
AVEVAWORLD

Civil & Environmental Engineering
IIHR – Hydroscience & Engineering

Cloud-based Machine Learning Solution to Increase Heterogenous Feedstock Conversion to Renewable Natural Gas

AVEVA World Conference 2025

Craig Just

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Iowa Wastewater and Waste to Energy Research Program (IWWERP)

Patent Pending: MACHINE LEARNING-ENABLED OPTIMIZATION OF BIOGAS PRODUCTION

The University of Iowa and industry partners increase profitability of renewable natural gas facilities

Challenge

- Lack of real-time information decreased efficiency and increased downtime
- Lack of trend data limited operator insight
- Lack of a pathway to a digital twin solution limited longer-term value proposition

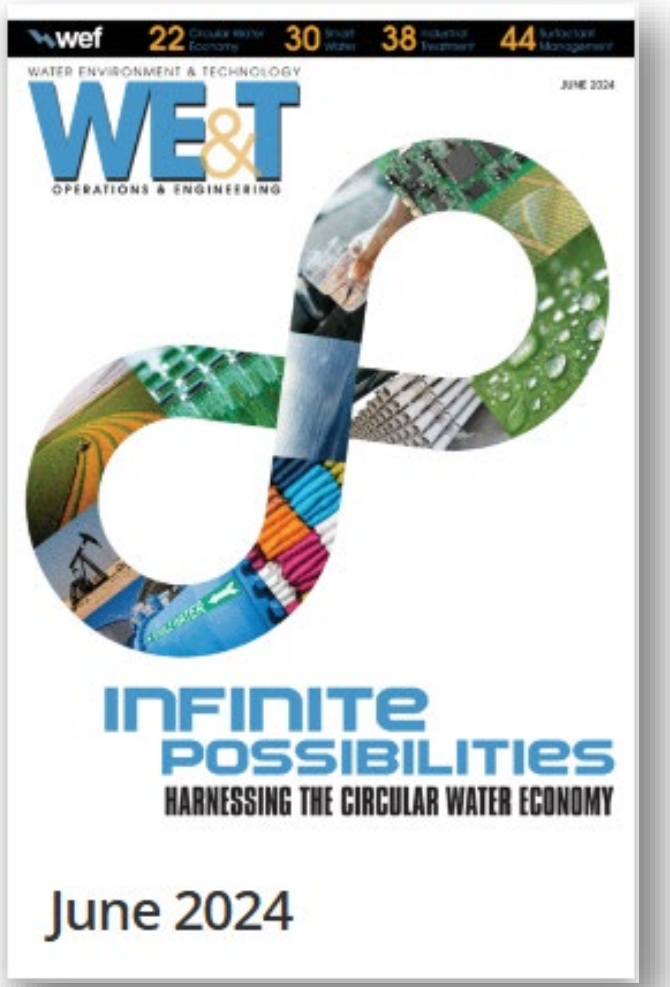
Solution

- Deployed AVEVA Connect Data Service, Communities, Advanced Analytics, and Visualization to deliver real-time data and trends to facility operators

Results

- Delivered a cloud-based, machine learning solution to predict feedstock and digester composition in real-time
- The solution provides a pathway to digital twin implementation

The June 2024 issue of Water Environment & Technology provides a digital twin “maturity spectrum” framework



Level 4. Two-Way Data Integration and Interaction

- **Focus:** implementing two-way data communication to enable process optimization based on data analysis and model simulations
- **Benefits:** enables closed-loop control systems for automated process adjustments and facilitates scenario simulations for optimizing operations
- **Water sector adoption:** limited, but pioneering projects exist

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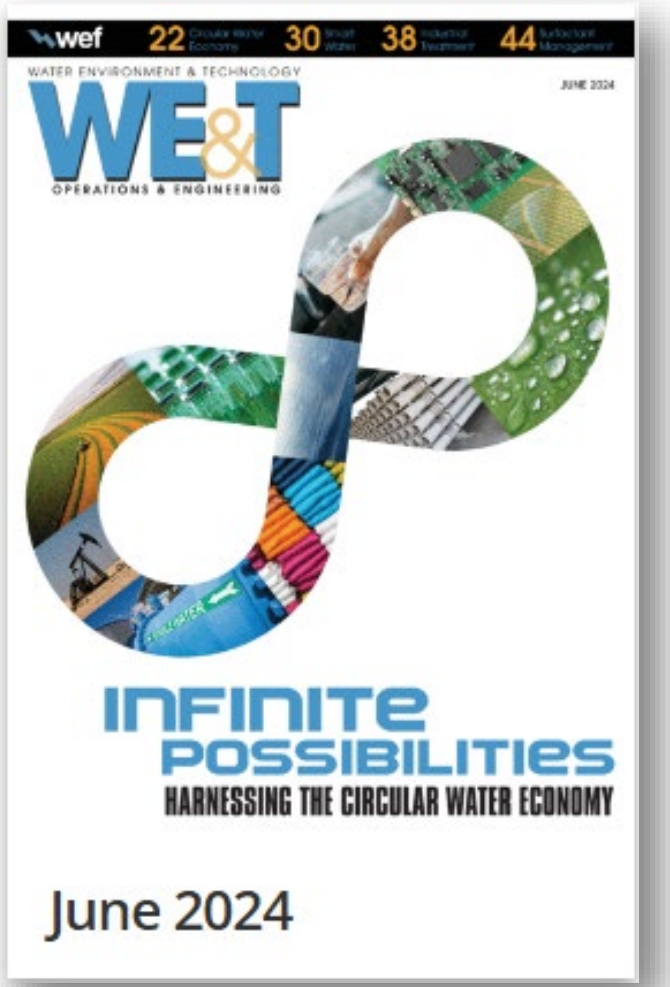


Level 5. Autonomous Operations and Maintenance

- **Focus:** creating a highly sophisticated DT capable of autonomous decision-making and self-optimization of processes with minimal human intervention
- **Benefits:** Achieves maximum efficiency and resource optimization through automated process control and predictive maintenance
- **Water sector adoption:** not yet achieved in the sector; represents the aspirational future state

Anaerobic co-digestion is a common-sense strategy to meet municipal climate goals and make money by diverting organic waste from landfills

Reducing landfill CH_4:

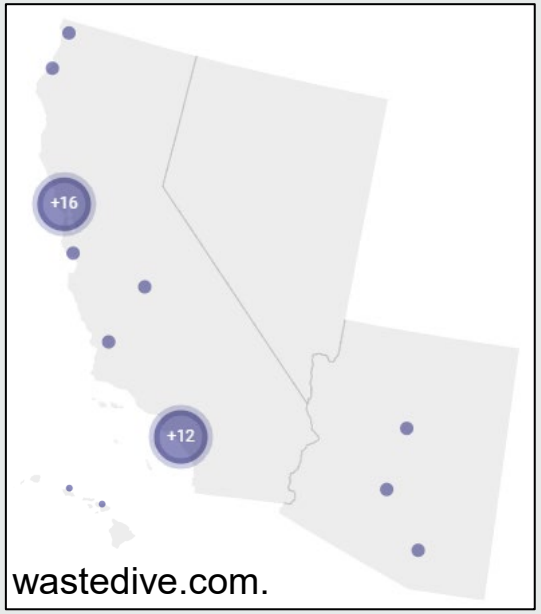
Methane is 86x more potent than CO_2 as a greenhouse gas (20-year)

"Waste" is 18% of methane emissions

$$CH_4 >> CO_2$$

Global Methane Hub, **2024**.

Cities with zero organic landfill inputs



The U.S. wastes 73 to 152 million metric tons (161 to 335 billion pounds) of food per year

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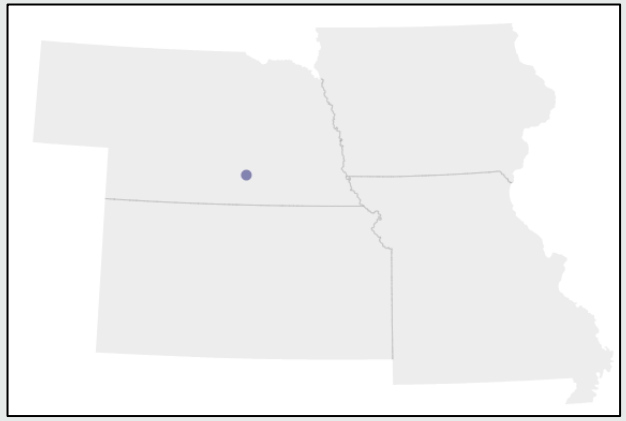
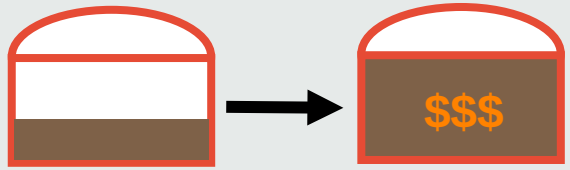


wastedive.com.

43,000,000 tons per year capacity for food waste processing – 41% utilization in 2019!



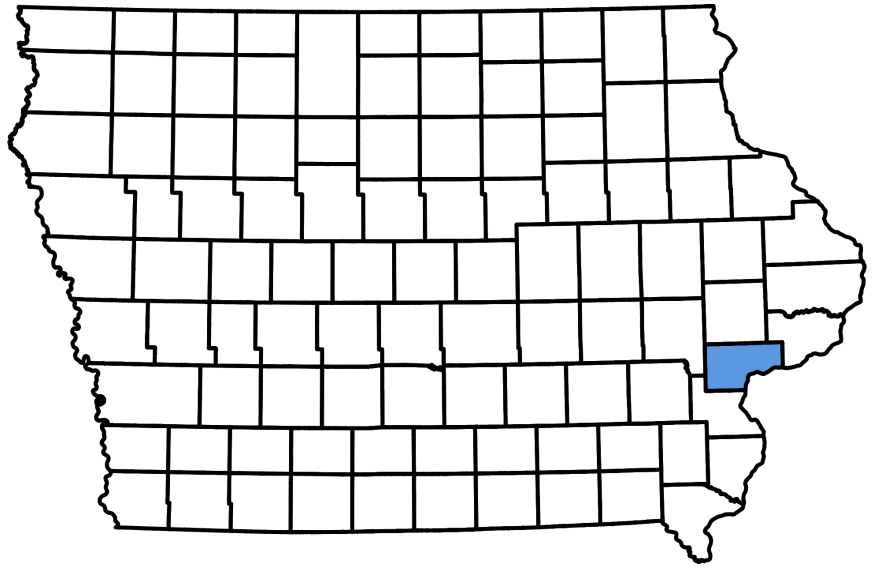
EPA, 530-R-23-003, **2023**.

The U.S. wastes 73 to 152 million metric tons (161 to 335 billion pounds) of food per year

The City of Muscatine is partnering with IWWERP on an EPA-funded project to improve anaerobic co-digestion

The Muscatine Water Resource Recovery Facility (WRRF)

Population ~24,000
5.5 MGD average daily flow
Trickling filter and activated sludge
Two anaerobic digesters ~1M gallons



Hauled organics are received, stored, and depackaged at the award-winning Muscatine Organic Recycling Center (MORC)

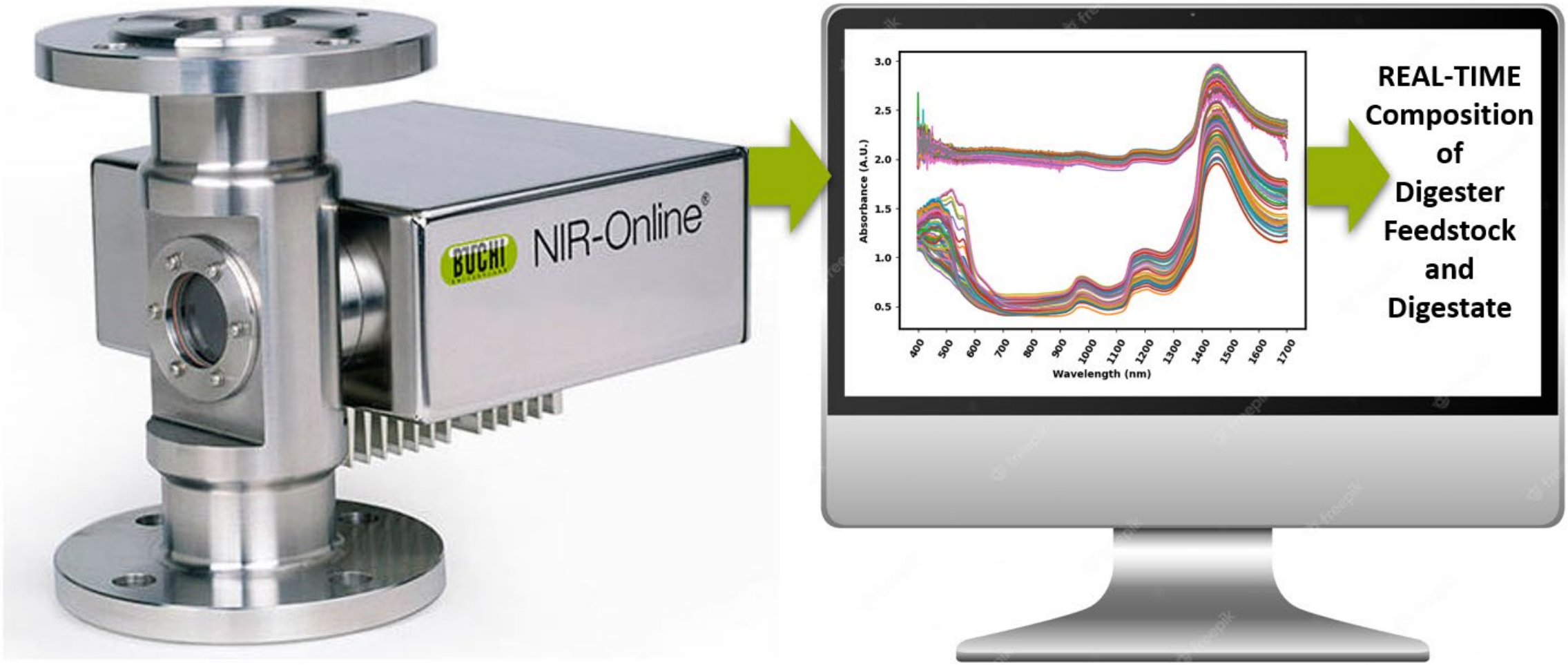
20 tons of waste per hour maximum

Nestle Purina, Kraft/Heinz, Conagra, West Liberty Foods and Hy-Vee

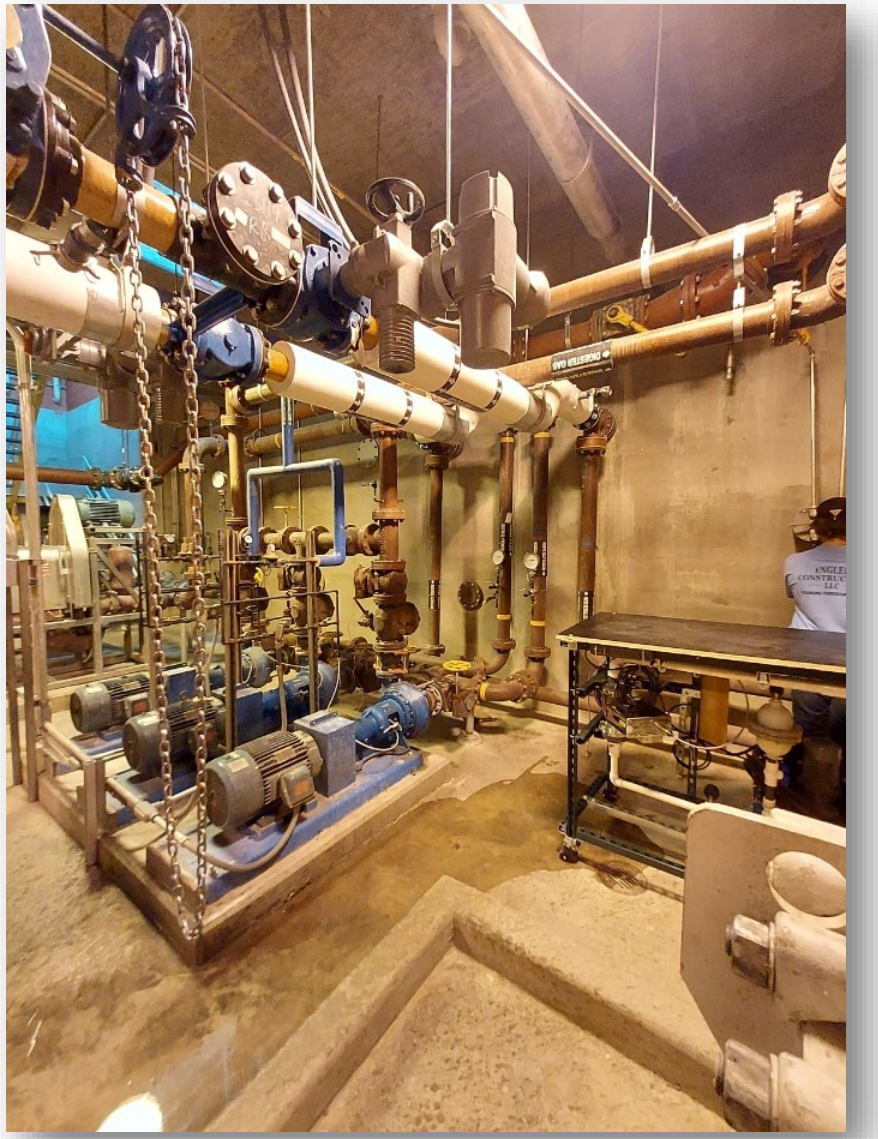
Municipal co-digestion creates operational challenges due to variable feedstock composition and availability

Maclaine Putney

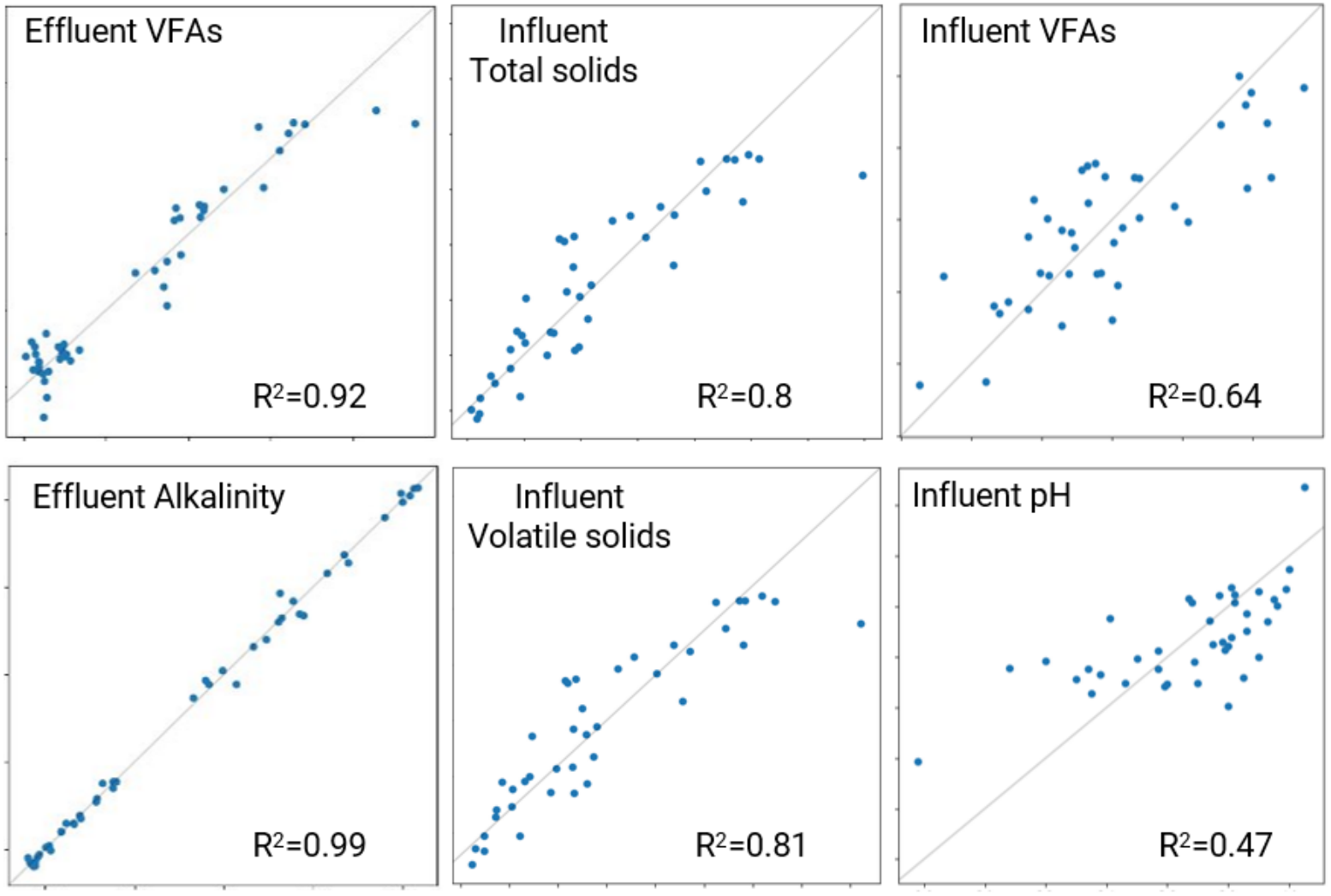
Real-time diffuse reflectance spectroscopy of HSW and digestate composition was implemented

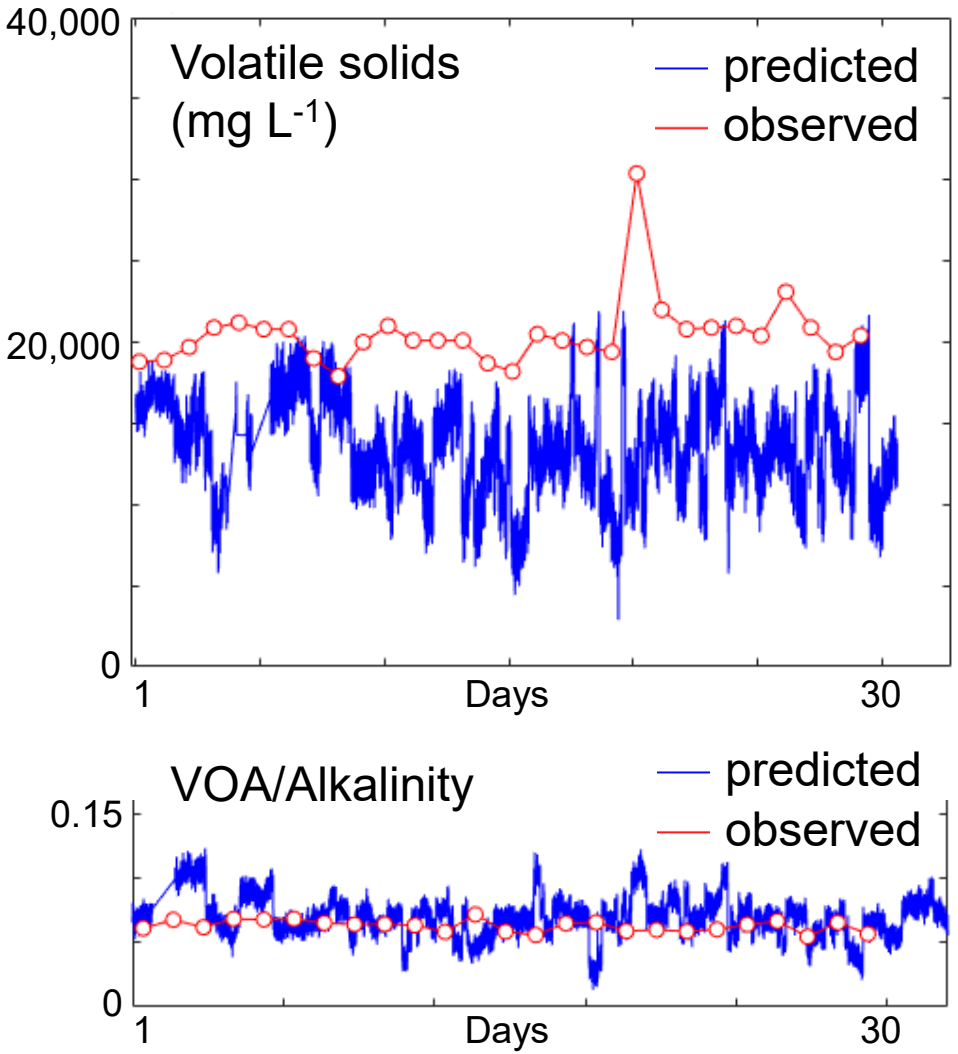


Buchi NIR-vis spectrometers were deployed on custom mobile carts

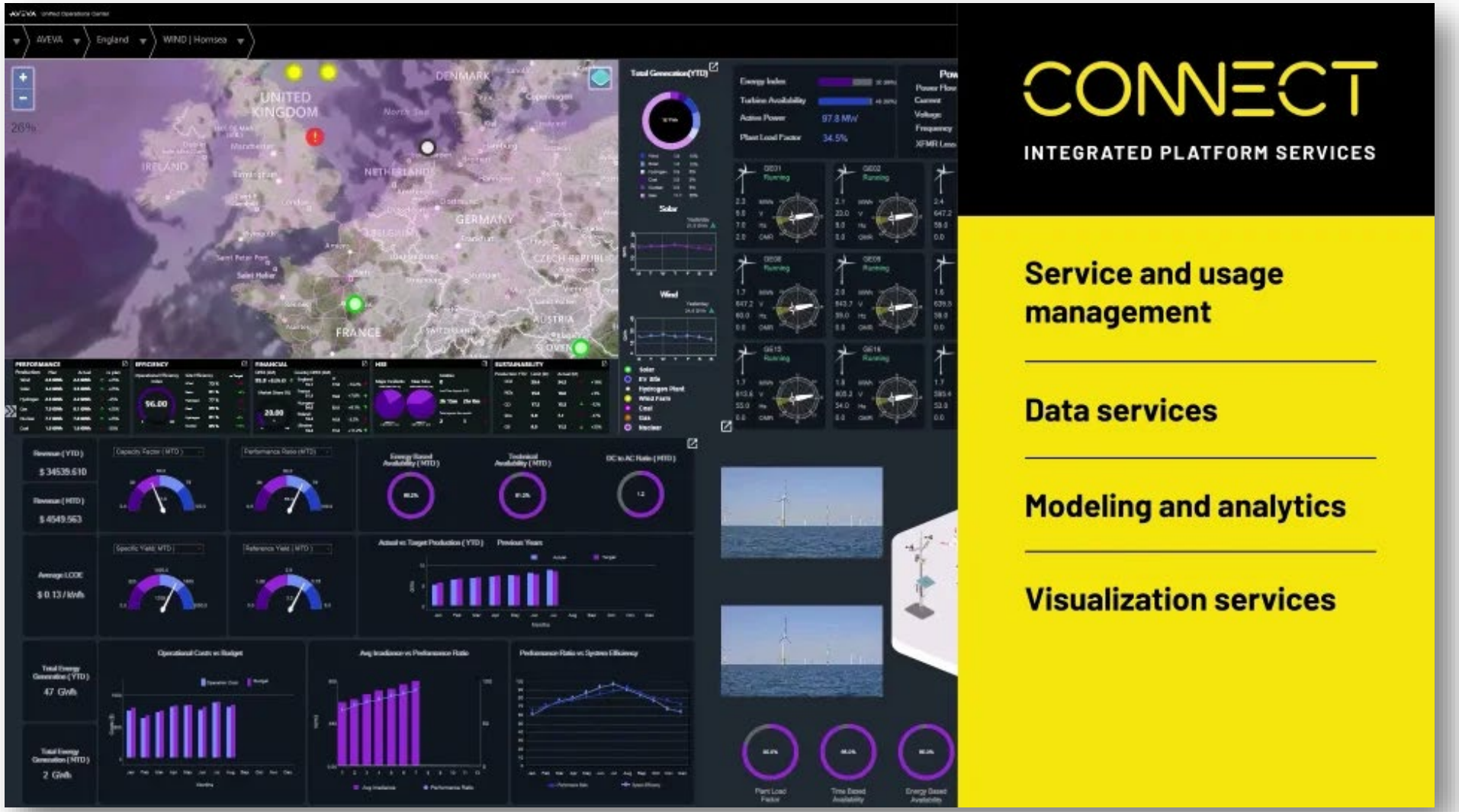


Diffuse reflectance spectroscopy provides real-time HSW and digestate composition monitoring





IWWERP has partnered with Schneider Electric and AVEVA to implement the CONNECT platform at the Muscatine WRRF and elsewhere



DIGESTER DOC
Simplifying Anaerobic Digestion

AVEVA

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COLLAPSE

Muscatine Status

Edit

Digestate Composition

05/29/2024 12:00:00 am - 06/04/2024 4:33:50 pm

	CURRENT VALUE	TREND
Alk	1,198.5	
pH	6.9231	
VS	10,652	
TOC	4,161.1	
TS	13,345	

HSW Composition View 1

05/29/2024 12:00:00 am - 06/04/2024 4:33:50 pm

	CURRENT VALUE	TREND
pH	3.2771	
COD	42,916	
VS	3,197.6	
TOC	1,545.7	
TS	33,446	

HSW Composition View 2

05/29/2024 12:00:00 am - 06/04/2024 4:33:50 pm

	CURRENT VALUE	TREND
Carbs	6.1631	
Fat	56.4	
Protein	76.555	

Carbon Conversion (%)

05/29/2024 12:00:00 am - 06/04/2024 4:33:50 pm

Carbon Conversion (%)

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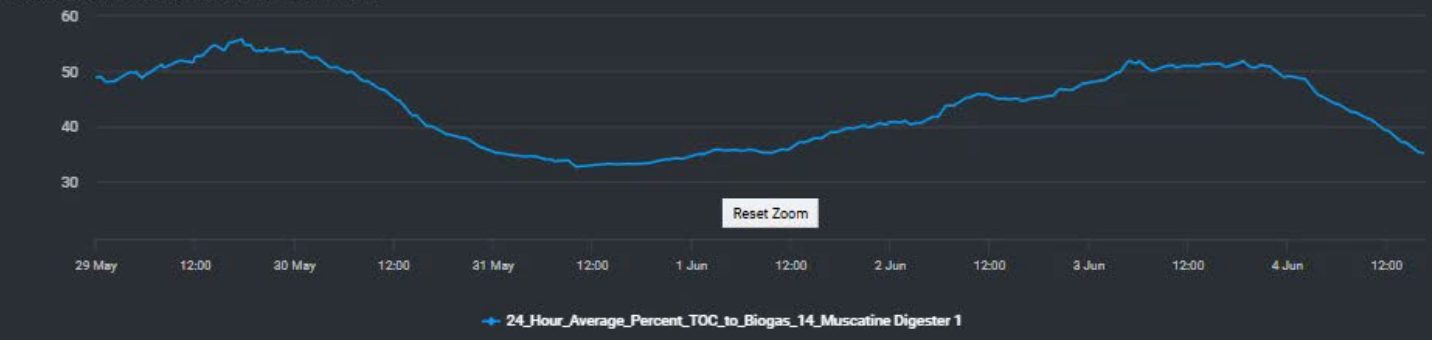

Muscatine Digestate

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Reaching digital twin levels 4 and 5 is possible at the Muscatine WRRF

"Lab" data

IWWERP at the University of Iowa

CONNECT

- Data Hub
- Advanced Analytics
- Visualization

Muscatine WRRF

CONNECT

- Data Hub
- Visualization

SCADA

SCADA "tags"

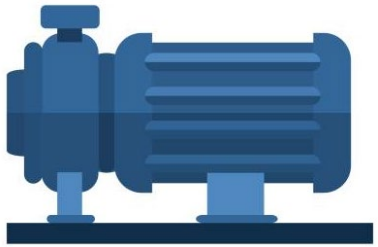
- Hauled waste flow
- Sludge flows
- Biogas flow
- Digester lid position

Level 4. Two-Way Data Integration and Interaction

Recommended HSW Flow

35 GPM

Level 5. Autonomous Operations and Maintenance



Model sets HSW pump speed

(operator oversight)

RENEWABLE NATURAL GAS | UNITED STATES

The University of Iowa and industry partners increase profitability of renewable natural gas facilities

IOWA

DIGESTER DOC
Simplifying Anaerobic Digestion

VALKYRIE
ANALYTICS

BÜCHI

Challenge

- Lack of real-time information decreased efficiency and increased downtime
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