



Technical Education and Analysis for Community Hauling and Anaerobic Digesters (TEACH AD)

TEACH AD Webinar Series - December 8, 2021

Developing Environmental Offsets from Anaerobic Digestion Projects:
Featuring a Case Study from Des Moines Metropolitan Wastewater Reclamation Authority
Renewable Natural Gas Upgrade

Technical Education and Analysis for Community Hauling and Anaerobic Digesters – **TEACH AD**

The goal of this program is to help communities and water resource recovery facilities in the Midwest region divert food waste from landfills by providing education and no-cost technical assistance to explore the increased adoption of anaerobic digestion and renewable energy biogas technologies.

- Educational Assistance
- Technical Assistance

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Webinar Speakers



Marcello Pibiri

UIC Energy Resources Center



George D. Sullivan

Net Zero Analysis



Scott Hutchens, P.E.

Des Moines Metropolitan Wastewater Reclamation Authority

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our sponsor!



Q&A

Submit your questions to the host using the Q&A box in the upper right-hand corner

Survey

After the presentation you will receive a brief survey. We appreciate your feedback

Presentations

A recording of today's webinar will be posted on the TEACH AD webpage and you will be emailed a link by early next week

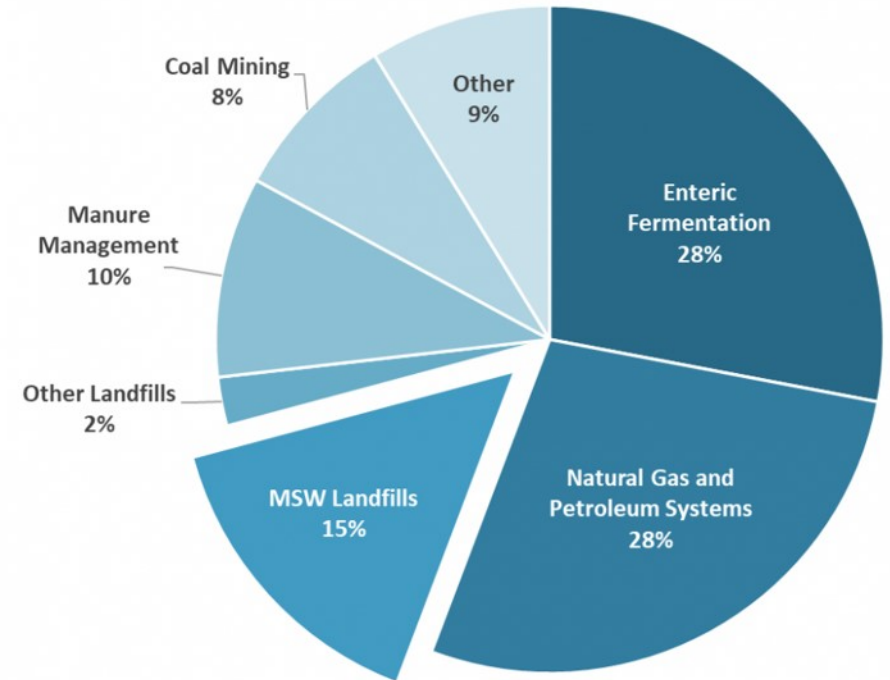
Technical Issues

Contact Sam Rinaldi at: samr@uic.edu or 312-996-2554 for assistance

Importance of diverting food waste from landfills

- Municipal solid waste (MSW) landfills are the third-largest source of human-related methane emissions in the United States
- By reducing the amount of food waste landfilled, we reduce methane emissions

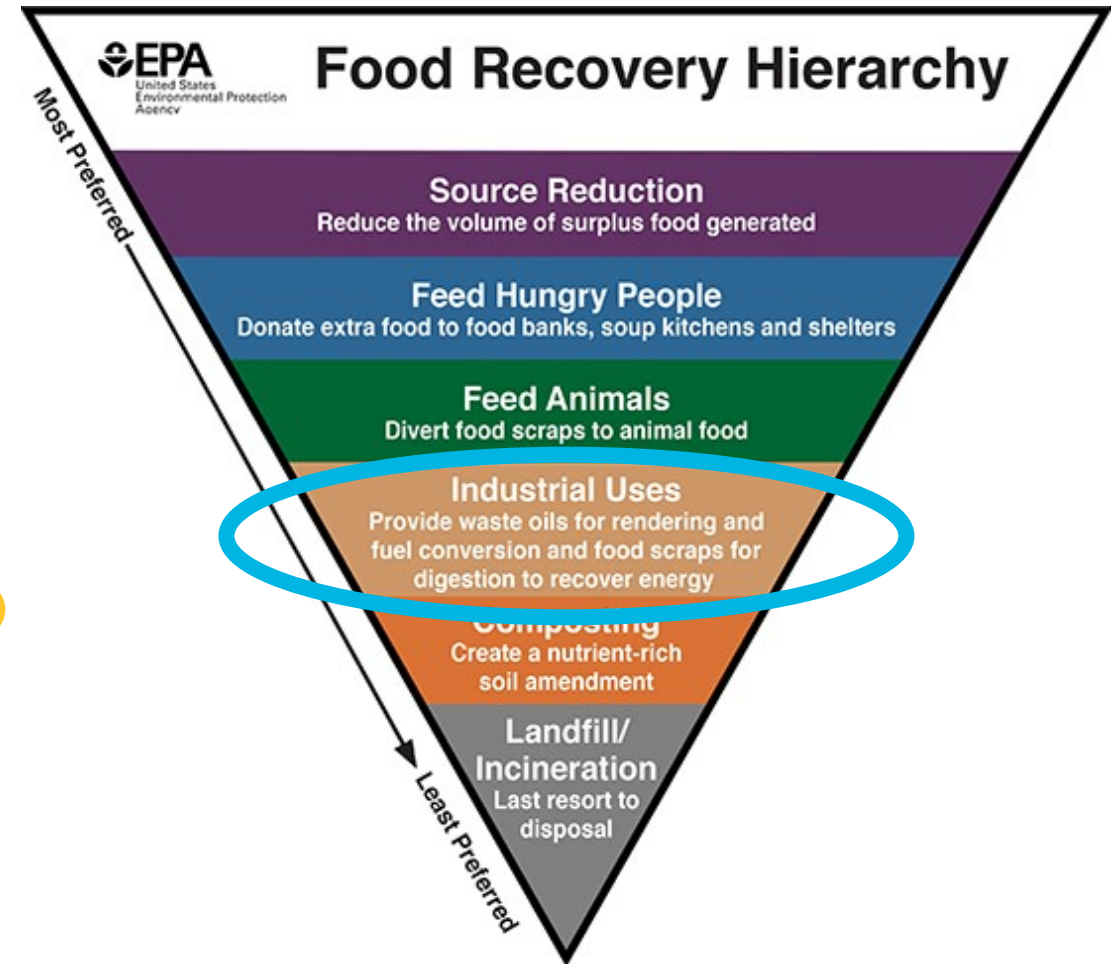
2018 U.S. Methane Emissions, By Source



Note: All emission estimates from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018*. U.S. EPA. 2020.

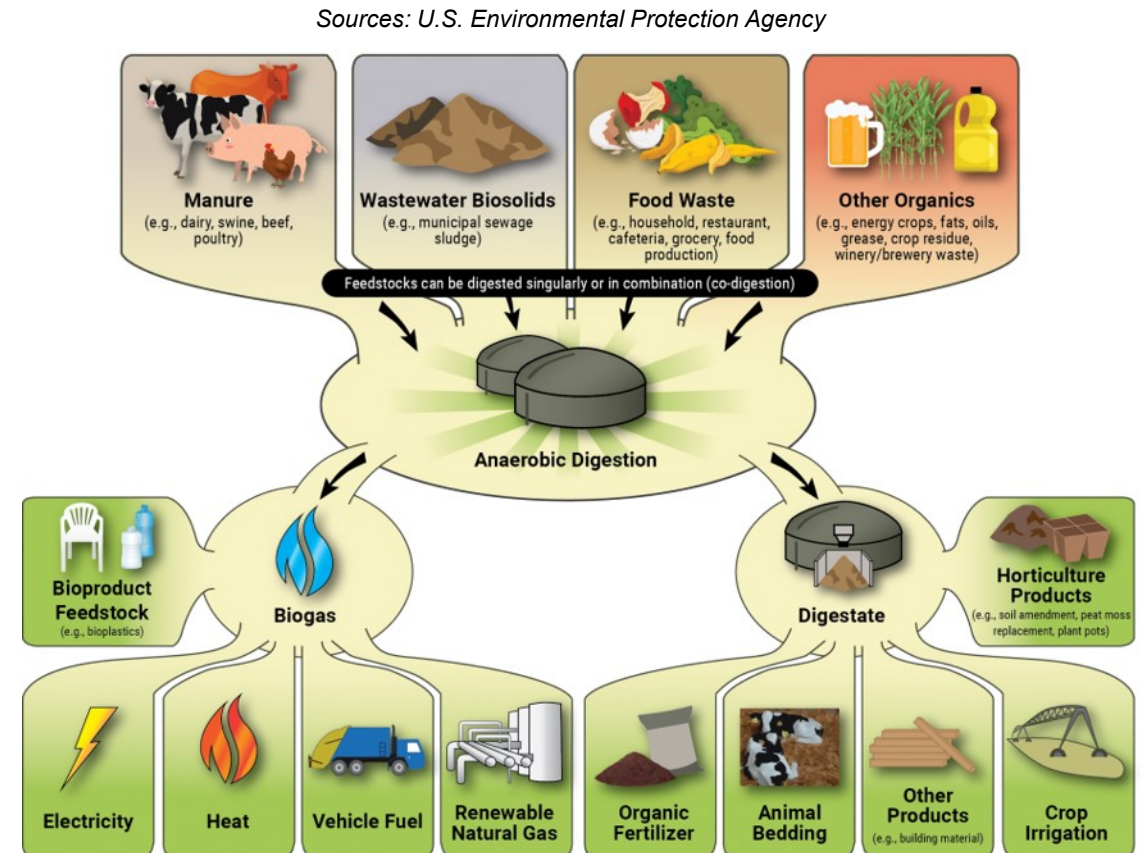
Importance of diverting food waste from landfills

- One-third of all food produced for human consumption worldwide is lost or wasted
- Source Reduction
- Feed People, Not Landfills
- Industrial Uses
 - **Anaerobic digestion**



Overview of anaerobic digesters

- Anaerobic digestion is the natural process in which microorganisms break down organic materials in the absence of oxygen.
- Two valuable outputs
 - Biogas
 - Digestate



Environmental Impacts of U.S. Food Waste:

What resources go into a year of food loss and waste in the U.S.?



*excluding impacts of waste management, such as landfill methane emissions



Greenhouse gas emissions of more than 42 coal-fired power plants

Enough water and energy to supply more than 50 million homes



The **amount of fertilizer** used in the U.S. to grow all plant-based foods for U.S. human consumption

An **area of agricultural land** equal to California and New York



Waste Water Treatment RNG

Carbon Offset Project Development

Presented by:

Net Zero Analysis & Design



We work globally, assisting companies in achieving Carbon Neutrality and Net Zero Emissions within United Nations frameworks.



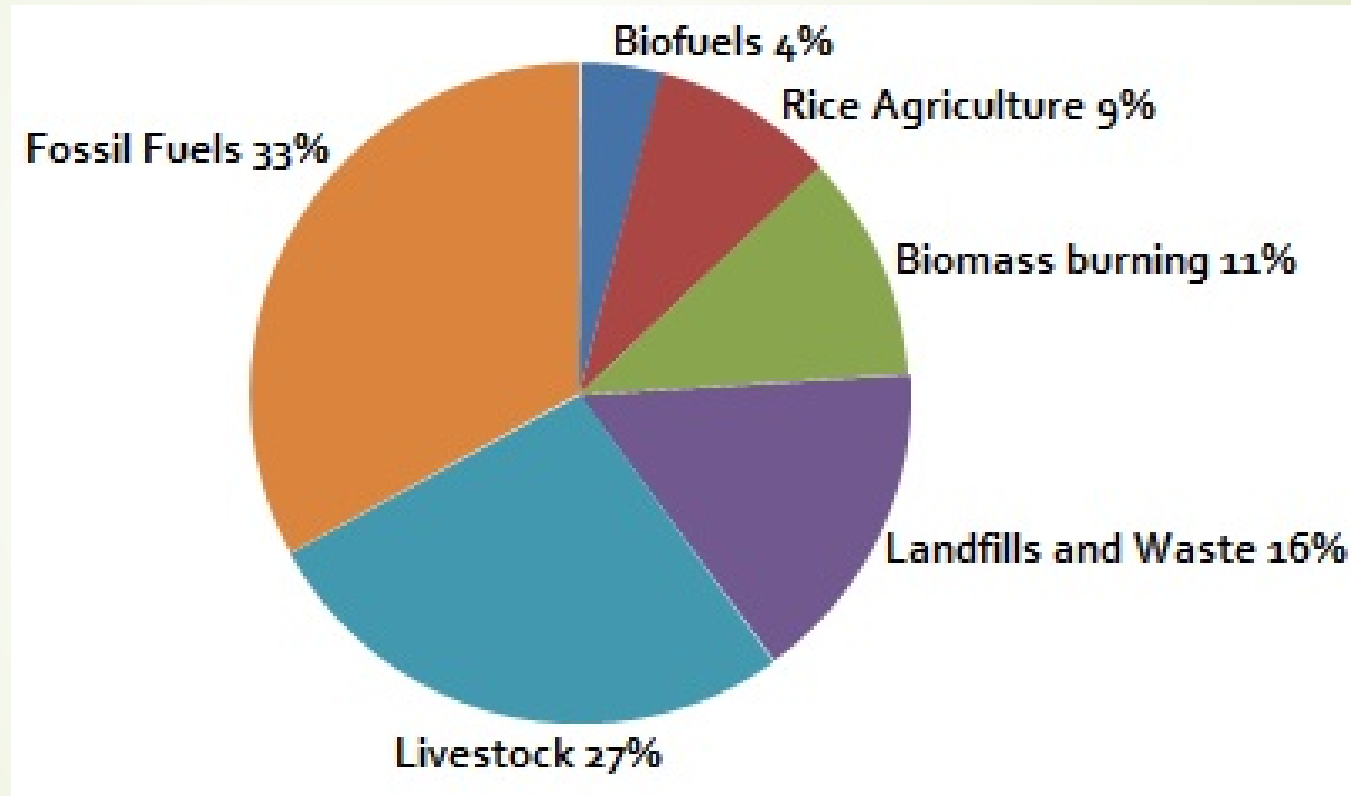
What is Renewable Natural Gas

- ▶ Methane is a powerful greenhouse gas with a 100-year global warming potential 28-34 times that of CO₂. Measured over a 20-year period, that ratio grows to 84-86 times.

About 60% of global methane emissions are due to human activities. The main sources of anthropogenic methane emissions are the oil and gas industries, agriculture (including fermentation, manure management, and rice cultivation), landfills, wastewater treatment, and emissions from coal mines. Fossil fuel production, distribution and use are estimated to emit 110 million tonnes of methane annually.*

* From <https://unece.org/challenge>

Sources of Methane






Anaerobic Digestion – Waste Water Treatment

- Food Aggregation to Waste Water Treatment Facilities
- Generates Several Cascading Carbon Offset Projects
- Using the RNG Generated to power the Waste Water Treatment Facility Results in:



Anaerobic Digestion – Waste Water Treatment

- Methane Collection and Destruction
 - Renewable Electric Generation (REC's)
 - Thermal Renewable Energy Credits (T-REC's)
 - Compressed RNG for Vehicle Use
- 



Carbon Offset Project Development

- ▶ United Nations Framework Convention on Climate Change - Clean Development Mechanisms (US - Methodologies)
- ▶ Methane Capture and Destruction – **Generators**
 - CHP - using RNG generates extremely low carbon
 - Renewable Electric used in the plant
 - Thermal RECs to heat the process
 - Compresses RNG for Transportation is Low Carbon Fuel Standard Credits



Carbon Offset Project Development

- ▶ United Nations Framework Convention on Climate Change - Clean Development Mechanisms (US - Methodologies)
- ▶ Methane Capture and Destruction – **Offtakers**
 - Plants and real estate for pipeline gas and renewable electric
 - CHP or District Energy Systems that generate electric and Thermal RECs
 - Large Users: Municipal, School Districts, Universities, etc.
 - Compresses RNG for transportation



Project Carbon Offset Generation

- ▶ United Nations Framework Convention on Climate Change – Clean Development Methodologies **RNG to Electric** –
 - Methane Capture and Destruction Project Generating Renewable Electricity is a standard Carbon Offset Project
 - Offtakers that use 100% Renewable Energy (aggregate use of 150,000 Mwh/year) are a secondary Carbon Offset Project
 - Electric Material Handling and/or EVs and EV Charging Stations Generate an additional carbon offset project
 - ✓ Low Carbon Fuel Standard Credits




Project Carbon Offset Generation

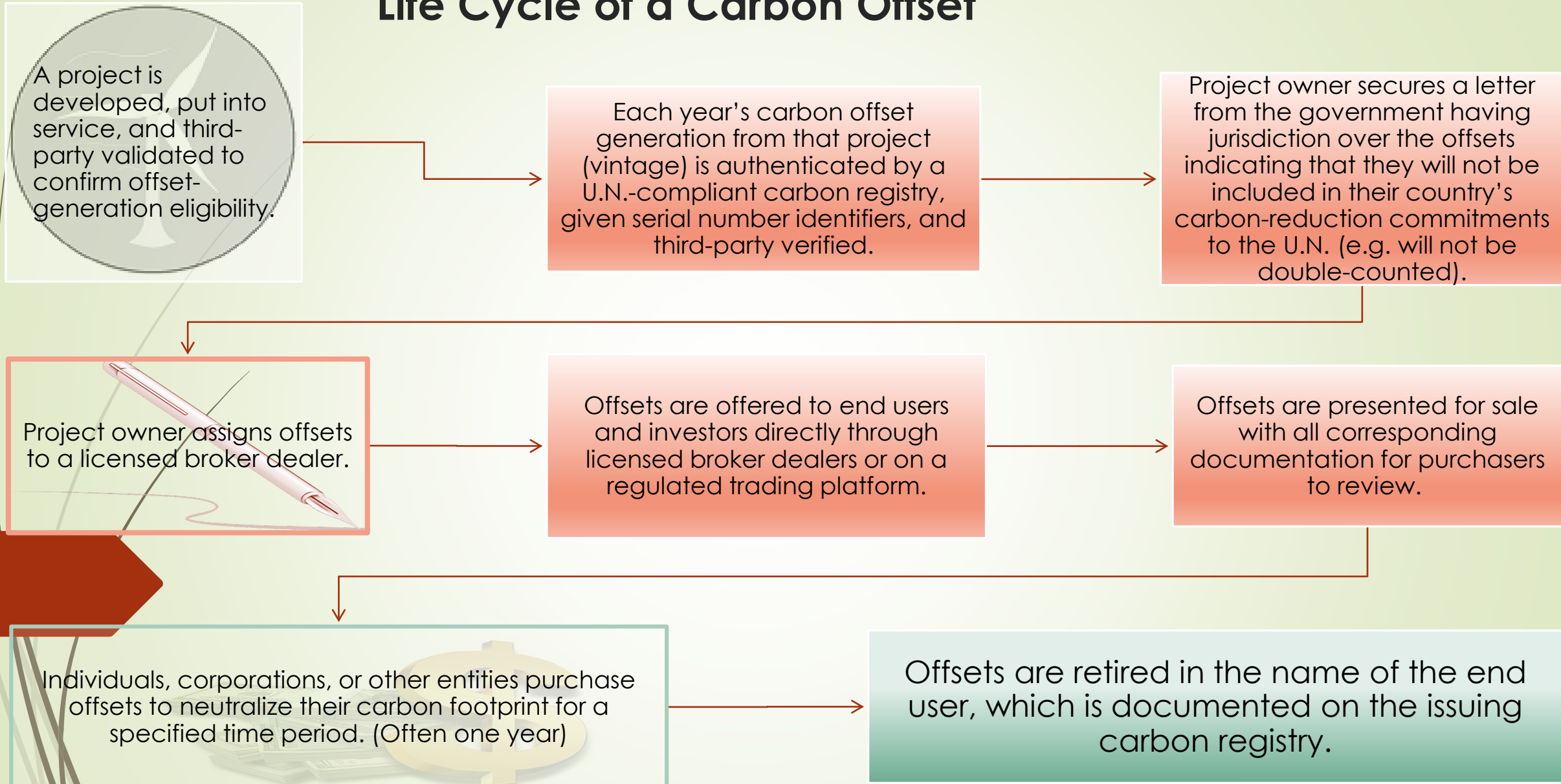
- ▶ United Nations Framework Convention on Climate Change – Clean Development Methodologies **RNG to CRNG and Pipeline Gas**
 - Compressed Renewable Natural Gas used in transportation generates:
 - ✓ Low Carbon Fuel Standard Credits (LCFS)
 - ✓ Renewable Index Numbers (RINs)
 - Offtakers that use 100% Renewable Natural Gas generate a secondary Carbon Offset Project



Carbon Offset Composition – 3 Prongs

- **Environmental** - MT of CO₂e sequestered from the atmosphere or not released to the environment
 - **Social** – Improved local, state/province, national economy and environmental health
 - **Governance** – Demonstrates proactive pursuit of new revenue opportunities, risk mitigation, and future-proofing to stakeholders. Increased public goodwill.
- 

Life Cycle of a Carbon Offset





Carbon Offset Project Rolls

- ▶ Project Proponent – is an ISO 14001 Environmental Management Systems Lead Auditor Specializing in ISO 14024/25 and ISO 14064/65/66
 - UNFCCC carbon offset registries
 - Current methodologies
 - Updated methodologies
 - Direction on new methodology development is technology-based projects
 - Annual UNFCCC Congress of the Parties ruling on methodologies



Carbon Offset Project Rolls

➤ Carbon Offset Registries

- U.S. SEC announcement requiring reporting to the UNFCCC under Principals for Responsible Investing
- UNFCCC Carbon Offset Platform
- Verra
- Gold Standard
- Other carbon offset registries have not held up to regulatory review and limit your carbon offset project income



Carbon Offset Project Rolls

- ▶ Independent 3rd Party Reviewer
 - ISO 14001 EMS Lead Auditor Specializing in ISO 14024/25 and ISO 14064/65/66
 - Registered as a 3rd-Party Reviewer with the Carbon Offset Registry you're filing your project on



Carbon Offset Project Rolls

- ▶ Life of a Carbon Offset Project

- Technology Carbon Offset Projects run for 10 years
- At Year 11, projects are reevaluated in accordance with the changes in the methodology that the project was filed under
- Carbon Offsets are generated annually
- Depending on the carbon market, prices range from \$6.00 to \$210.00 per offset



Carbon Offset Project Rolls

- Marketing, Selling, and Purchasing Carbon Offsets
 - Dodd – Frank Act of 2010
 - Defined Carbon Offsets as Securities
 - Regulated under the US SEC
 - Requires a SEC Regulated Broker/Dealer Review of the transaction
 - Entrex Carbon Market is currently the only SEC Regulated Carbon Market in the US



Thank You

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Entrex Carbon Market www.entrexcarbonmarket.com

WRA Co-Digestion & RNG Project Overview

DECEMBER 8, 2021

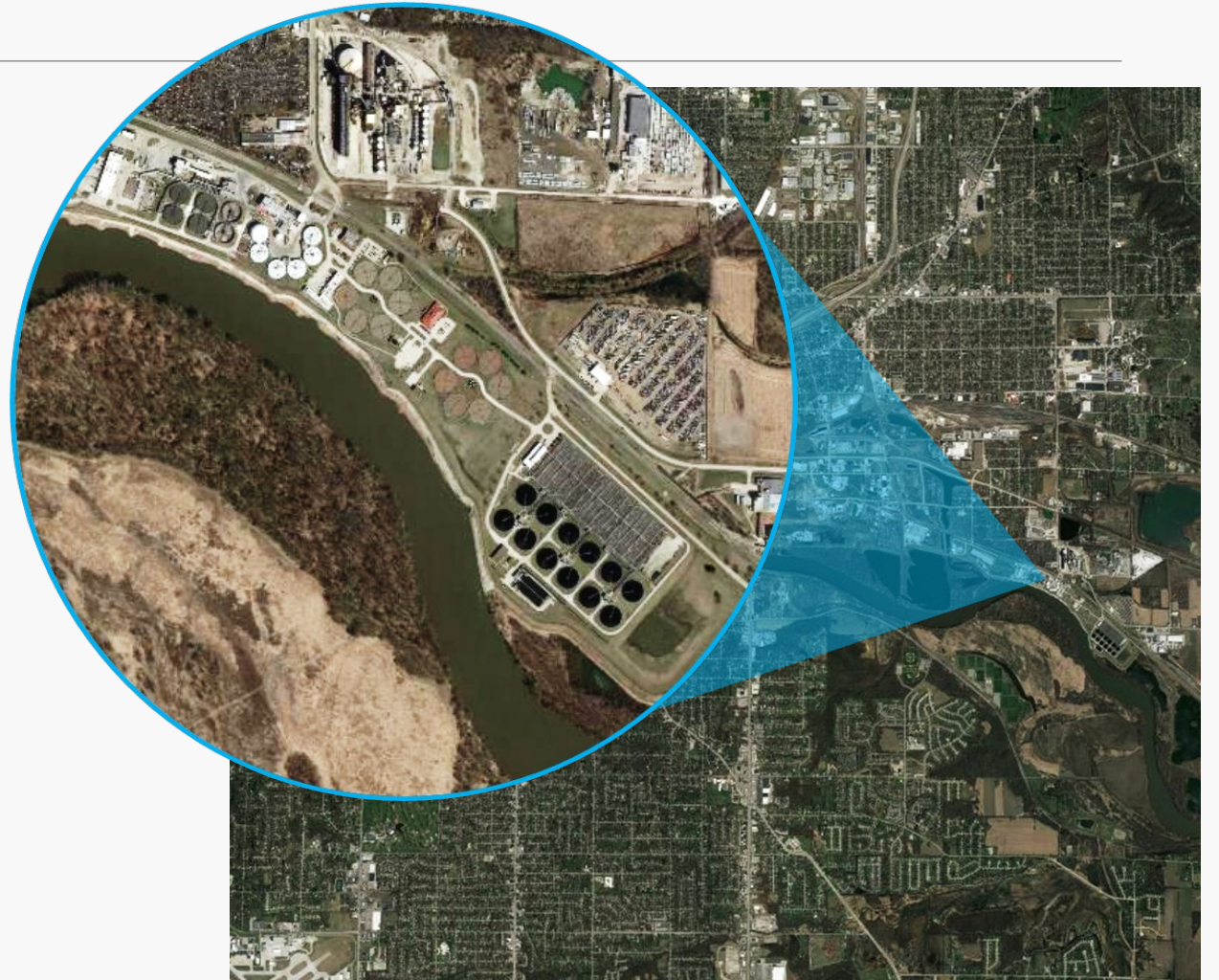
SCOTT HUTCHENS, WRA DIRECTOR

DES MOINES METROPOLITAN WASTEWATER RECLAMATION AUTHORITY

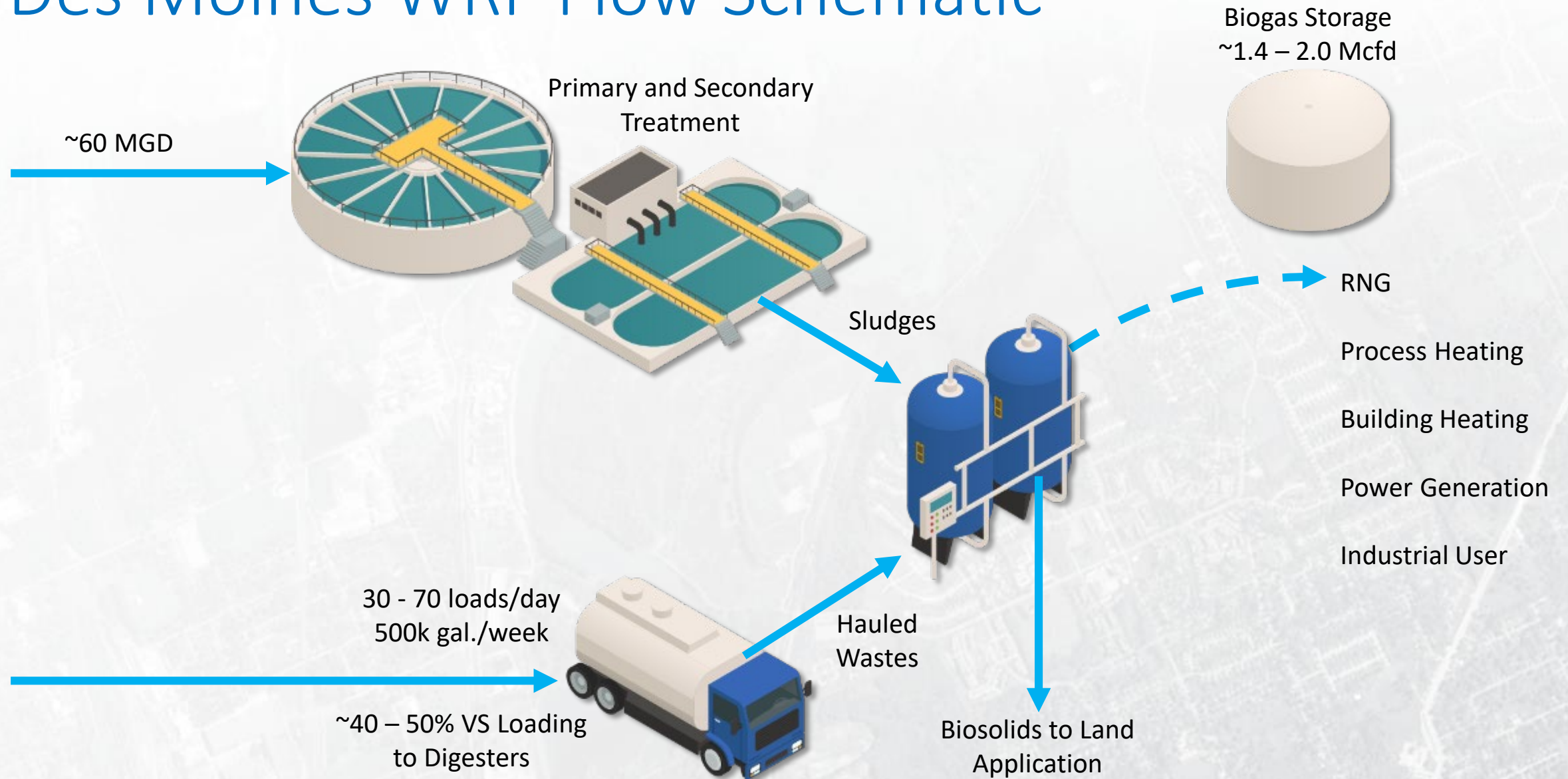


WRA Organization Facts

- The Des Moines Metropolitan Wastewater Reclamation Authority is located in the capital city of Iowa
- Established in 2004
- Includes 17 member communities in the Metro Des Moines area serving 500,000 residents
- Governed by a WRA Board made up of 21 participating community representatives



Des Moines WRF Flow Schematic

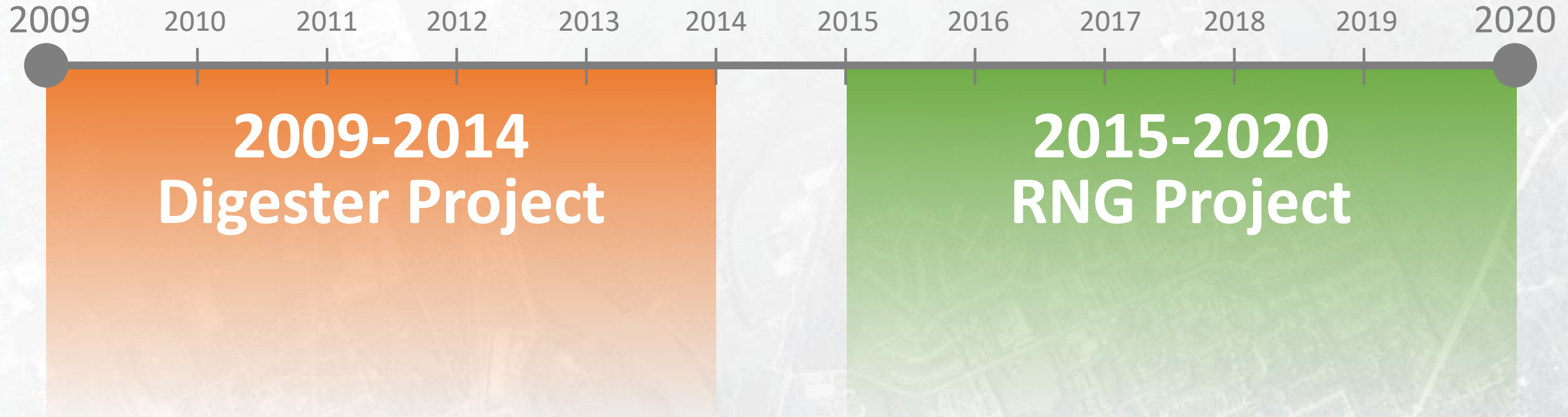


Co-Digestion Waste Sources

- Restaurant Grease Trap / Interceptor Waste
- Dairy Waste
- Biodiesel Waste
- Slaughterhouse / Meat Processing Waste
- Lutein / Protein Waste
- Waste Soy Oil
- Sewage Sludge
- Sugar Waste
- Rendering / Gelatin Waste
- Corn Syrup / Mash



WRA Projects Timeline

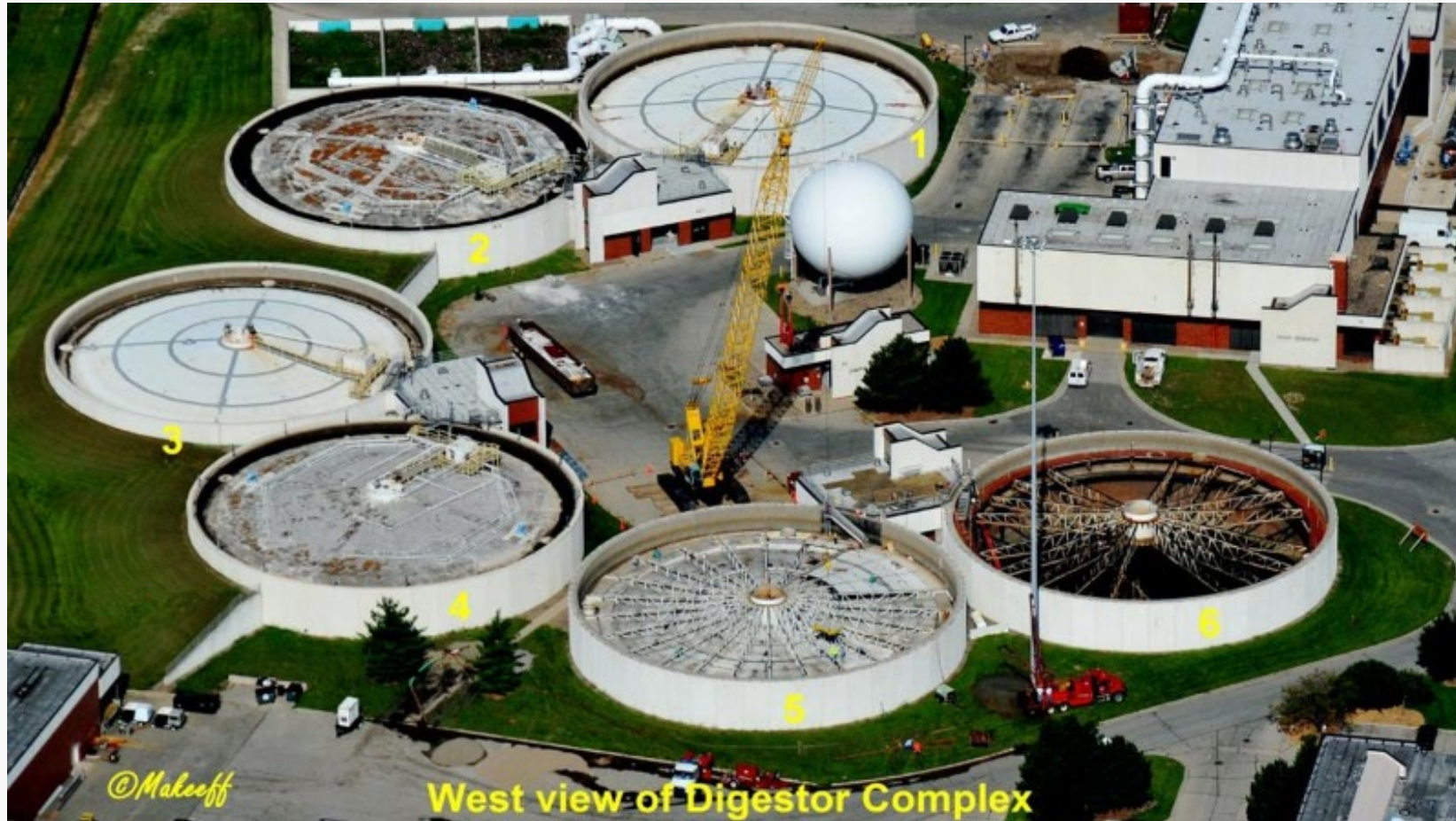


Existing Anaerobic Digesters (2011)

- Non-functional Tank Mixing
- Floating Digester Covers – prone to foaming upsets



New Concrete Fixed Digester Lids Under Construction



Construction of Drilled Concrete Piers



Fixed Concrete Digester Covers



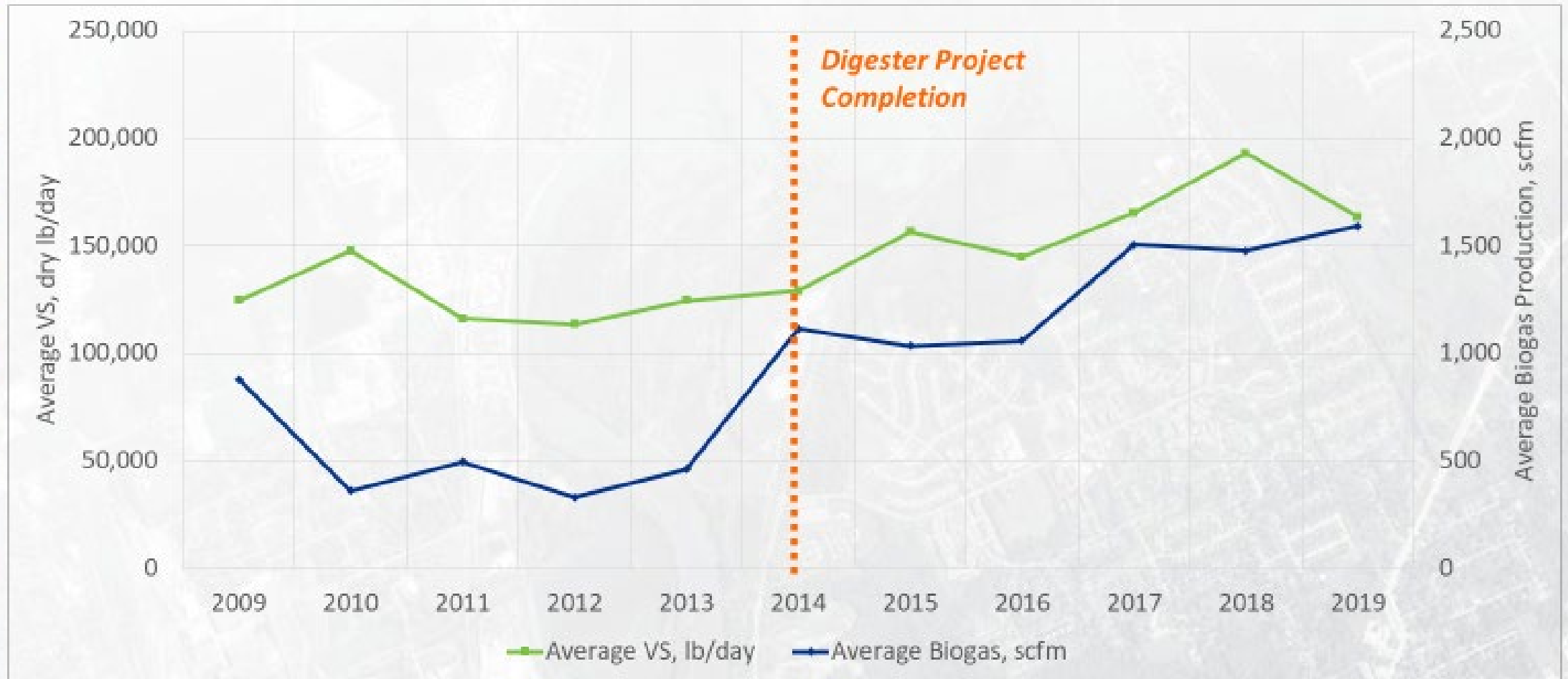
WRA Digester Complex



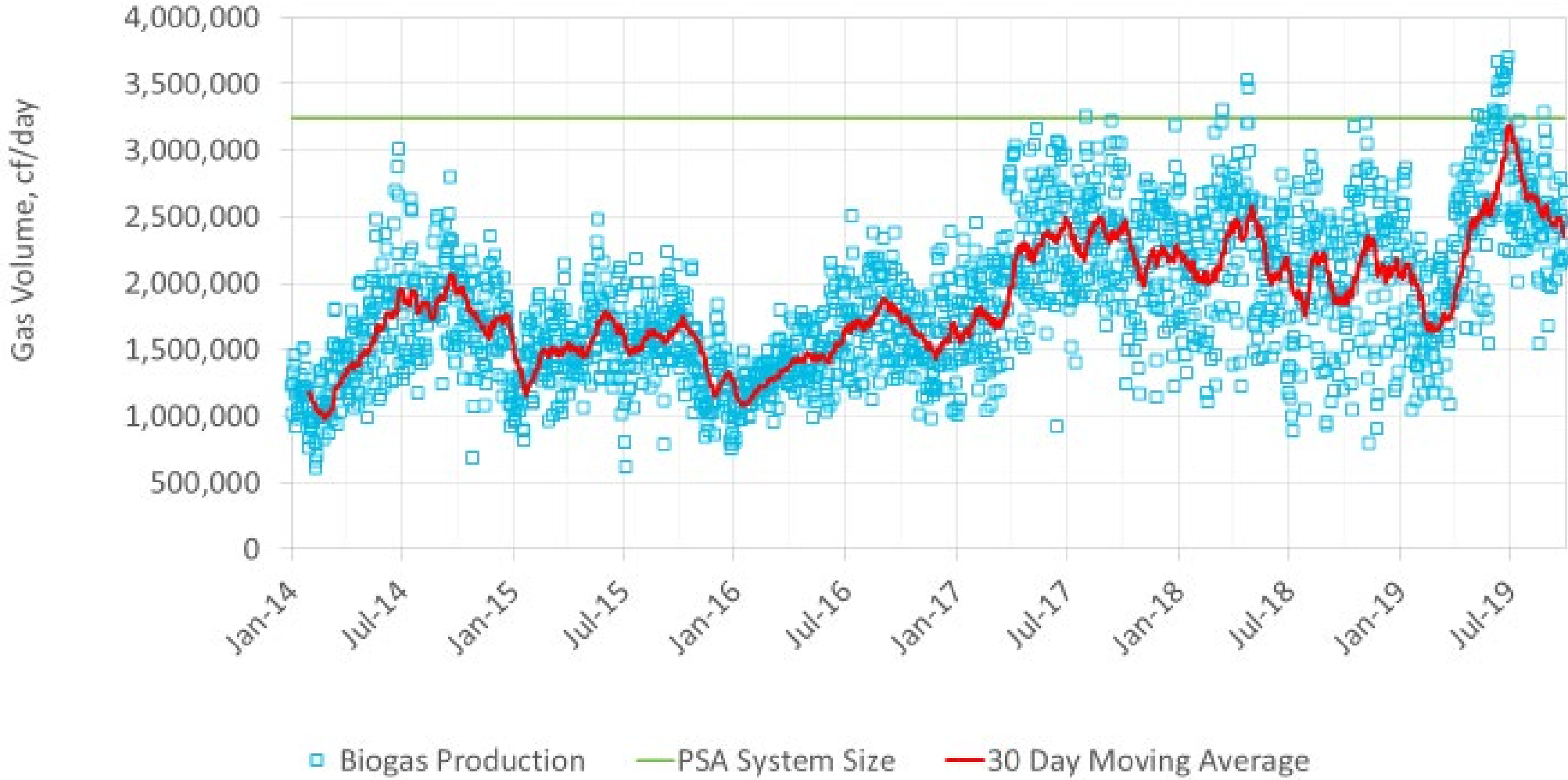
Hauled Waste Receiving



Historical Growth of Biogas Production

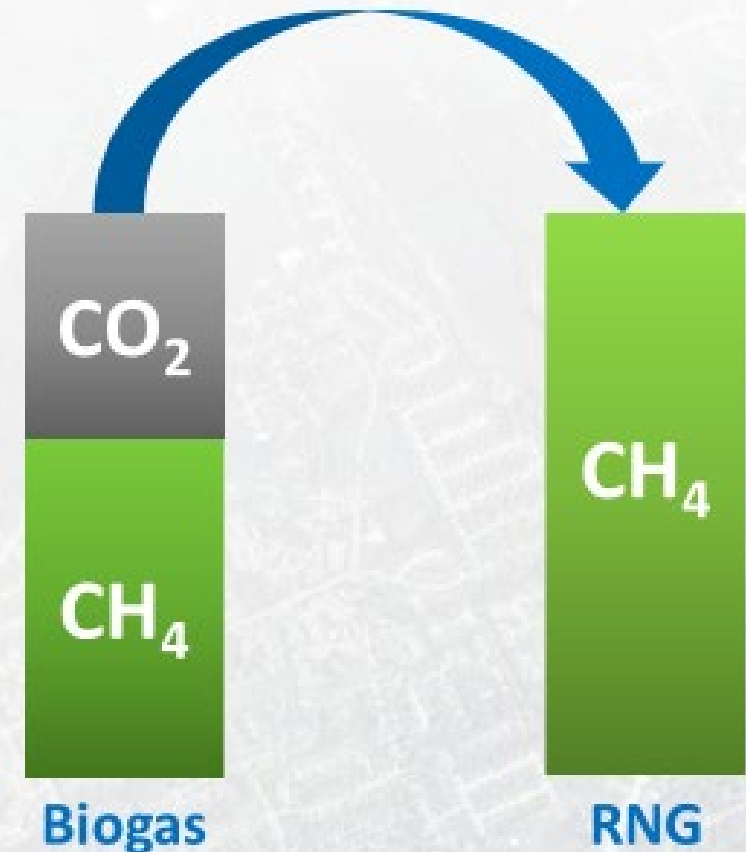


Daily Biogas Production, 2014-2019



\$20 M Biogas to Renewable Natural Gas (RNG)

- 2015-2020
- Upgrade byproduct of wastewater treatment (biogas) to renewable natural gas for pipeline injection
- Project objectives
 - Maximize production of renewable energy
 - Maximize return on investment and renewable energy revenue
 - Beneficially utilize existing infrastructure
- Provides fuel for 5,500 US homes per day

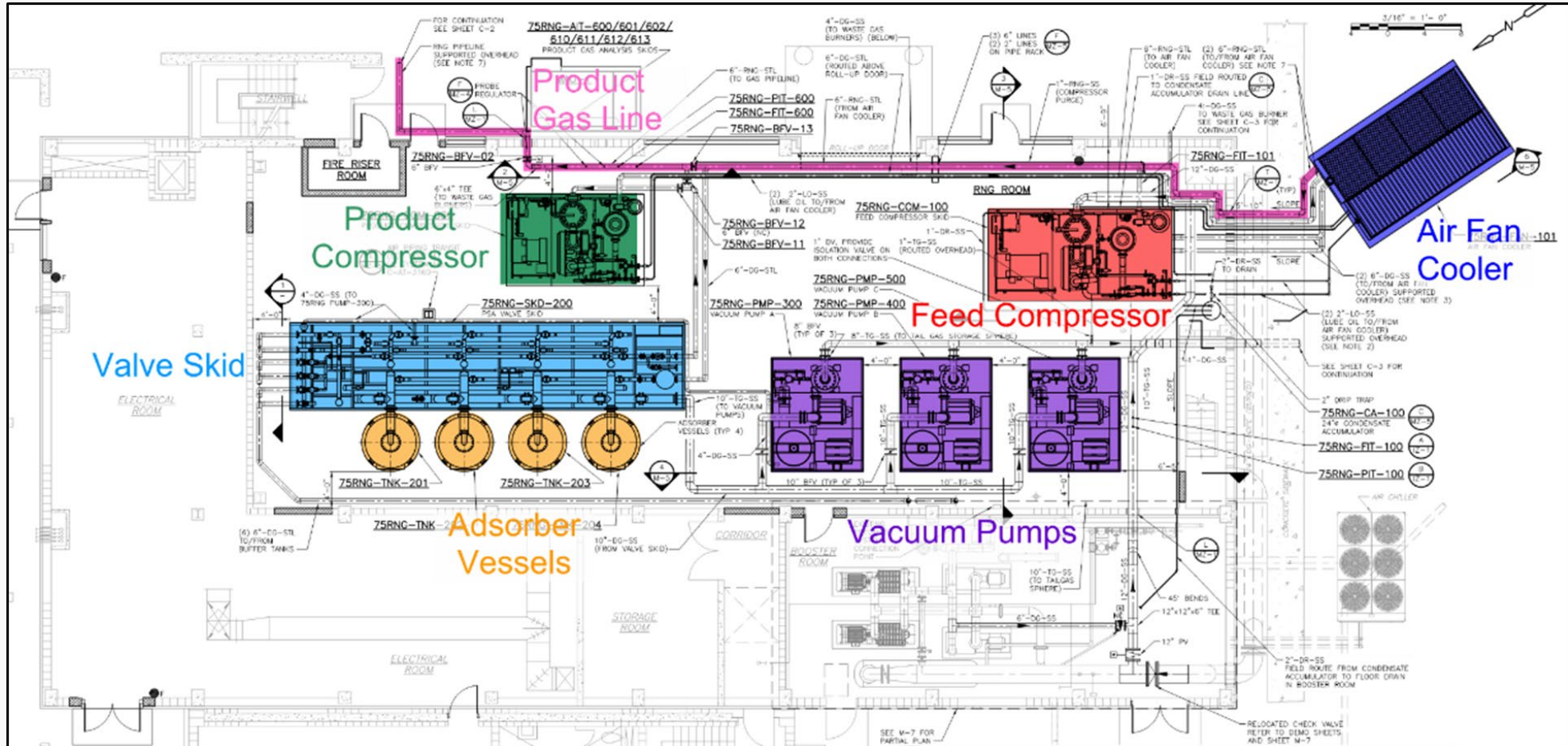


RNG System Design Criteria

Inlet Biogas Flow: 2250 SCFM

Component	Digester Gas	Pipeline Specification
BTU Content	~660 BTU/scf	> 950 BTU/scf
Carbon dioxide	35%	< 3% by volume
Nitrogen	0.7%	< 4% by volume
Total Inerts (N ₂ + CO ₂)	~36%	< 5% by volume
Oxygen	<0.2%	< 0.3% by volume
Water	Saturated	< 5 lb/mmscf
Hydrogen sulfide	Actual: 50-600 ppm Design: 6,000 ppm	< 0.25 grain/Ccf
Total Sulfur	N/A	< 20 grain/Ccf
Volatile Organic Compounds	10-30 ppm	0 ppm

Project Schematic



Old Biogas Fueled Generators













Thermal Oxidizer



System Design Criteria

- Inlet Biogas Flow: 2250 SCFM**

Component	Digester Gas	Pipeline Specification	System Performance (May 2020)
BTU Content	~660 BTU/scf	> 970 BTU/scf	>990 BTU/scf
Carbon dioxide	35%	< 3% by volume	~0.2% by volume
Nitrogen	0.7%	< 4% by volume	~0.03% by volume
Total Inerts (N₂ + CO₂)	~36%	< 5% by volume	~0.25% by volume
Oxygen	<0.2%	< 0.3% by volume	<15 ppm O ₂
Water	Saturated	< 5 lb/mmscf	ND
Hydrogen sulfide	Actual: 50-600 ppm Design: 6,000 ppm	< 0.25 grain/Ccf	0 ppm H ₂ S
Total Sulfur	N/A	< 20 grain/Ccf	ND
Volatile Organic Compounds	10-30 ppm	0 ppm	ND

Monetizing Environmental Attributes in the RNG Market

Short Term Contract – October 2020 to August 2021

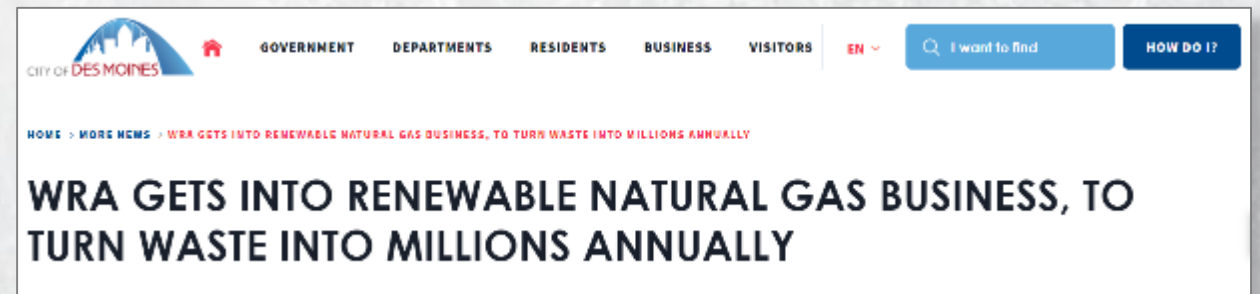
- Allowed WRA to Explore Long Term Deal as we gained operational experience
- Sold Brown Gas Locally as Required by Tariff
- Environmental Attributes were stored – Sold to 3rd party

Long Term Contract – 2021 to 2031

- Explored Options – Qrins, Rins, Fixed Price Market
- Fixed Price Contract for 10 Years
 - Stable Revenue Stream
 - 4-5 Year Project Payback
 - Required Favorable Carbon Intensity Score

Overall Project Outcome

- Conversion of 60 MGD of municipal wastewater + 21,000 tanker trucks/yr of hauled waste into **renewable energy**
- Provides natural gas for 5,500 homes/day
- Organic waste tipping fees: \$1-\$1.5M/yr
- Renewable natural gas value: \$5-6M/yr
- Anticipated payback of ~4-5 years
- [Local News Coverage](#)
- [City of Des Moines Press Release](#)



WRA Director Quote at Start-Up

*“Our facility is the largest wastewater treatment plant in the state of Iowa and one of the first to implement a project of this kind. We’re also the first to inject **renewable natural gas** into the pipeline of the utility company we worked with. It’s been a long time coming but the **collective hard work of many individuals** has allowed this to be a very special and historical moment for our organization.”*

- Scott Hutchens, WRA Director

Thank You

Scott Hutchens, P.E.
WRA Director

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DMMWRA.org

TEACH AD – Educational Assistance

- In person workshops (2)
 - Onsite events
 - Tour of the site
- Webinars (10)
 - Will cover different aspect of an anaerobic digestion project
 - **Join us again on March for our 4th Webinar**
- Project profiles (8)
 - Will highlight successful AD projects
 - **First project profile covering UW Oshkosh Urban Dry Digester**

TEACH AD – Technical Assistance

- Anaerobic Digestion Technical Assessments (20)
 - U.S. EPA’s Co-Digestion Economic Analysis Tool (CoEAT)
 - Initial economic and physical feasibility assessment for (co)digestion of organic wastes
 - Standardized 2-4 page letter report
 - **Technical assistance with a hemp processing business, WRRFs, UIC and more**



TEACH AD - Contact

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PROGRAM OFFERINGS

Technical Assessments

In-person Workshops

On-line Webinars

Project profiles

ELIGIBLE FACILITIES AND PROJECTS

Water Resource Recovery Facilities

Municipal Food Waste Digesters

Community - Based Digesters

Food Processing, On-Farm Digesters

Questions & Answers



Marcello Pibiri

UIC Energy Resources Center



George D. Sullivan

Net Zero Analysis



Scott Hutchens, P.E.

Des Moines Metropolitan Wastewater Reclamation Authority

TEACH AD Webinar Series

Join us again on March for our 4th
Webinar!

Thank You

Please fill out our survey.

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Thank You