment
      - 50% unregulated land treated as regulated.
        - » So, 25% of unregulated land meet aggressive performance standard.
  - **CAFO Production Areas:**
    - Waste management, barnyard runoff control, mortality composting, precision feed management
    - Unregulated AFOs (not subject to CAFO permits) included in WLA portion of TMDL – same standards except no feed management on dairies.

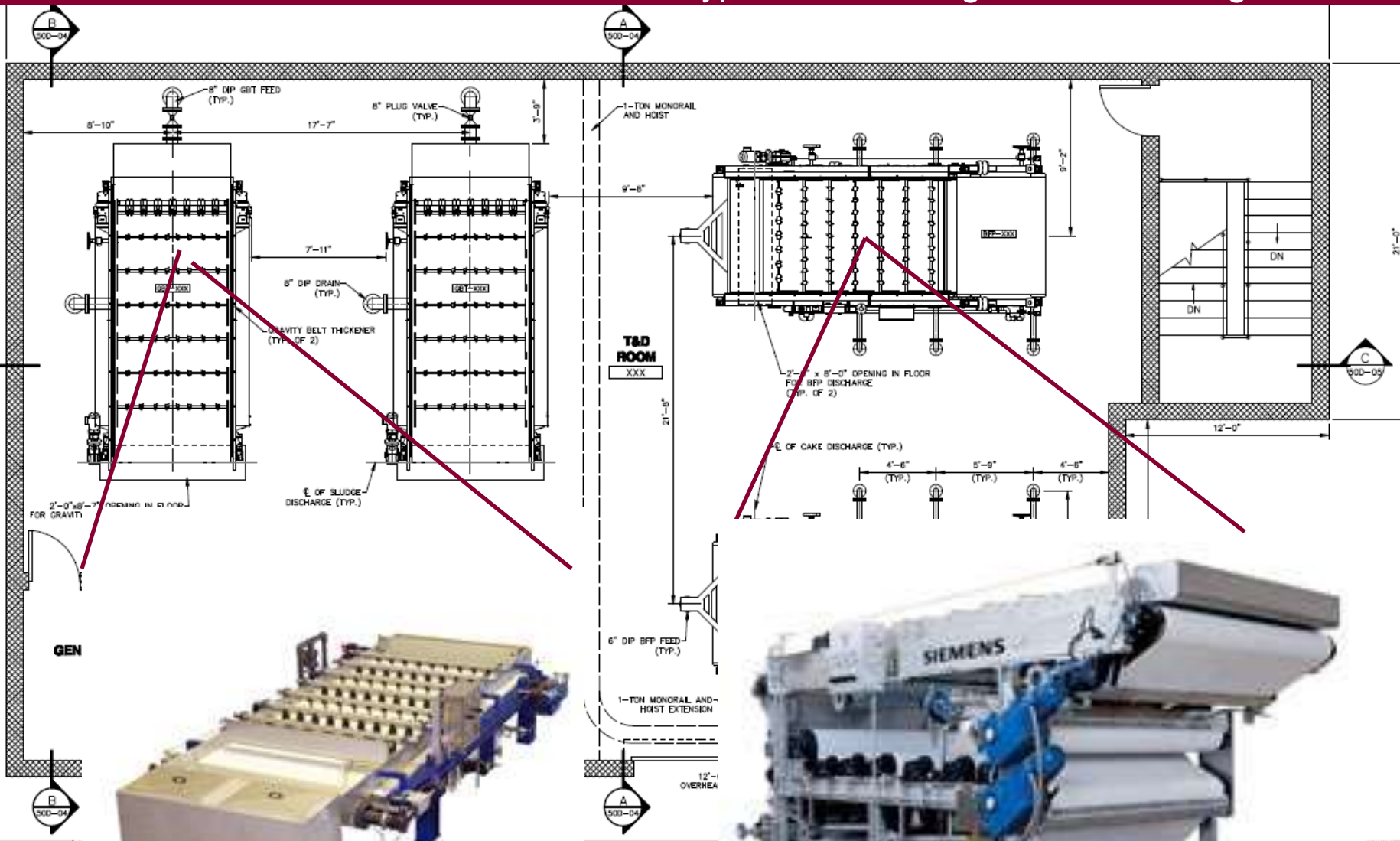
Source: Chesapeake Bay TMDL – Draft September 24, 2010

# What is a Regional Biodigester Facility?

- **Centralized Facility**
  - Collection of Animal Manure from local Agricultural Operations
  - Production of Biogas and Related Energy (Steam, Electricity, Hot Water)
  - Transport to Centralized Facility for Pretreatment, Digestion and Disposal
  - Export of Commodities and Environmental Attributes from Facility
  - Revenue Sharing with Local Agricultural Operation
- **Alternative Feedstocks Additions**
  - Collection of Other Products to increase Energy Efficiency and Reduce Costs for Local Industries
    - Post Consumer Food Wastes
    - Industrial Food Wastes
- **Focused Treatment and Disposal**
  - Concentrated Nutrient Removal
  - Large Environmental Footprint, attracting National Interests and Markets



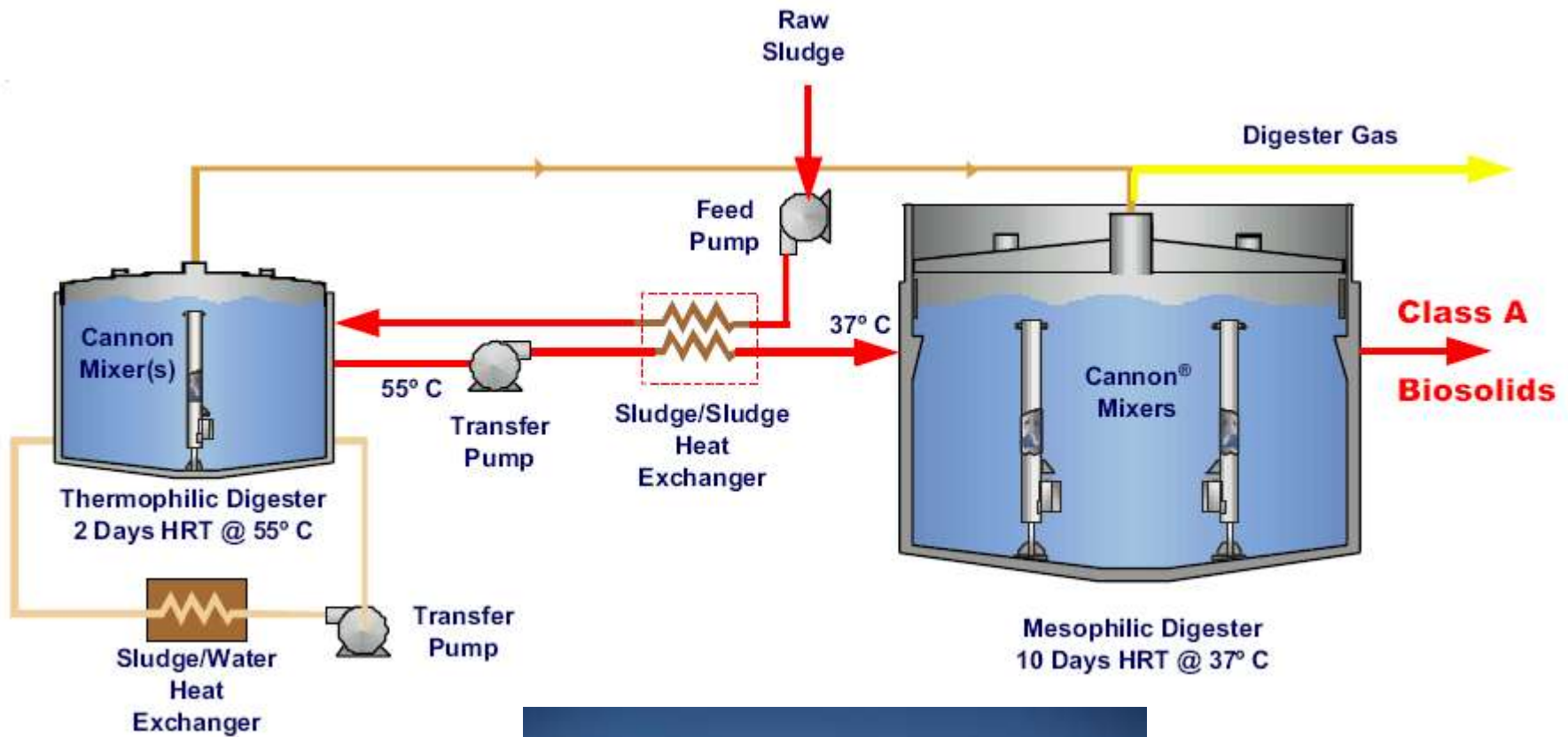
# Typical Thickening and Dewatering Devices

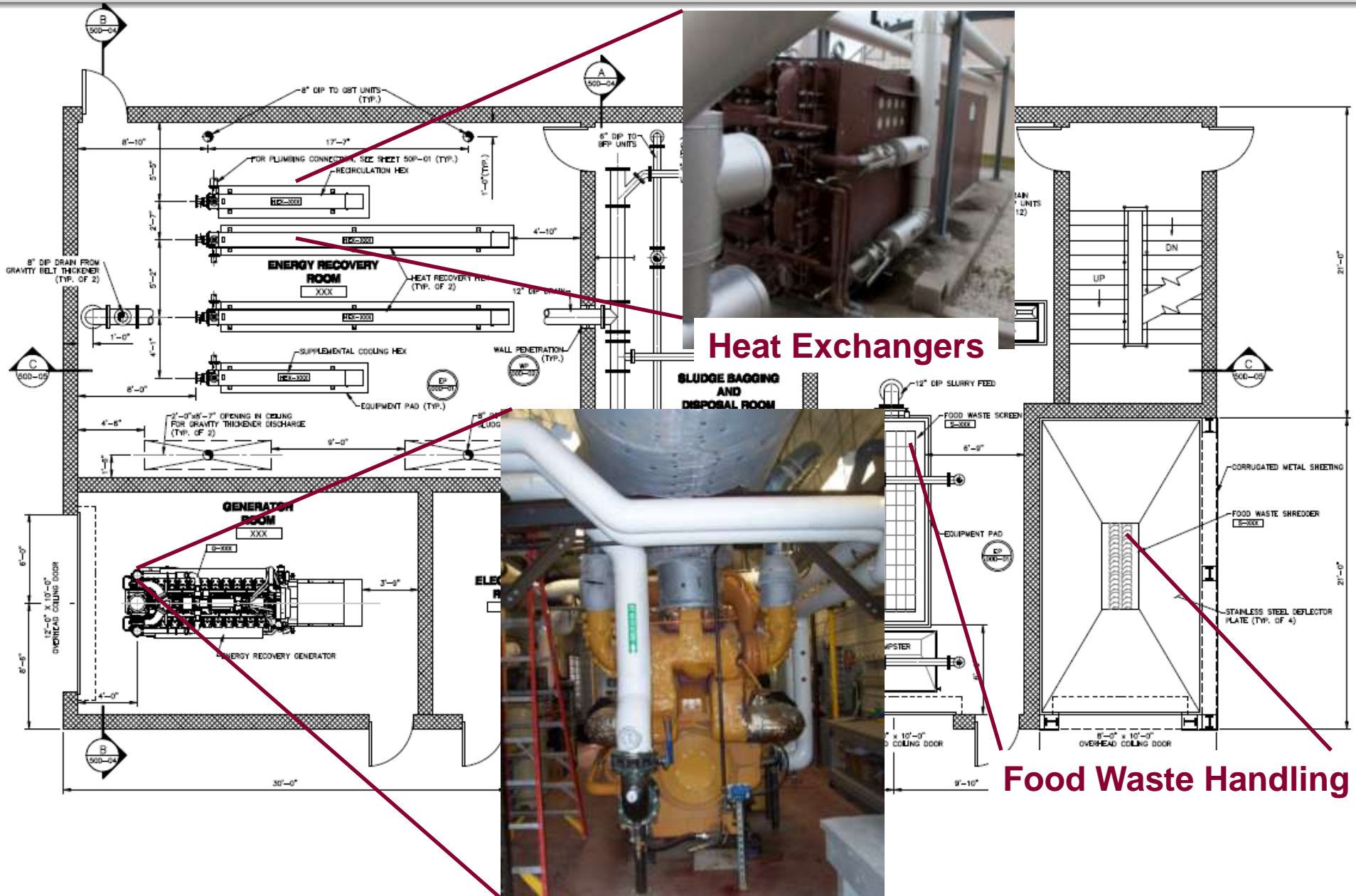


Two (2) 2.0 M Gravity Belt Thickeners

Two (2) 2.0 M Belt Filter Presses

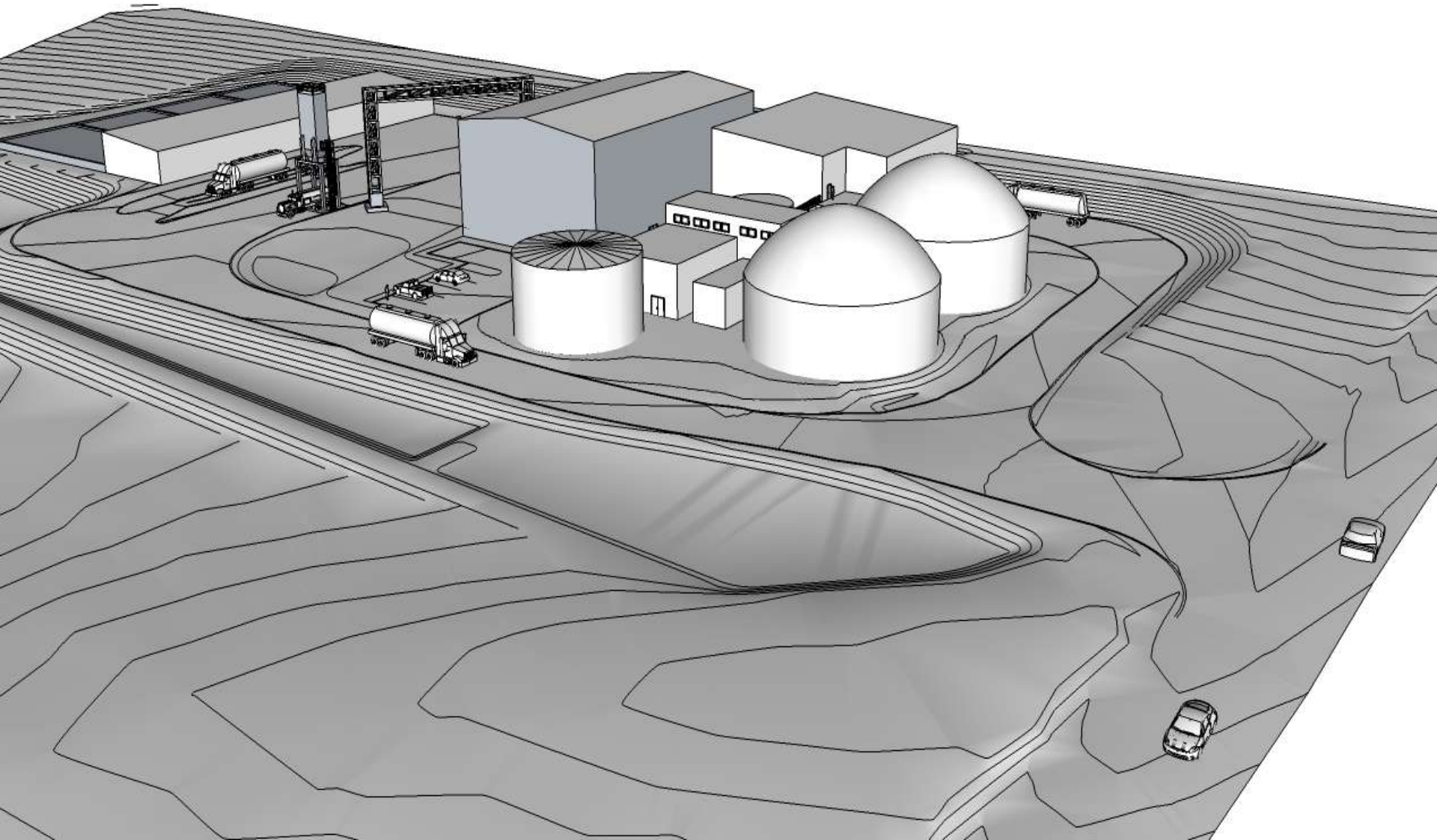
# Typical Two-Stage Anaerobic Digestion





**Biogas Fueled Generators Produce ~5 MW of Green Power**

# Typical Regional Biodigester Facility



# Nitrogen/Phosphorus Cycle – Raw Manure

- Based upon published literature and field testing by HRG, the predicted Influent Nitrogen and Phosphorus is as follows:
  - Influent TKN per Animal 0.64 #/d
  - Influent TP per Animal 0.10 #/d
  - Influent TKN Concentration 3,060 mg/l
  - Influent TP Concentration 450 mg/l
- This data assumes that the manure will be collected within 7 days of excretion and non-aerated storage is provided.



# Nitrogen/Phosphorus Cycle for Biodigester Facility

- During Anaerobic Digestion
  - Cell material is destroyed, freeing Nitrogen and Phosphorus into the liquid manure.
  - Due to biological activity, almost all Organic Nitrogen is expected to convert to Ammonia.
- Wastewater Captured from Thickening and Dewatering Processes is routed to an on-site advanced wastewater treatment facility or conveyed to POTWs.
  - On-site facility is designed to reduce and remove Nutrients for a low-level Discharge.



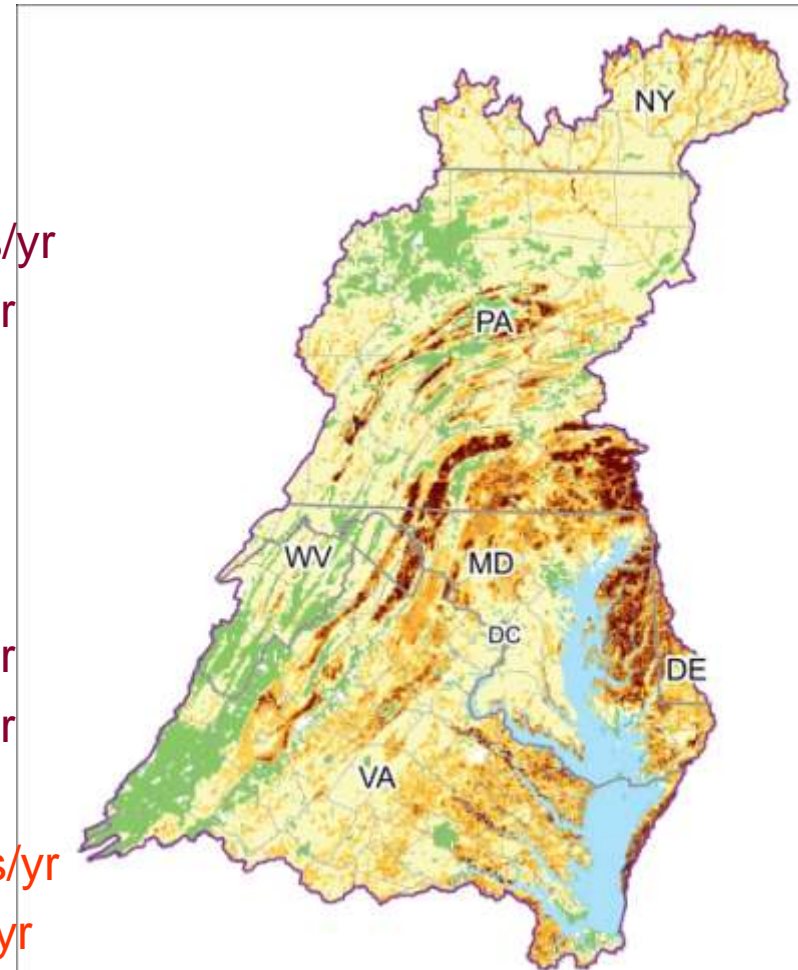
# Proposed Hydraulic Process Train

- Wastewater Treatment
  - Wastewater from Thickening and Dewatering approximately 0.160 MGD
  - Equivalent in Organic Load to 40 MGD of domestic wastewater
  - If on-site treatment is required:  
Advanced Biological Treatment with Membrane Bioreactors and 20 Tons per Day of Oxygen Generation
  - Effluent Goals of <5 BOD, <5 TSS, <5 TN, <1 TP
  - Effluent is suitable for Reuse Applications, including irrigation, and process water



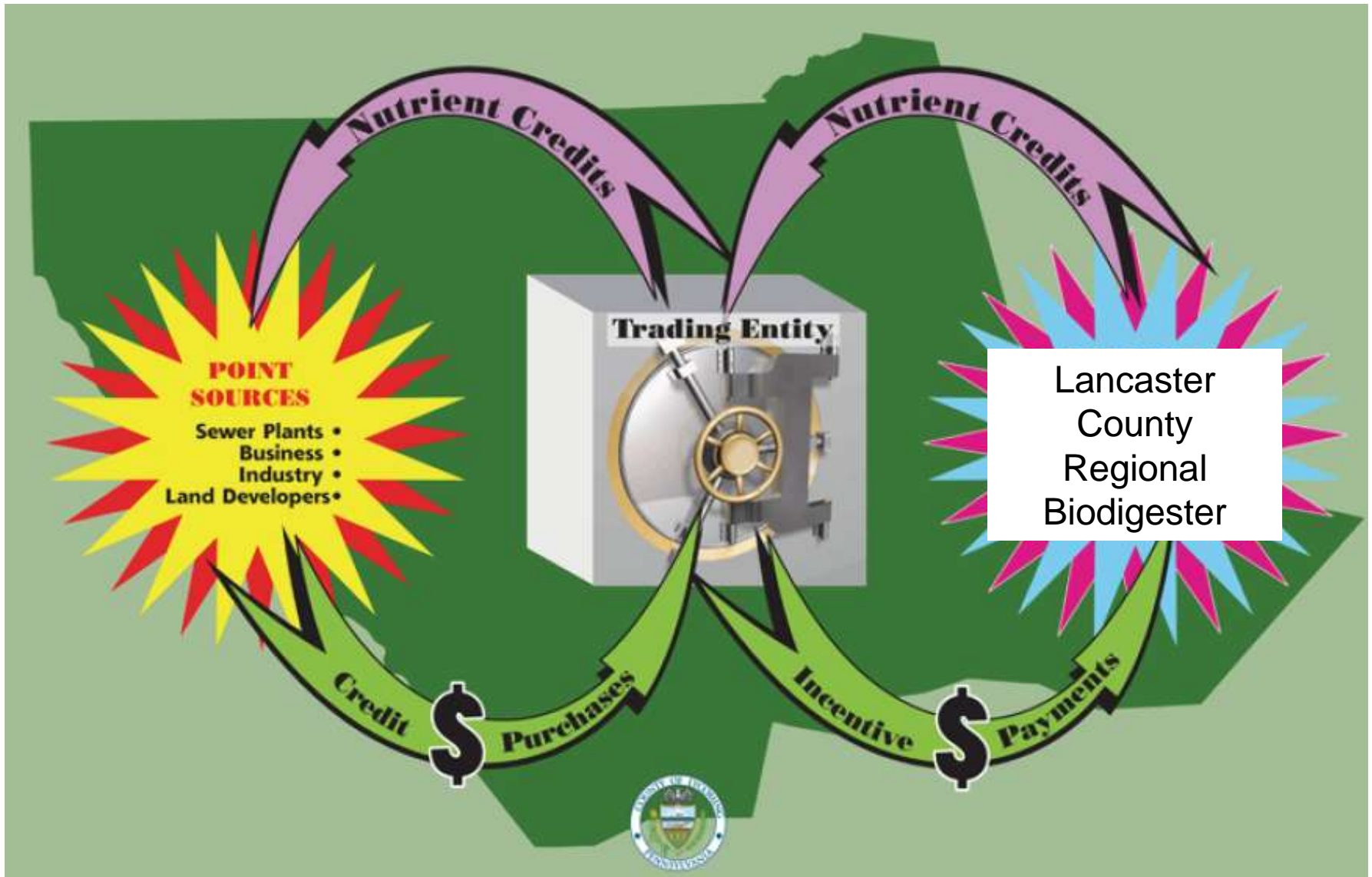
# Nutrient Credit Generation

- Influent to Facility Loadings:
  - Nitrogen Loading 2,035,726 lbs/yr
  - Phosphorus Loading 972,100 lbs/yr
- Discharged from the Facility (Air/Water):
  - Nitrogen Loading 62,247 lbs/yr
  - Phosphorus Loading 395 lbs/yr
- Replacement Fertilizer:
  - Nitrogen Loading 977,650 lbs/yr
  - Phosphorus Loading 243,450 lbs/yr
- Nutrient Credits Produced:
  - Nitrogen +-650,831 lbs/yr
  - Phosphorus +-38,527 lbs/yr

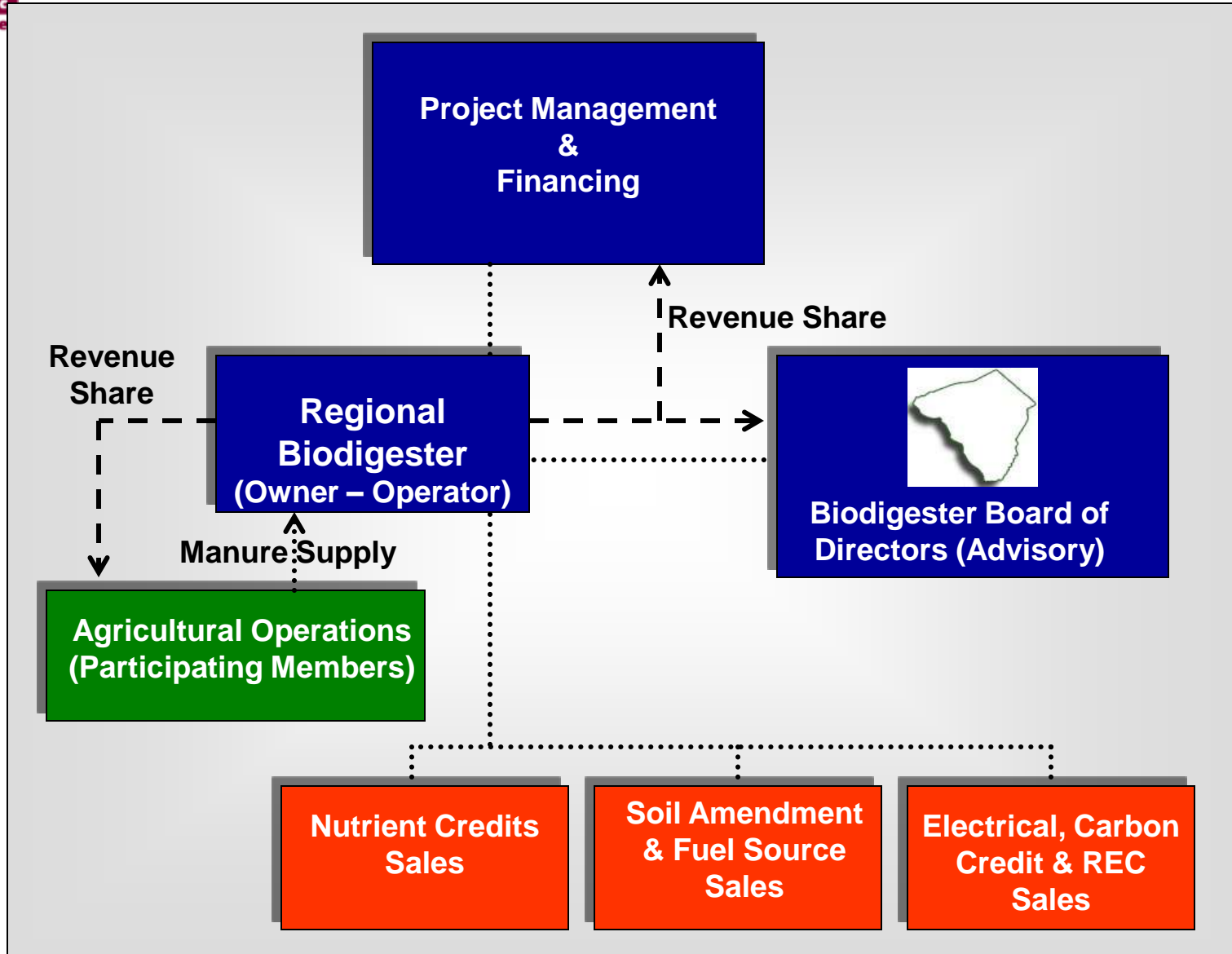


Source: PA DEP Nutrient Trading Guidance

# Nutrient Credit Trading



# Organizational Structure of Digester Facility



# Revenue Sources and Markets

- **Electricity Sales (Utilities and Local Facilities)**
  - Below 5 MW, PA is Financially Advantageous State to Deploy Alternative Energy Sources
- **Environmental Attribute Sales (National and Regional Entities)**
  - Renewable Energy Certificates
  - Carbon Credits
  - Nutrient Credit Sales
- **Soil Amendment/Dried Fuel Sales (Regional and Local Markets)**
  - Dried Manure/Biosolid Combination is valuable Soil Product
  - Has Fuel Characteristics of Lignite Coal, Less Environmental Impact
- **Biosolids Tipping Fees for Sludge Drying (Local POTW's) and Post-Consumer Food Products**
  - Produces Environmentally Sustainable Product at Low Costs

# Agricultural Producer Benefits

- **Increased Revenue**
  - Reduction in manure disposal costs
- **Potential for Herd Expansion**
  - Removes Manure and Nutrient Planning as Critical Factor in Herd Management
  - Reduces Risk of Future Regulatory Impacts
- **Enhanced Opportunities for Nutrient Management**
  - Removal of Manure allows for Alternative Strategies
    - Cover Cropping
    - Precision Agriculture
    - Riparian Buffers

# Lancaster County Community Benefits

- **Agricultural Community Stability Enhancement**
  - Increased Revenues for Agricultural Community
  - Protection from Regulatory Impacts/Cost Impacts – EPA Focused on Lancaster County
- **Reduced Operational Costs for Local Facilities**
  - Reduced Cost for Disposal of Food Manufacturing or other Industrial or High-Strength Wastes
  - Reduced Cost for Biosolids Disposal for WWTP's
  - Avoided Capital Costs for WWTP's for Nutrient Removal
- **Energy Utilization and Optimization**
  - Utilizing Waste Products (such as Food Waste) to generate Alternative Energy as opposed to Landfilling

# Lancaster County Biodigester Feedstock Needs

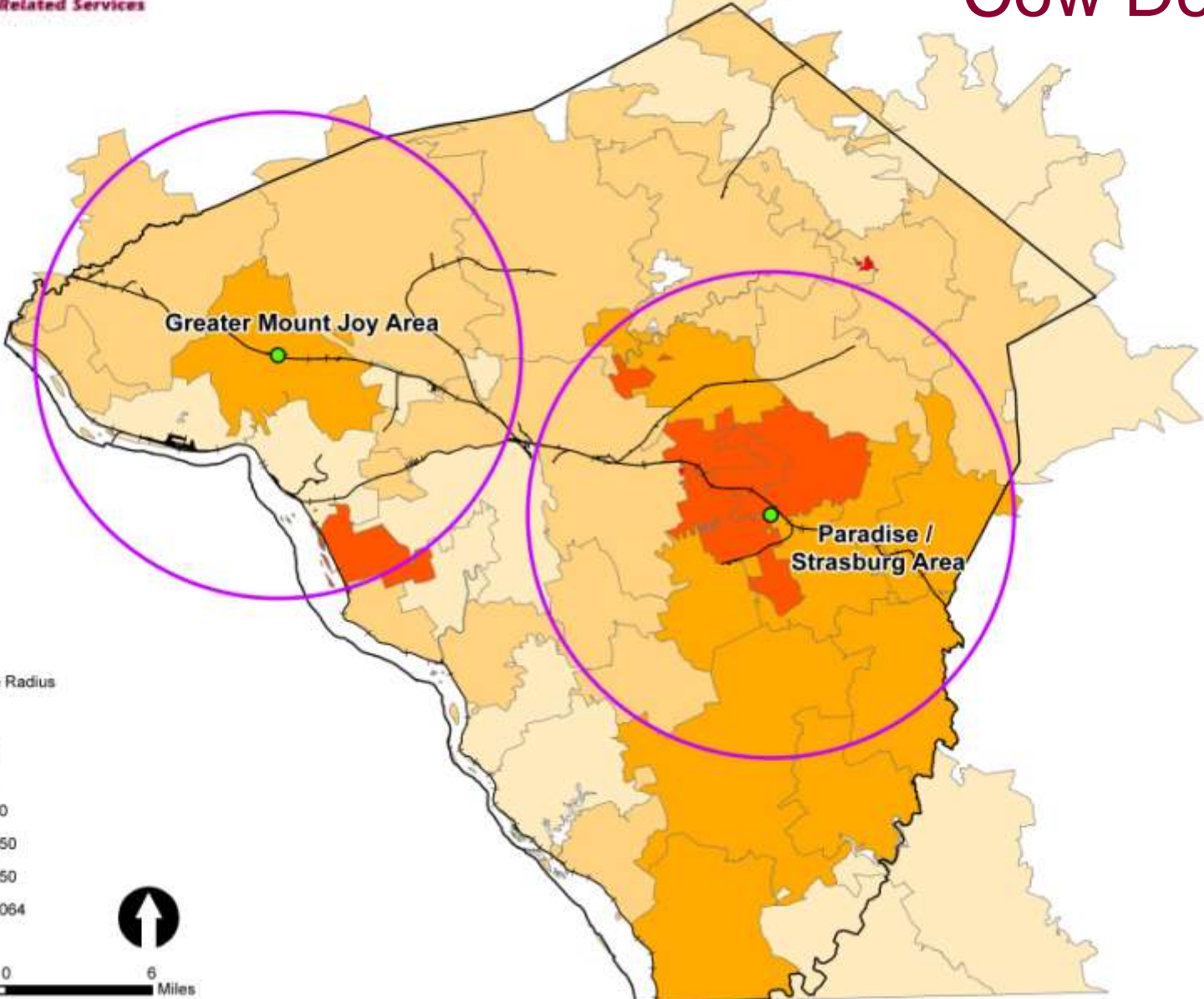
- Plant Needs - 0.170 Million Gallons per Day (MGD) of Dairy Manure or Equivalent located within a 10-mile radius from the facility
- Approximately 7,000 Dairy Cow Treatment Capacity
- Alternate Feedstocks as a supplement to Dairy Manure:
  - Waste Food Products (Commercial/Industrial)
  - Alternative Manure (Swine)
  - High Strength Industrial Organic Waste
  - Municipal Sludge

# Potential Project Sites in Lancaster County

- **Feasibility Study goal is identification of 2 potential project sites for further study**
- **Greater Mount Joy Area**
  - Dense animal herds, large farms especially near Washington Borough
  - Highway networks (Routes 283, 441 & 30)
  - Railroad access nearby
  - Potential partnerships with industrial/manufacturing facilities
  - Interconnection to nearby electric substations
- **Paradise/Strasburg Area**
  - Dense animal herds – 50% of dairy cows in County are within 10 miles of Paradise
  - Known water pollution issues in the form of stream impairments
  - EPA, PA DEP and private environmental groups have identified this area for nutrient compliance enforcement



# Lancaster County Cow Density



# Next Steps for Lancaster County Project Implementation

- **Forming of Partnerships**
  - Agricultural Community Participation
  - Commercial/Industrial Sector Participation
  - Identification of potential sites
  - Project “Synergies”
- **Feasibility Study Completion**
  - Review Feedstock Characteristics and Energy Value
  - Develop Estimates of Probable Construction Costs
  - Review Operational and Maintenance Costs and Revenue Generation
  - Due Diligence Report
- **Pilot Testing**
  - If Feasibility is Viable, Evaluate Actual Performance for Comparison
  - Proof of Design



**Thank You!**

**Questions?**