EISENMANN

ANAEROBIC DIGESTION BIOGAS PLANTS

INVESTING IN ENERGY PRODUCTION FROM AGRICULTURAL RESIDUES AND BIOWASTE MAKES SOUND ECONOMIC SENSE – AS MANY LOCAL GOVERNMENT AGENCIES, UTILITIES AND WASTE DISPOSAL COMPANIES HAVE DISCOVERED. IT IS ALSO GOOD FOR THE ENVIRONMENT. THAT IS WHY STATE SUBSIDIES FOR RENEWABLES ARE RISING WORLDWIDE – UNDERPINNING THE LONG-TERM ECONOMIC VIABILITY OF YOUR BIOGAS PLANT.

CONTENTS

BIOWASTE – A VALUABLE RESOURCE

Around the globe, waste management legislation is becoming ever stricter and governments are promoting renewable power. This makes energy generation from biowaste all the more attractive.

Effective Biowaste Processing

The untapped potential of organic waste as a source of energy can be leveraged to improve the cost-effectiveness of compost plants. Plug-flow digesters allow the generation of valuable electricity, heat or biomethane.

Biogas can be upgraded to produce pure biomethane. This can be fed directly into the public gas grid. Alternatively, it can be efficiently converted to heat and power in decentralized CHP systems. CHP technology ensures that almost all potential energy is put to use. After further treatment, biomethane can also be employed as vehicle fuel.

The study "Optimization of the utilization of organic waste" by the German Federal Environment Agency examined the environmental footprint of various methods of processing biowaste. Digestion was ranked number one across eight out of nine environmental impact categories. In terms of fossil fuel consumption and greenhouse effect, plug-flow digestion outperformed all other methods by a wide margin.

Biogas Composition

Methane 40 - 75%	Water vapor 0 - 10%
Carbon dioxide 25 - 55%	Trace gases 0 - 5%

US Market Potential

Food waste makes up 20% (34 million tons annually) of the overall waste sent to landfills. Currently, only 3% of this is recovered and composted. If half of this organic waste was anaerobically digested, enough electricity would be generated to power 2.5 million homes each year.* The American Biogas Council projects up to 12,000 potential sites ready for development and predicts that renewable biogas could displace as much as 10-15% of fossil fuel based natural gas consumption by 2023.

Market Drivers

- Growing public and political call for renewable energy
- Climate protection regulations
- Recycling and organic diversion initiatives
- More advanced technologies
- Subsidy and grant availability

* Source: American Biogas Council, US Environmental Protection Agency

OFFERINGS AND BENEFITS IN BRIEF

Each Eisenmann biogas plant is custom-designed for your location. We tailor your system to feedstock, desired output, and regional and national legislation. Upon request, we coordinate the entire project: from applying for permits to installing and commissioning turnkey systems. Our biogas plant consulting and other services provide you with expert advice and practical support.

- Anaerobic digestion of high-solid waste in a plug-flow digester
- High organic load with optimum residence time
- Extremely high gas yield
- User friendly automated system
- Rapid on-site installation thanks to modular design
- Enclosed system prevents emission of offensive odors
- Customer-specific solutions for throughputs from 5,000 metric tons/year
- Turnkey manufacturing and installation
- Proven end-to-end process knowledge
- Trusted and experienced leader
- 100 biogas plants worldwide
- 66 years' experience in industrial plant engineering
- More than 40 years in the USA

Biogas plant in Perris, USA.
Eisenmann has the only high solids continuously mixed plant operating in the US and the first to be approved in California for pipeline quality gas injection.

Biogas plant in Schwerin, Germany.

Biogas plant in Härnösand, Sweden.

CONTINUOUS DIGESTION OF HIGH-SOLID WASTE

Pretreatment
Before digestion begins, organic waste is subject to pretreatment. Foreign matter is removed and the waste homogenized, and if necessary, sanitized. Depending on the feedstock, pretreatment will consist of some or all of the following steps:

- Particle Size Reduction
- Removal of metals
- Homogenization
- Grading/sorting

Intermediate storage
To ensure uninterrupted gas production, the feedstock must be fed uniformly and continuously into the plant – even on weekends. The following intermediate storage and automatic feeding systems meet a variety of space and other requirements:

- Sliding-floor containers
- Drag chain conveyors
- Walking floor systems
- Concrete silo with automatic crane system
- Tanks or pits for liquid feedstocks

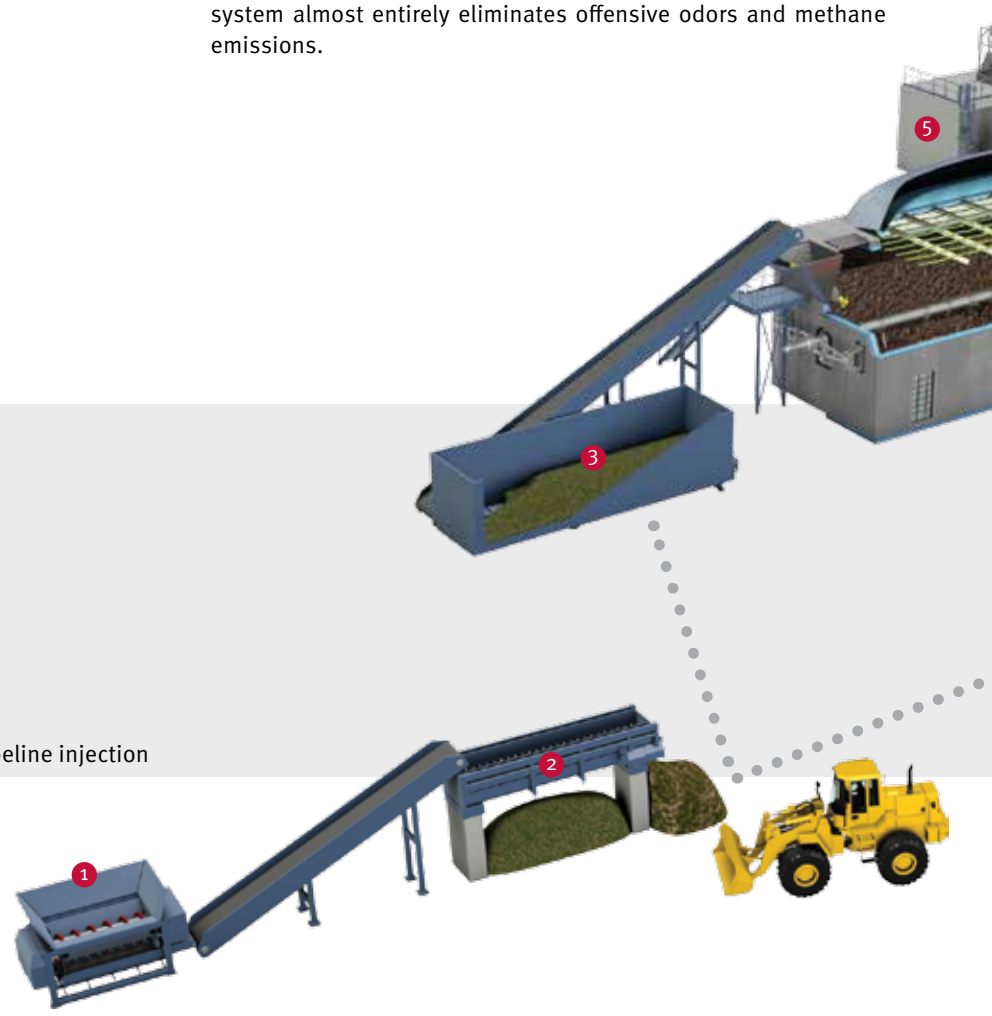
The substrate is fed into the digester by conveyor belt or crane, and dropped into a feed hopper. Plug screws introduce the substrate below the surface of the liquid within the digester, ensuring anaerobic conditions. Eisenmann's completely enclosed system almost entirely eliminates offensive odors and methane emissions.

DIGESTION PROCESS

1. Particle Size Reduction
2. Grading/Sizing

Pretreatment

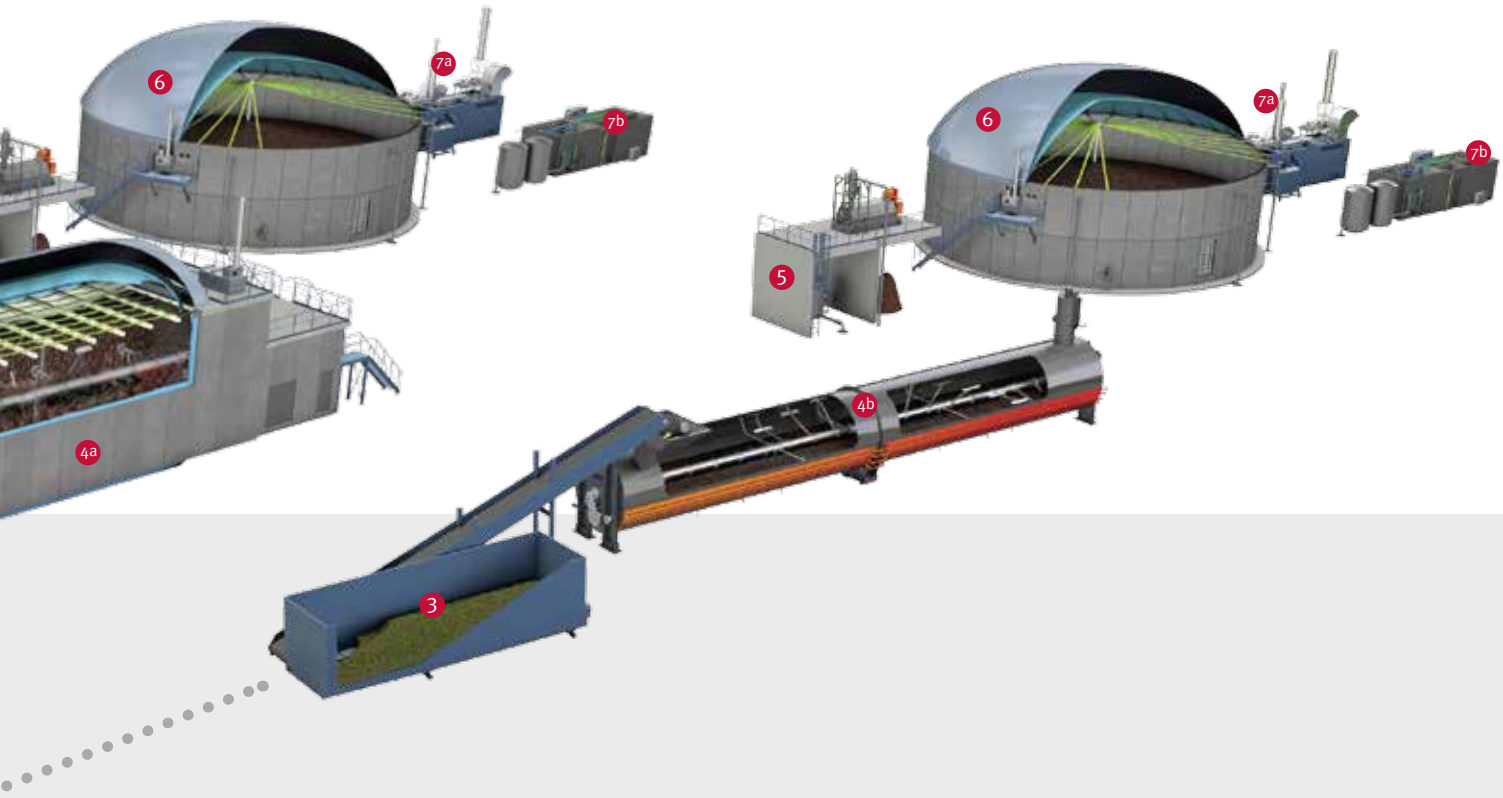
3. Intermediate storage
4a. Processing in a concrete digester
4b. Processing in a steel digester
5. Liquid reduction and nutrient concentration
6. Liquid Digestate storage
7a. Use of gas as fuel for CHP
7b. Biogas upgrading for vehicle fuel and/or pipeline injection



Digestion
The central feature of the Eisenmann biowaste plant is the plug-flow digester with horizontal agitator. This design delivers the best digestion results and reliable operation. The plug-flow digester provides the ideal microbiological conditions for efficient conversion of organic materials into biogas. The design maximizes microbial contact with the feedstock and ensures a high gas yield and dependable, uninterrupted operation.

Eisenmann's solution ensures there is sufficient residence time for full biowaste sanitization. It supports very high organic loads and high solid content.

Robust systems are in place to ensure effective plant safety across all operations. Steam heat maintains precise, even temperatures. An industrial-standard control system, in conjunction with continuous monitoring and logging of all relevant process parameters, enables fully automated operation and exceptional reliability.



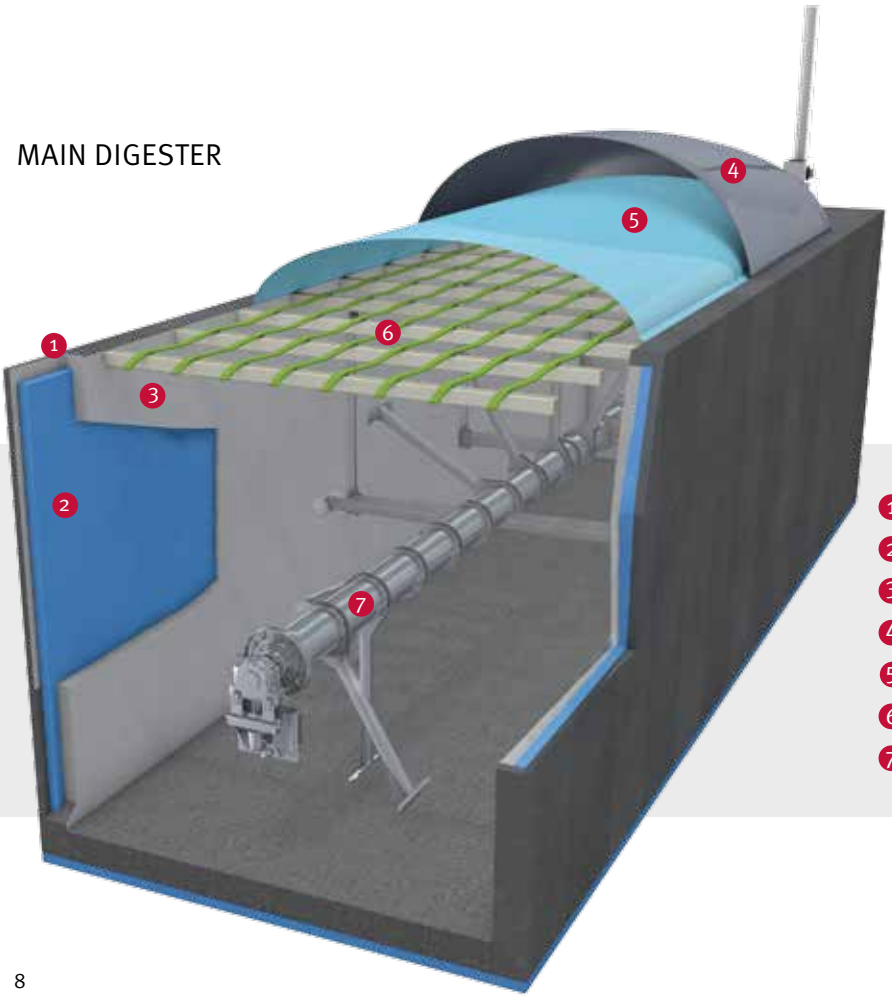
BIOWASTE PROCESSING IN PLUG-FLOW DIGESTERS

Eisenmann plug-flow digesters

With the plug-flow process, it is not necessary to dilute high-solid feedstocks with large quantities of liquid, such as slurry or surface water. This reduces digestate volumes, allowing more compact biogas plants. Eisenmann digesters made from prefabricated concrete elements have a rectangular cross-section, which means they are fully and easily accessible to inspectors. For this purpose, digesters are fitted with large pressure-tight doors.

Our steel digesters are cylindrical in design and suitable for low and high throughputs.

MAIN DIGESTER



1. Outer wall
2. Insulation
3. Concrete inner wall

Prefabricated elements

4. Exterior membrane
5. Gas membrane support webbing
6. Belt

Double membrane gas holder

7. Horizontal agitator

Double membrane gas holder
The roof of the digester generally comprises a removable double membrane gas holder with a gas-level indicator for controlling the flow to downstream equipment. Fully enclosing the system ensures completely safe biogas production and handling. Alternatively, digesters can be constructed with concrete roofs.

Pressure-tight doors
Pressure-tight doors provide easy access for inspections.

Control system
An industrial-standard control system, in conjunction with continuous monitoring and logging of all relevant process parameters, enables fully automated operation with exceptional reliability.

Safety systems
Comprehensive safety systems in accordance with applicable local legislation and standards ensure that the plant functions safely in all operating modes.

Horizontal agitator
The horizontal agitator thoroughly mixes the feedstock and prevents the formation of foam. Continuous agitation releases gas from the homogenized material.

Design features
- External bearing, separated from sealing system
- Monitoring of rotational speed and torque
- Frequency-controlled drive with planetary gear
- Continuous lubrication via automatic grease pumps
- Floating hollow shaft means no central bearing is required

Separation
Screw-press separators divide the digestate into liquid and solid phases. After separation, the solid digestate can be composted.

Material intake and digester.

Separation and gas storage.

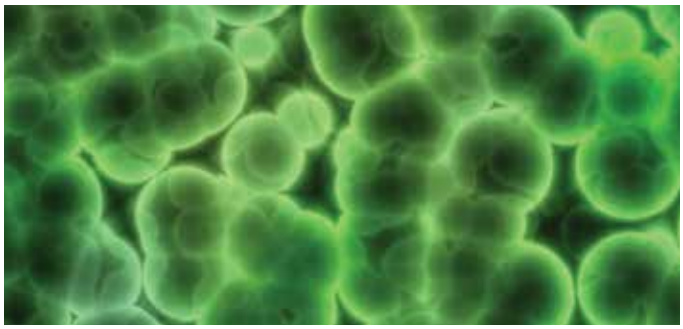
BIOGAS PLANT CONSULTING

The goal of our consulting services is to ensure the biogas plant is operated to deliver the best possible results. We conduct tests on the feedstock, and provide recommendations. This is followed by a controlled start-up phase in conjunction with monitoring and analysis.

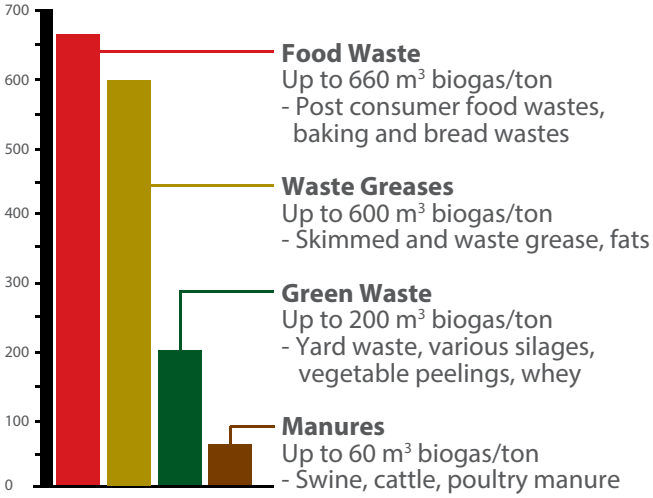
Drawing on our experience with many comparable plants, we can then make specific recommendations on gas yield potential, biological issues and trace elements. We can also offer expert advice on alternative feedstock, and on plant modification or expansion. Close collaboration with our service unit helps ensure maximum system uptime and consistently high performance.

We offer you:

- Advice on and recommendations for feedstock
- A tailor-made start-up plan
- Analysis of all biologically relevant operating parameters
- Recommendations on best-practice plant operation
- Optimization of plant operation by means of monitoring and analysis



Potential Biogas Yield from a Range of Feedstocks



SERVICES

Eisenmann offers a broad portfolio of services. These are tailored to customers' specific requirements, taking into account existing in-house skills, cost structures, and their need for specialist support. We believe in building a true partnership, driven by customer imperatives.

Services:

- Inspection
- Maintenance
- Repairs
- Remote diagnosis
- Stand-by support
- Maintenance contracts
- Full-service solutions

BIOGAS PLANT IN PERRIS, USA

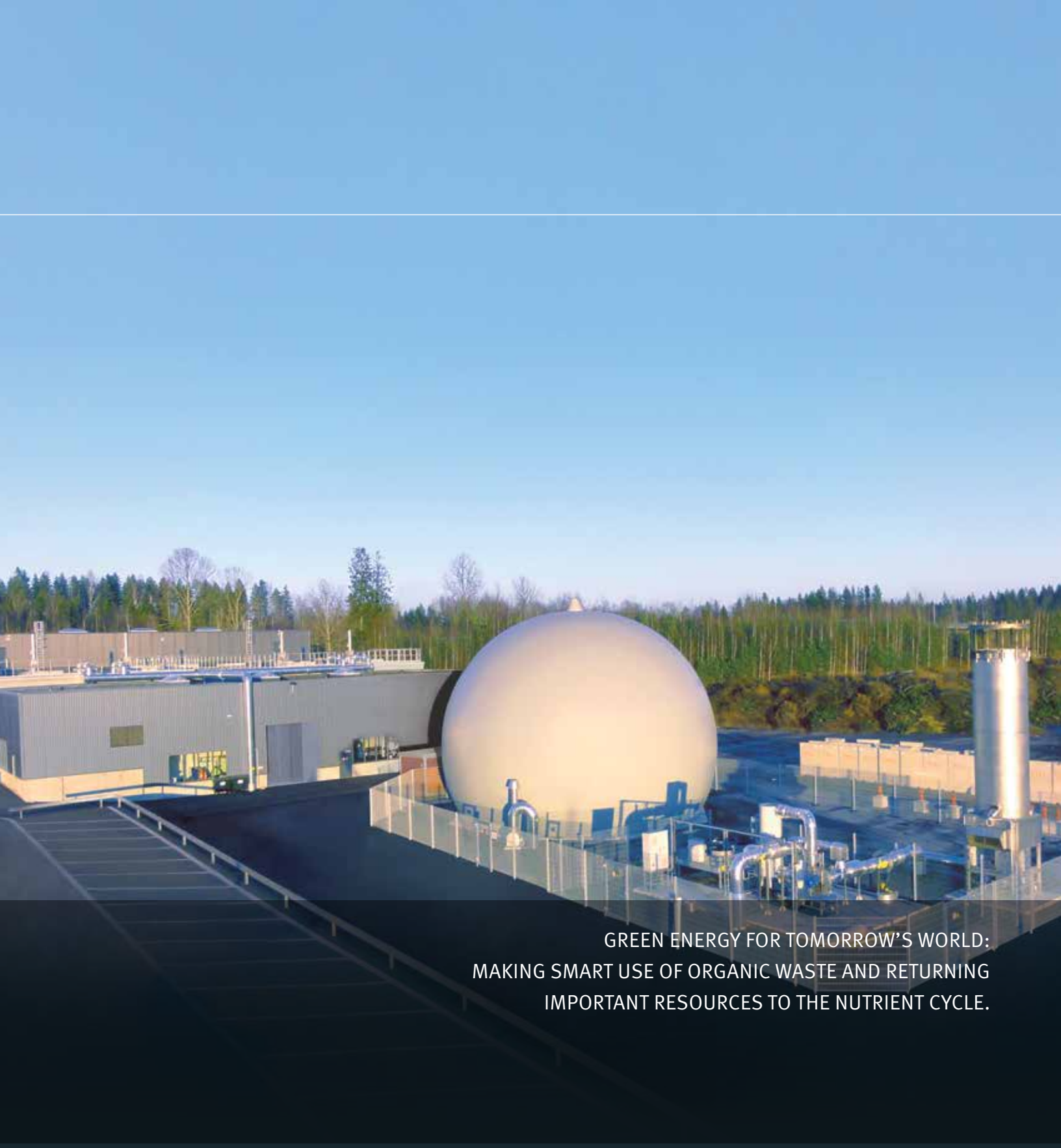
Technical data	
Year of construction	2016
Feedstock	More than 60% high-solid biowaste
Feedstock throughput	160,000 metric tons/year
Digester capacity	Main digester: 8 x 1,400 m^3 Post digester: 2 x 2,400 m^3
Biogas flow rate	Around 1,800 Nm^3/h
Biogas yield	Around 14.4 million m^3/year
Diesel liter equivalent yield	Around 7.6 million l/year

CR&R in California, our largest biowaste digestion plant worldwide.

BIOGAS PLANT IN SCHWERIN, GERMANY

Technical data	
Year of construction	2014
Feedstock	Source-separated biowaste
Feedstock throughput	12,500 metric tons/year
Digester capacity	900 m^3
Biogas flow rate	180 Nm^3/h
Installed power, CHP plant	370 kW

Concrete digester with a capacity of 900 m^3.

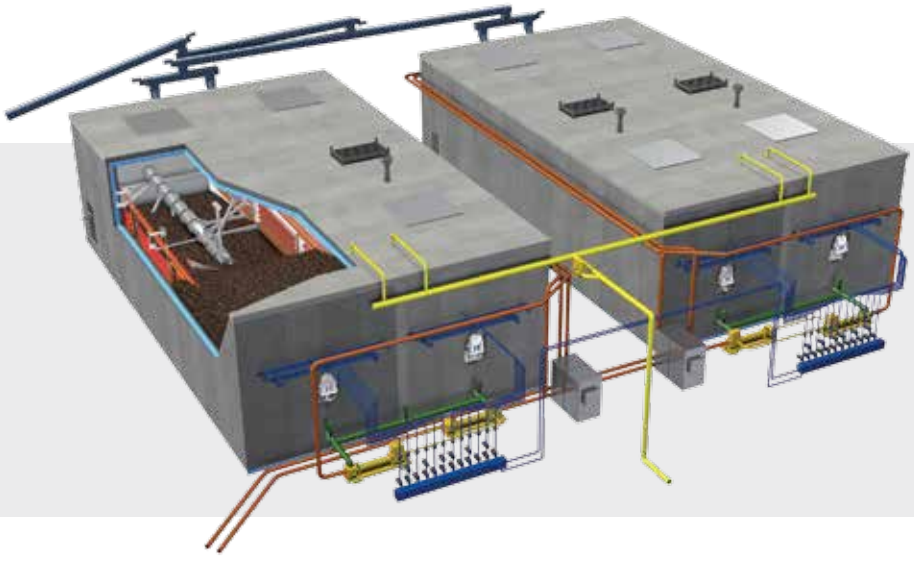


GREEN ENERGY FOR TOMORROW'S WORLD:
MAKING SMART USE OF ORGANIC WASTE AND RETURNING
IMPORTANT RESOURCES TO THE NUTRIENT CYCLE.

BIOGAS PLANT IN LATHI, FINLAND

Technical data	
Year of construction	2014
Feedstock	Biowaste, sewage sludge, silica
Feedstock throughput	44,000 metric tons/year
Digester capacity	4 x 900 m^3
Biogas flow rate	1,300 Nm^3/h

Labio Oy, Finland – our largest biowaste digestion plant in Europe.



BIOGAS PLANT IN HÄRNÖSAND, SWEDEN

A 340 m³ steel digester with external sanitization in a 160 m³ cylindrical steel tank.

Technical data	
Year of construction	2016
Feedstock	Biowaste, sewage sludge
Feedstock throughput	6,000 metric tons/year
Digester capacity	Main digester: 340 m^3 Sanitization tank: 160 m^3
Biogas flow rate	90 Nm^3/h

BIOGAS PLANT IN BIAŁA PODLASKA, POLAND

Concrete digester with a volume of 2 x 800 m³.

Technical data	
Year of construction	2013
Feedstock	Organic fraction of household waste
Feedstock throughput	20,000 metric tons/year
Digester capacity	2 x 800 m³
Biogas flow rate	260 Nm³/h

THIS IS EISENMANN

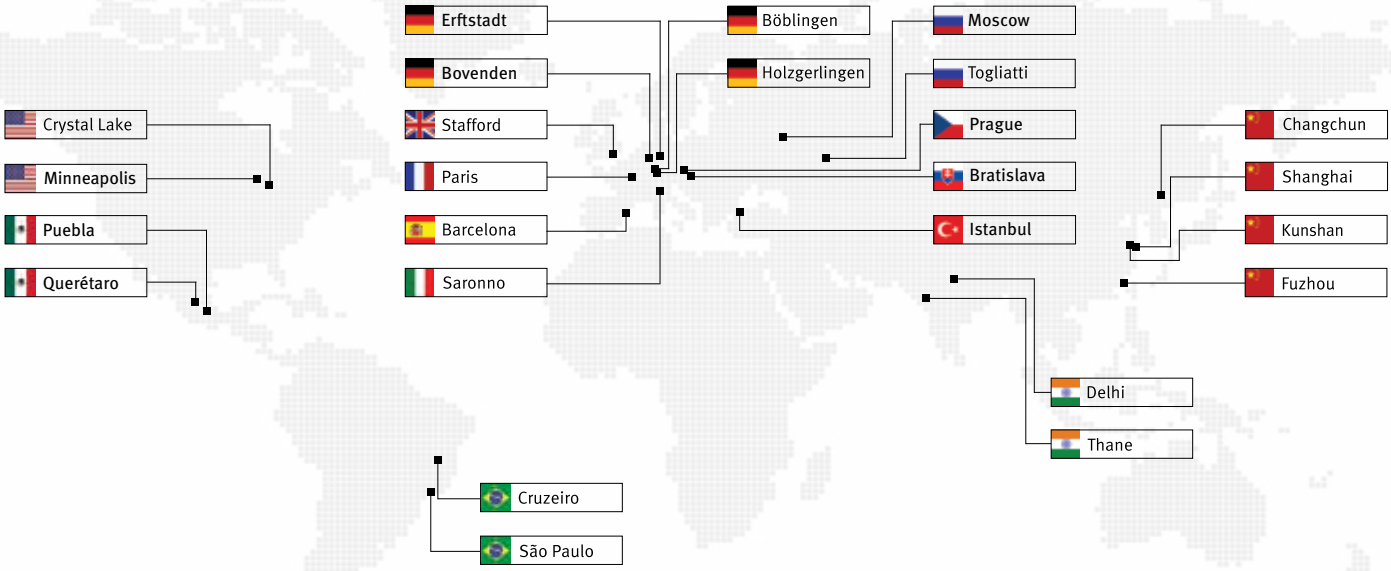
Eisenmann is a leading global provider of industrial solutions and services for surface finishing, material flow automation, thermal process technology and environmental engineering. A family-run business founded in 1952 in southern Germany, Eisenmann develops and builds made-to-measure manufacturing, assembly and distribution plants that are highly flexible, energy- and resource-efficient – and have been deployed by enterprises throughout the world for over 65 years. The company has around 3,200 employees at 25 locations in 14 countries in Europe, the Americas and BRIC nations. In 2016, Eisenmann posted sales revenues of 862 million euros.

Specialist engineers and technical staff comprise around half of the workforce. Thanks to their in-depth understanding of process engineering, they are able to develop plant configurations precisely tailored to each application. Prior to shipping, the systems are fully assembled and thoroughly tested at our dedicated Technology Center, ensuring problem-free installation and rapid commissioning at the customer site.

Ground-breaking technology, high customer satisfaction and outstanding cost-effectiveness underscore the stand-out quality delivered by Eisenmann.

Technology Center in Holzgerlingen, Germany.

EISENMANN LOCATIONS



EISENMANN

Eisenmann Corporation
150 E. Dartmoor Drive Crystal Lake, IL 60014
Phone: 815 455 4100

www.eisenmann.us.com