

The ISG logo consists of the letters "ISG" in a bold, blue, sans-serif font, centered within a white square. The square is positioned in the upper center of the image against a textured blue background.

ISG

Cutting-Edge Concepts in Dairy Plant Construction

THE ISG PERSPECTIVE ON SUSTAINABILITY

Today's Presenters



Brian Gjerde, PE

*Vice President, Food and Industrial
Business Unit Leader*



Rachel Kloos

Water/Wastewater Group Leader

Firm Overview

Renovation/Remodel



Expansion/Addition



New Construction



ENGINEERING

Civil
Electrical
Land Surveying
Mechanical
Municipal
Refrigeration
Structural
Technology
Telecommunications
Transportation
Water/Wastewater

ENVIRONMENTAL

Assessments + Review
Geographic Information Systems
Permitting + Compliance
Planning + Feasibility
Testing + Monitoring

ARCHITECTURE

Architecture
Interior Design
Landscape Architecture
Planning

PLANNING

Development
Engagement
Funding
Planning
Project Evaluation

Establish Your Sustainability Goals

Metric tons
CO₂e/# of finished
product, raw milk



Real Time
Measurement

YOU!

GREENHOUSE GAS EMISSIONS

DIRECT
EMISSIONS

INDIRECT
EMISSIONS

FUEL IN VEHICLES

REFRIGERANT LEAKS

FOSSIL FUELS UTILIZATION

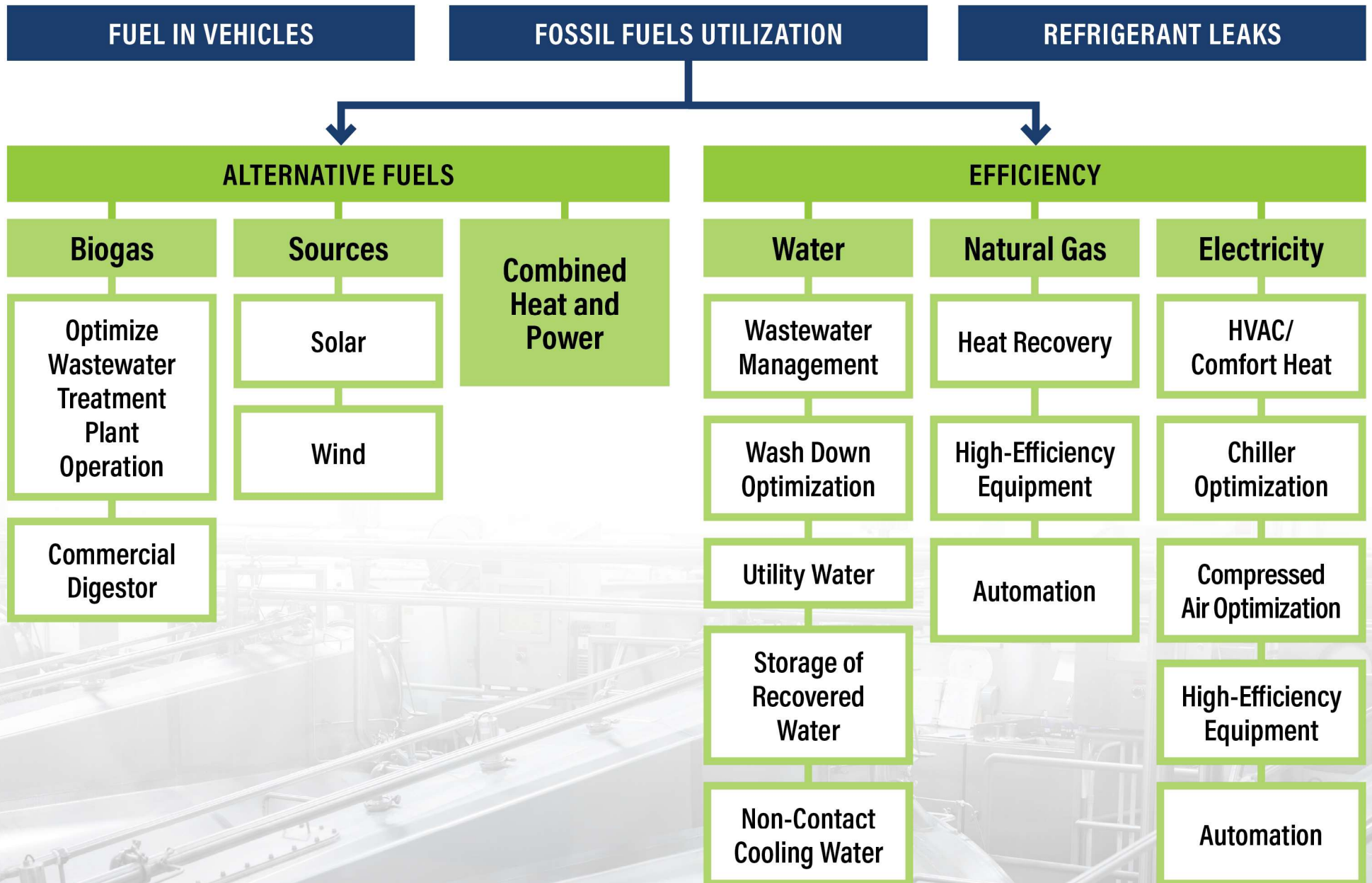
PURCHASED ELECTRICITY

PURCHASED WATER

PURCHASED RAW MATERIALS

CITY WASTEWATER TREATMENT

Sustainability + Direct Emissions



Sustainability + Indirect Emissions



PURCHASED ELECTRICITY



PURCHASED WATER

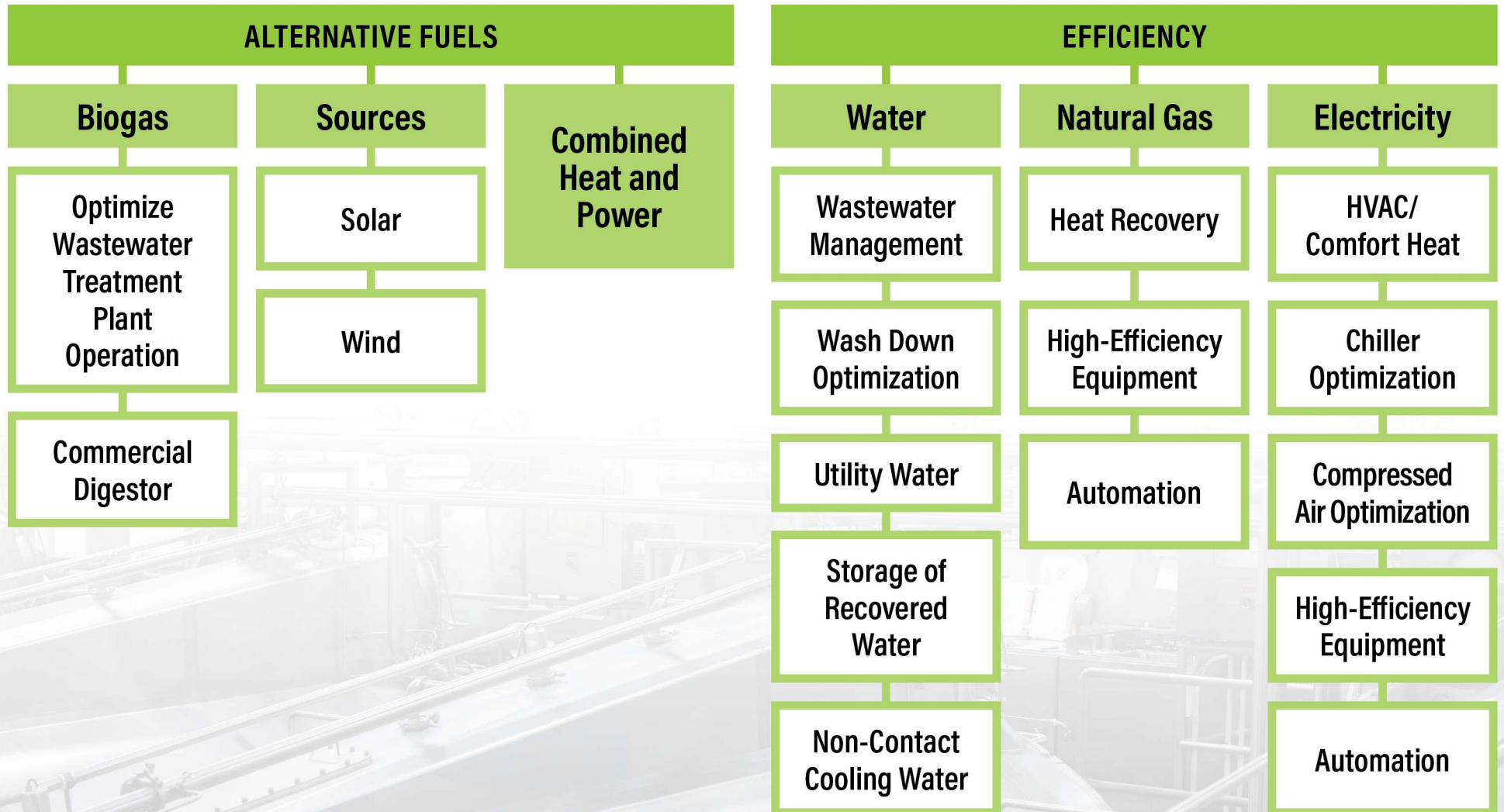


PURCHASED RAW MATERIALS

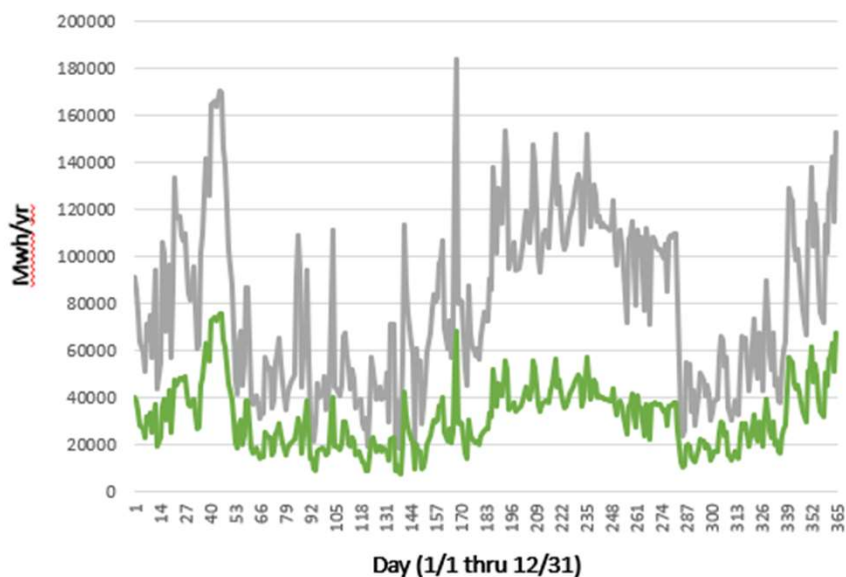


CITY WASTEWATER TREATMENT

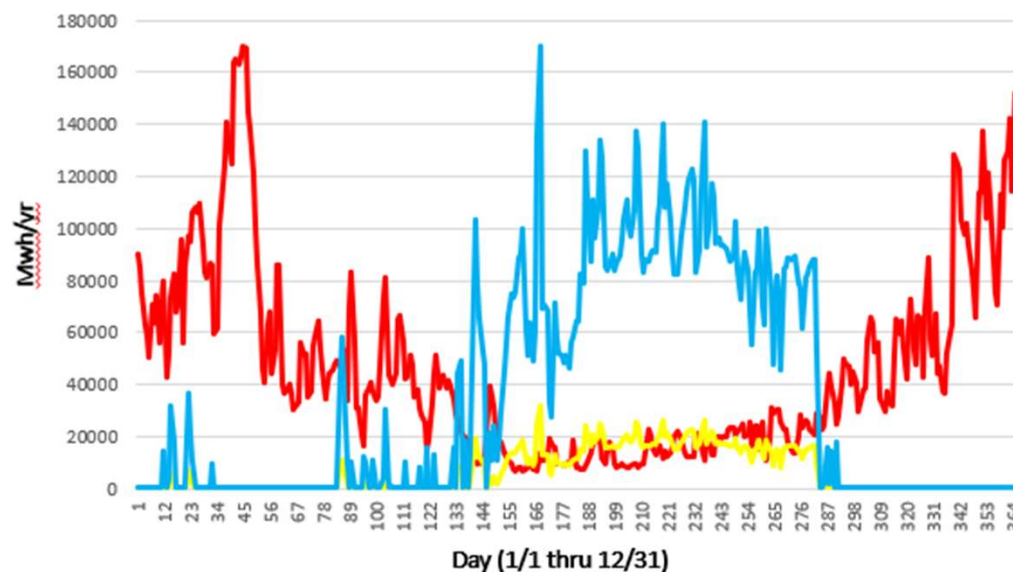
Solutions to Meet Sustainability Goals



**Total Load Profile
(Conventional vs. Geo+HP)**



**HVAC Load Profile
(Heating and Cooling)**



EXAMPLE

Sustainability Roadmap

Technology Comparison

Technology	Capital Costs	Operating Costs	Nat Gas Offset MWh/yr	% Nat Gas Offset	CO2eq Offset (Metric Tons/yr)	Notes
Energy Recovery Ventilation	\$5M-\$7.5M	Minimal	9000	9%	2133	Additional net capital savings possible by reducing other HVAC equipment sizing. Operating costs offset by 1300 MWh/yr electrical savings.
Geothermal Cooling	\$3M	Net Savings	0	0%	0	Additional net capital savings possible from elimination of HVAC chillers. 1,700 MWh/yr net electrical offset.
Geothermal Heating & Cooling	\$5M	Cooling - Equal Existing Heating - \$22.5/MWh	10600	10%	2512	Additional net capital savings possible from elimination of other HVAC chillers.
Waste Heat Recovery (WHR)	<\$1M	<\$1/MWh	10000	10%	2370	Limited to applications below recovery temperatures.
WHR w/ Heat Pumps	\$1.5M	\$18/MWh	18000	17%	4266	Limited to applications under 140° F.
WWTP Biogas Recovery	<\$1M	\$2.5/MWh	15730	15%	3725	Capital cost excludes buffer tank. Additional 1060 MWh/yr capacity potential from food waste collection. Assumes 0.11 lb CO2eq/MMBtu (0.17 kg CO2eq/MWh)
Landfill Gas Recovery	\$5M-\$10M	\$6-\$12/MWh	20290	19%	4805	Operating costs from EPA. Could vary with easement agreements. Assumes 0.11 lb CO2eq/MMBtu (0.17 kg CO2eq/MWh)
Biomass Boilers	\$20M-\$40M	\$22/MWh	55000	53%	12260	Assumes 9.09 lb CO2eq/MMBtu (14.1 kg CO2eq/MWh)
Electric Boilers	Varies	\$90/MWh	As needed	As needed		Capital costs are typically lower than natural gas boilers.

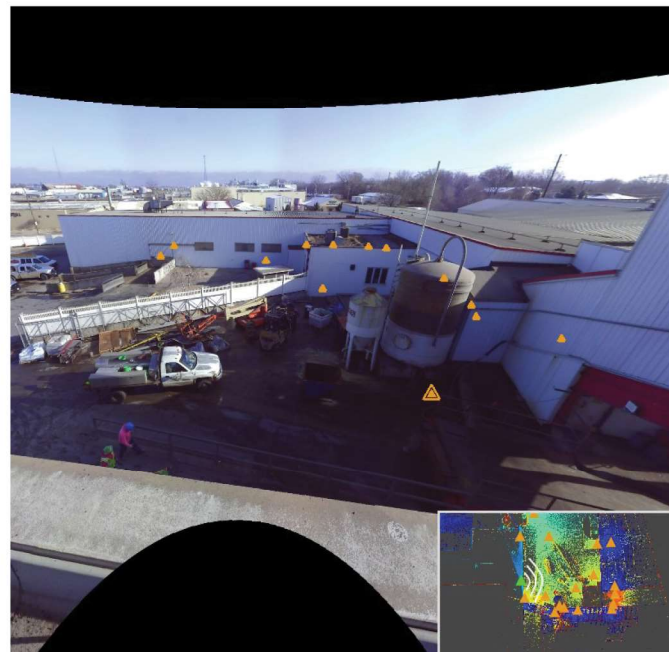
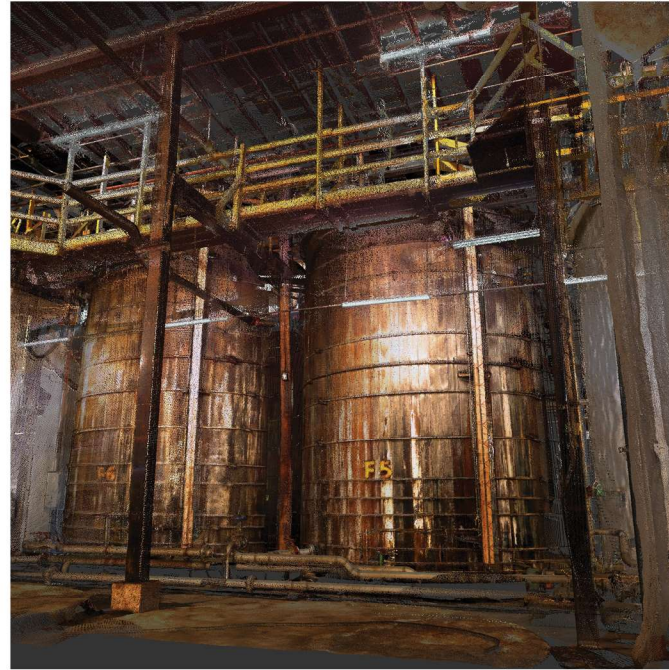
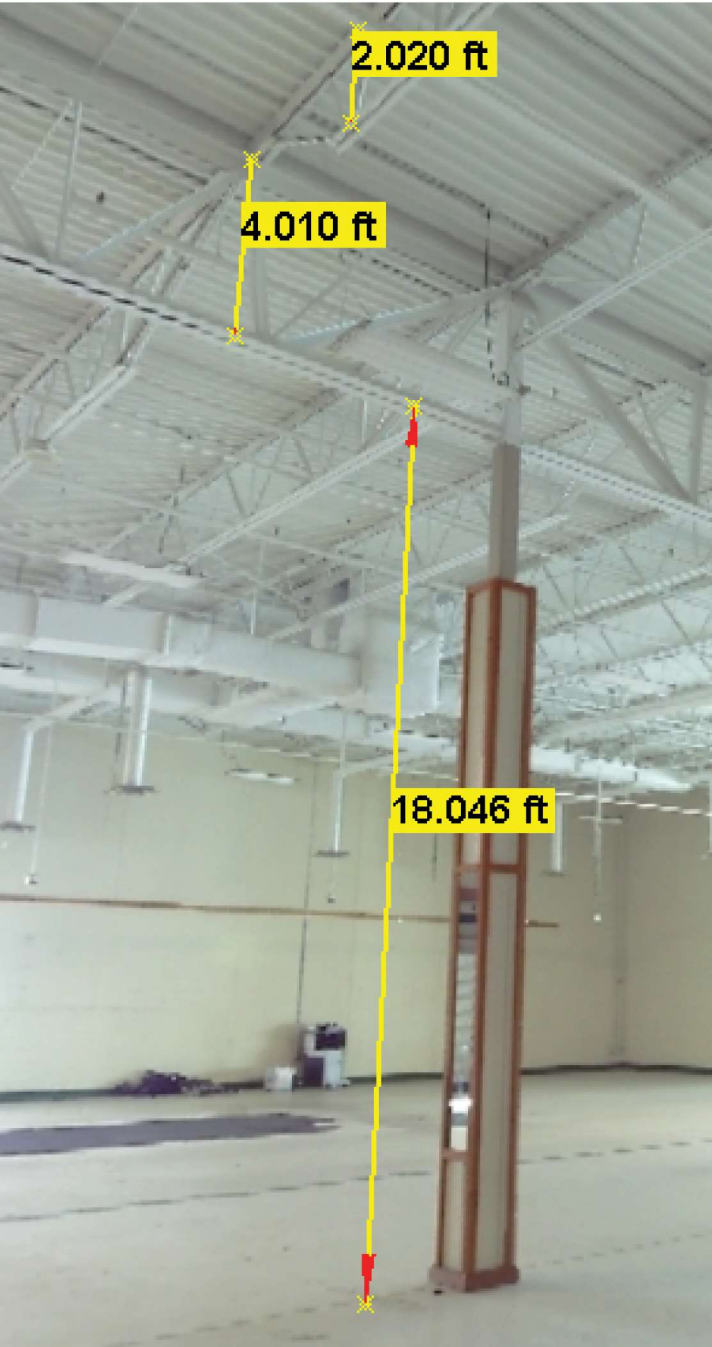
Note: Operational costs assume \$0.09/kWh electricity and \$14.59/MWh natural gas. Assumes 0 CO2eq electricity and 237 kg/MWh CO2eq natural gas.

EXAMPLE

Sustainability Roadmap

Technology	Cumulative Capital Cost	Cumulative Avg. Op Cost \$/MWh	Cumulative Nat. Gas Offset	Cumulative Nat. Gas Offset	Payback (Avg.) yrs	CO2eq Offset (Metric Tons/yr)
Waste Heat Recovery (WHR) GGY Autoclaves (20k)	\$1M	\$1	5%	10820	6.8	2564
WHR Air Compressors		\$1	8%			
WHR Chillers		\$1	10%			
WWTP Biogas Recovery	\$2M	\$2	25%	26550	6.0	6292
Energy Recovery Ventilation (Clean-Up Mode Only)	\$3.5M-\$4.5M	\$2	29%	30466	10.4	7220
Geothermal Heating & Cooling	\$6.5M-\$7.5M	N/A	36%	37866	19.3	8974
		\$5				
WHR w/ Heat Pumps on Chillers	\$8M-\$9M	\$6	40%	41266	24.0	9780
Landfill Gas Recovery	\$13M-\$19M	\$7	59%	61556	34.2	14589
Biomass Boilers	\$33M-\$59M	\$14	112%	116556	N/A	26849

Leveraging Technology: 3D Scanning



Accurate as-built documentation from 3D scanning is transformed into highly detailed models used throughout the process

Benefits of 3D scanning and detailed models include clash detection and walk throughs to develop the design

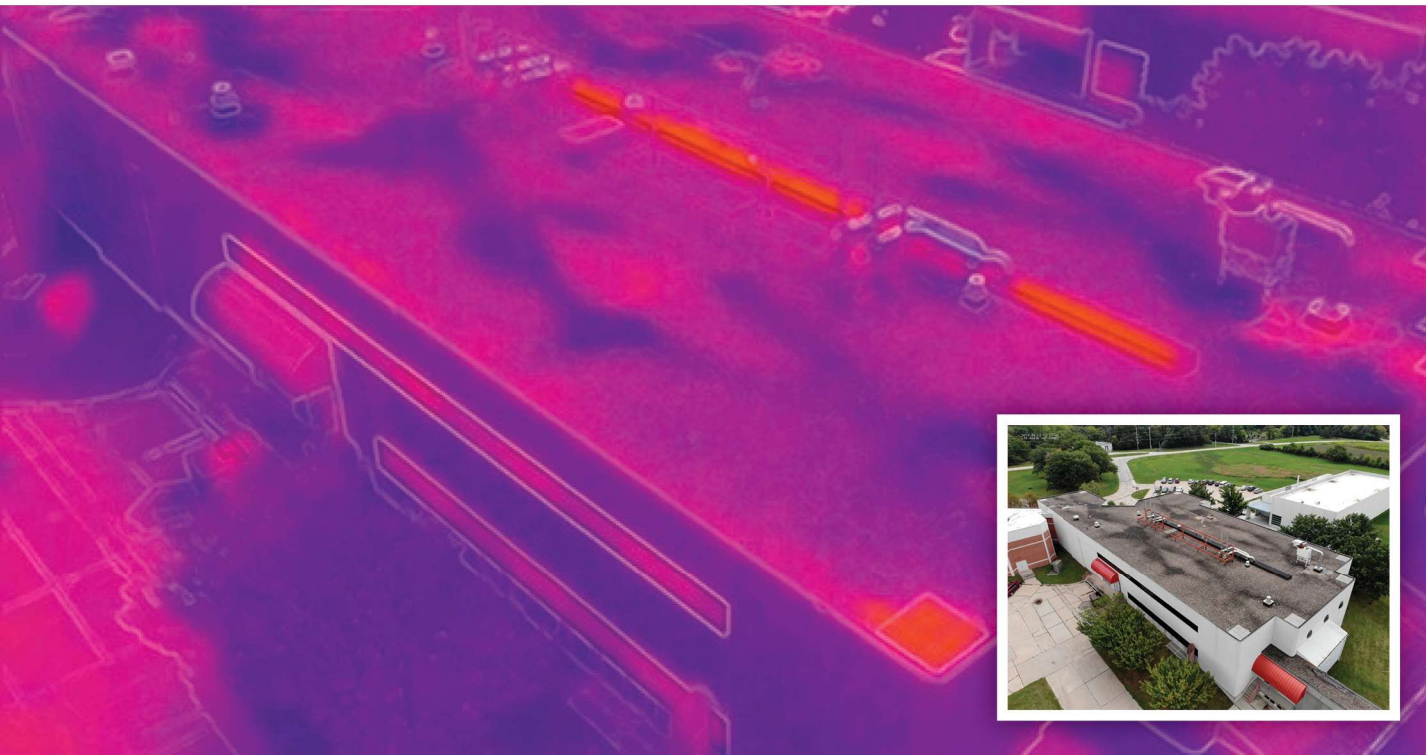
3D SCANNING

Leveraging Technology: Drone + LiDAR

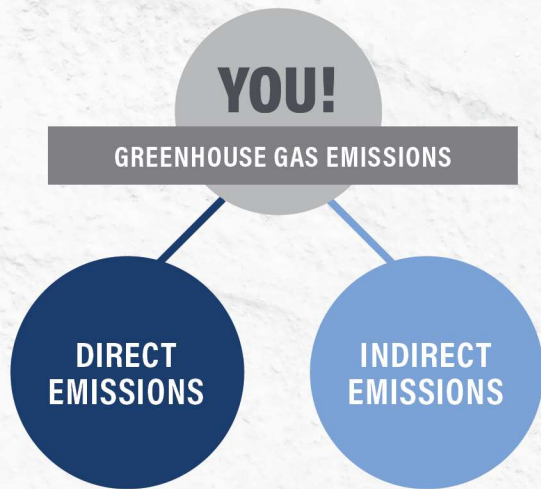


LiDAR drone
footage provides
survey-grade data

Thermal imagery
from drones
can streamline
decisions
throughout
construction



Key Takeaways



**Establish
sustainability goals**

ALTERNATIVE FUELS			EFFICIENCY		
Biogas	Sources	Combined Heat and Power	Water	Natural Gas	Electricity
Optimize Wastewater Treatment Plant Operation	Solar		Wastewater Management	Heat Recovery	HVAC/ Comfort Heat
	Wind		Wash Down Optimization	High-Efficiency Equipment	Chiller Optimization
Commercial Digester			Utility Water	Automation	Compressed Air Optimization
			Storage of Recovered Water		High-Efficiency Equipment
			Non-Contact Cooling Water		Automation

**Identify and
prioritize solutions**



Implement solutions

Thank You!



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ALTERNATIVE RESOURCES



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