NYWEA-NEWEA Joint Spring Technical Conference and Exhibition | Saratoga Springs, NY

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Design & Performance Evaluation of a Solar-Assisted Dryer with Decentralized Thermal Recovery System

Harvest Technology | Alexander Krämer

Engineering 4 Environment | Steffen Ritterbusch, PhD

HARVEST TECHNOLOGY

Overview

- Solar Drying
- Sludge Reformer
- Case Study
- Future Work

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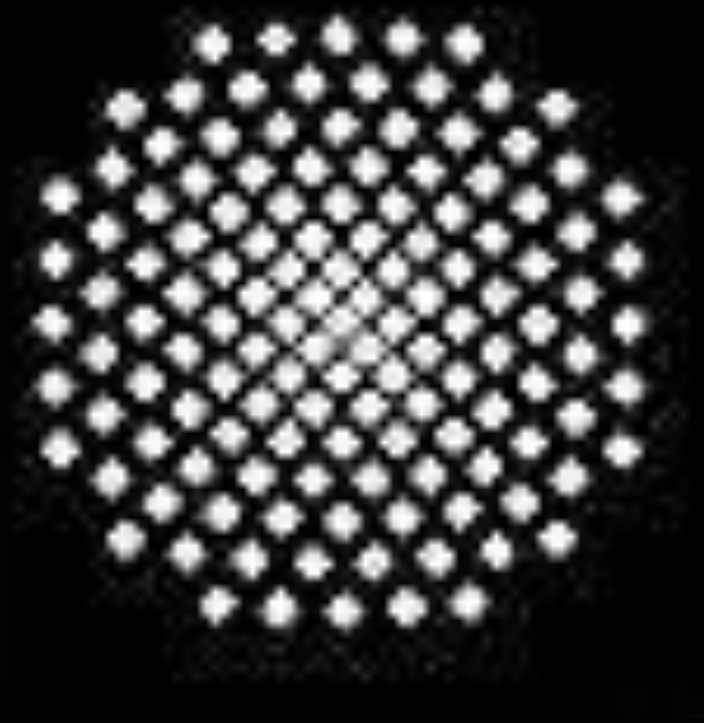
HARVEST
TECHNOLOGY

University Hohenheim

- 26 diploma thesis
- 3 doctorate thesis
- 7 R&D projects:
  - wastewater sludge
  - renewable energy sources

University Stuttgart



- 7 diploma thesis
  - wastewater sludge
  - Biomatter waste
- 150 scientific publications

Solar Drying

1,000 PE | 10,000 PE | 100,000 PE

Small Plants
1,000 – 5,000 t/yr @ 20% DS

Storage Dryer
Electric Mole

Solar

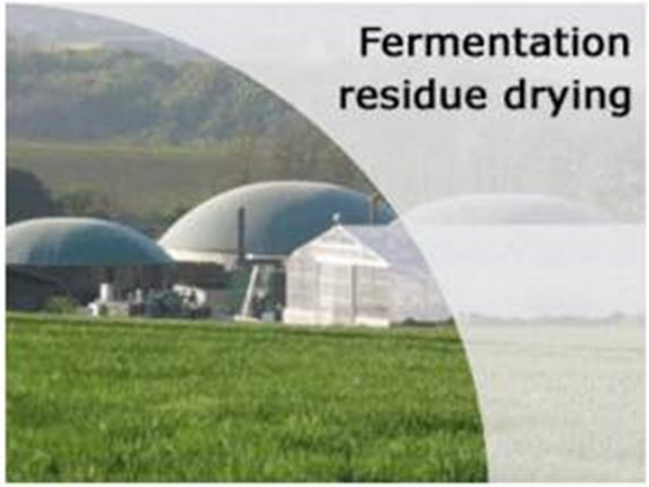
Medium Plants
5,000 – 15,000 t/yr @ 20% DS

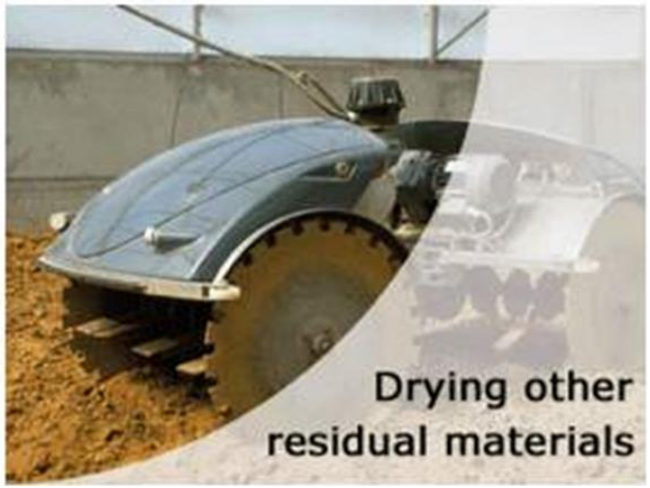
Batch
Electric Mole

Continuous
Sludge Manager

Solar | Waste Heat

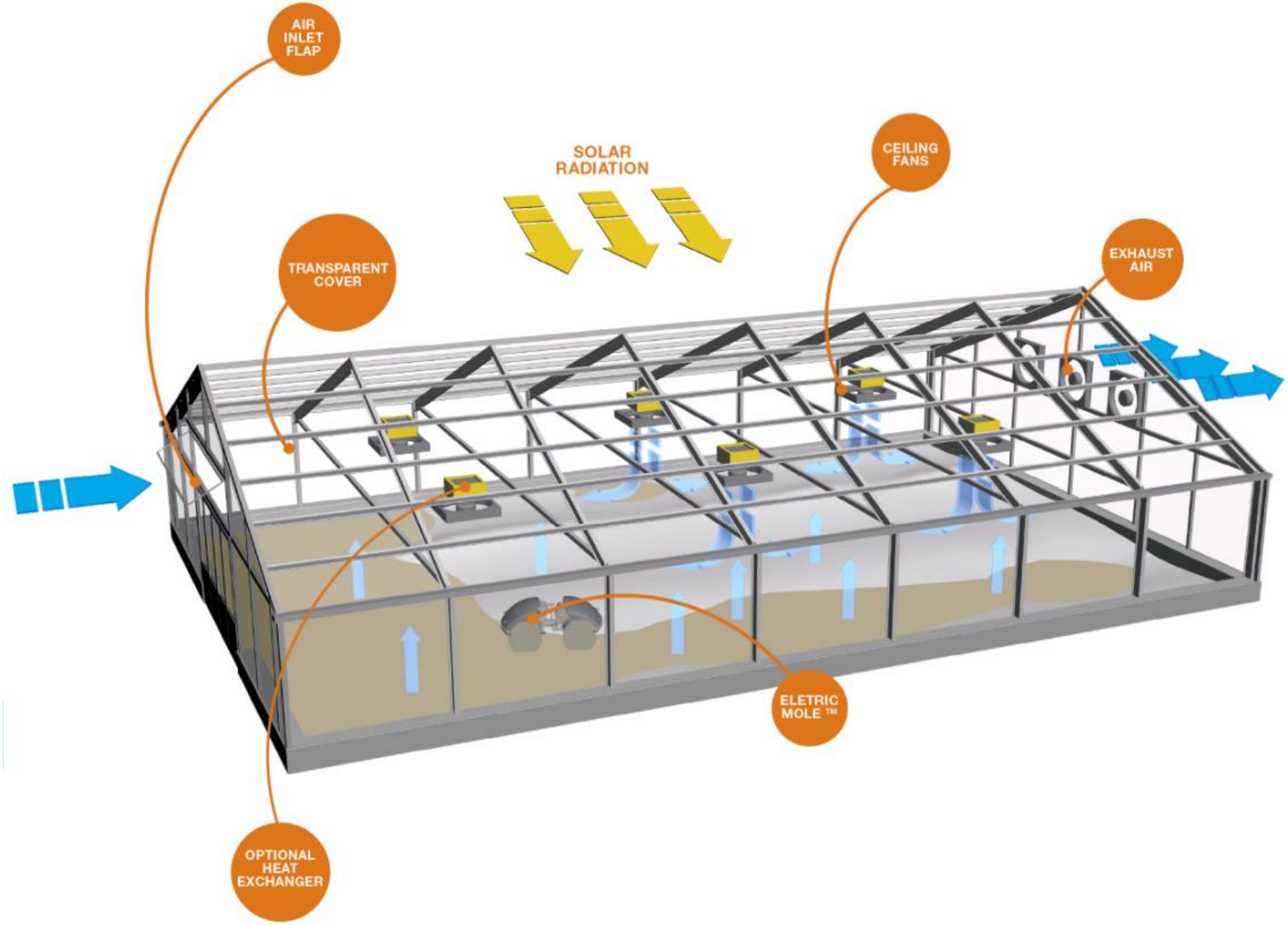
Solar | Waste Heat





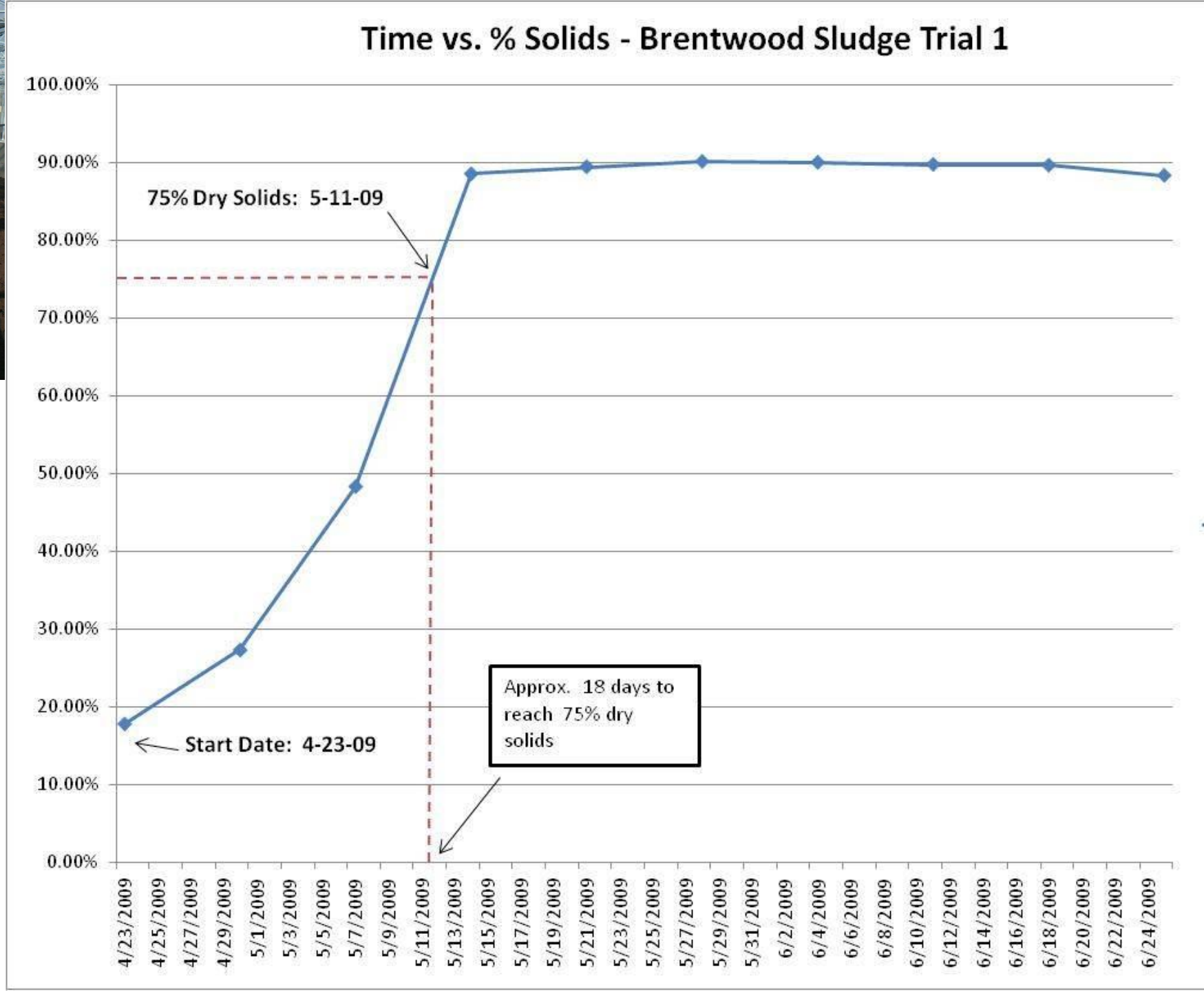
HARVEST TECHNOLOGY

Batch Operated System

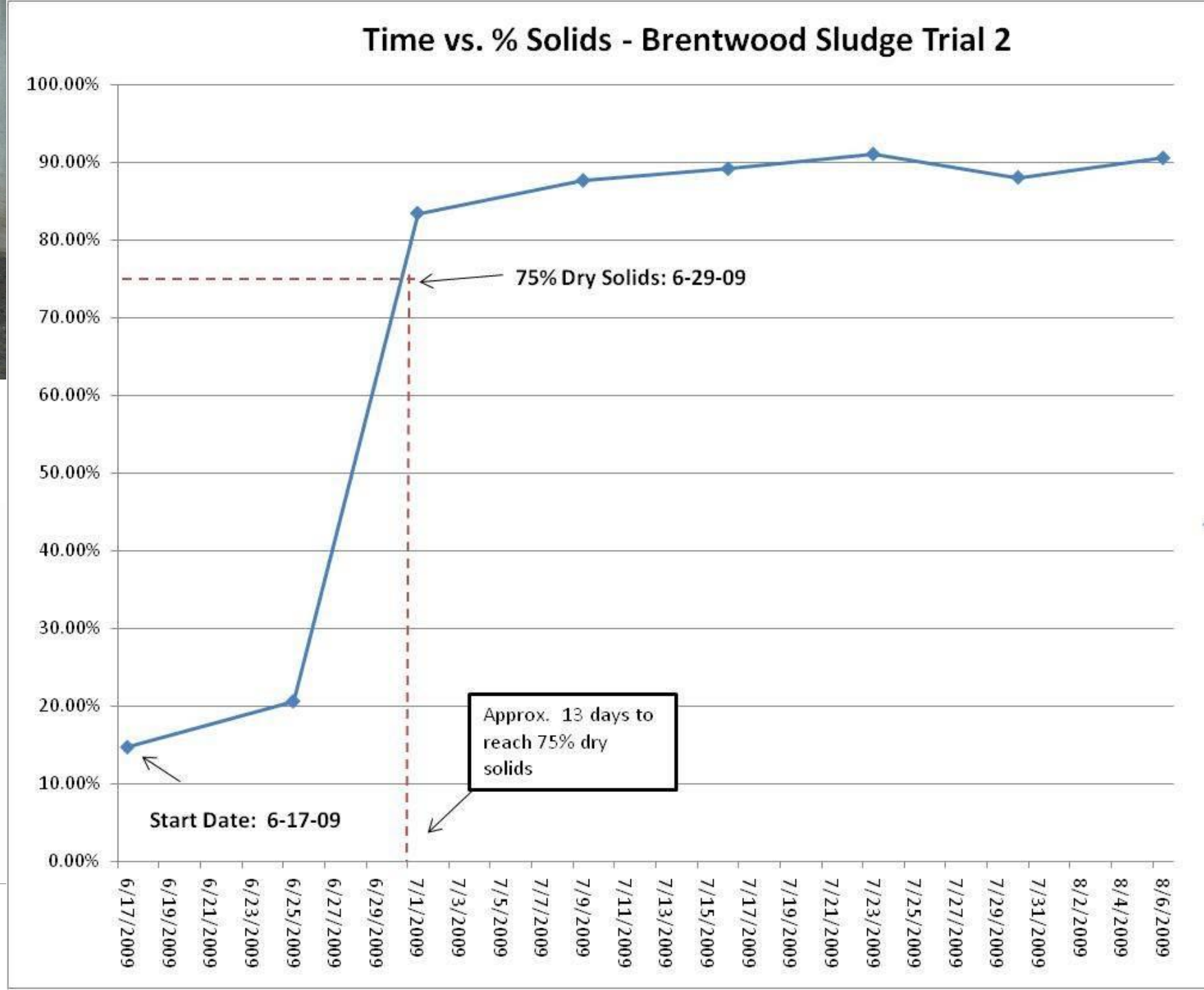



Robert


René


Time vs. % Solids - Brentwood Sludge Trial 1
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
75% Dry Solids: 5-11-09
Start Date: 4-23-09
Approx. 18 days to reach 75% dry solids
4/23/2009
4/25/2009
4/27/2009
4/29/2009
5/1/2009
5/3/2009
5/5/2009
5/7/2009
5/9/2009
5/11/2009
5/13/2009
5/15/2009
5/17/2009
5/19/2009
5/21/2009
5/23/2009
5/25/2009
5/27/2009
5/29/2009
5/31/2009
6/2/2009
6/4/2009
6/6/2009
6/8/2009
6/10/2009
6/12/2009
6/14/2009
6/16/2009
6/18/2009
6/20/2009
6/22/2009
6/24/2009

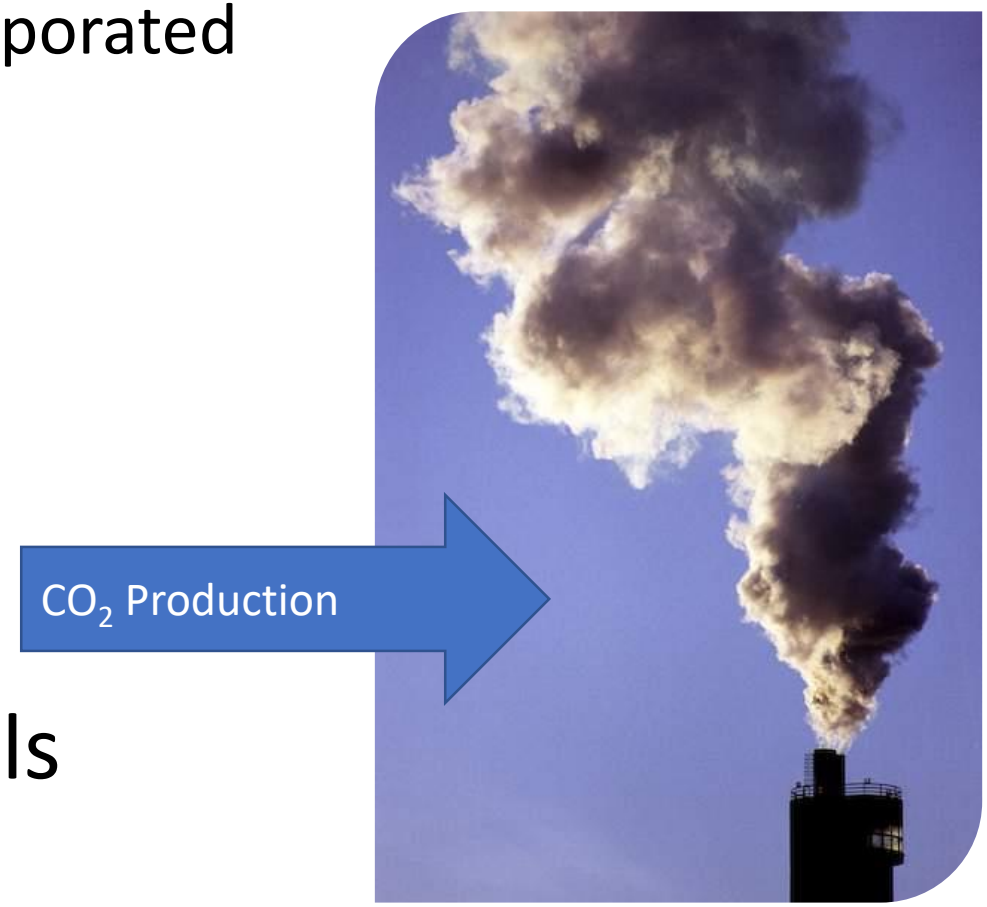

Marielou


Time vs. % Solids - Brentwood Sludge Trial 2
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
75% Dry Solids: 6-29-09
Approx. 13 days to reach 75% dry solids
Start Date: 6-17-09
6/17/2009
6/19/2009
6/21/2009
6/23/2009
6/25/2009
6/27/2009
6/29/2009
7/1/2009
7/3/2009
7/5/2009
7/7/2009
7/9/2009
7/11/2009
7/13/2009
7/15/2009
7/17/2009
7/19/2009
7/21/2009
7/23/2009
7/25/2009
7/27/2009
7/29/2009
7/31/2009
8/2/2009
8/4/2009
8/6/2009

The Concern with drying Sludge / Biosolids

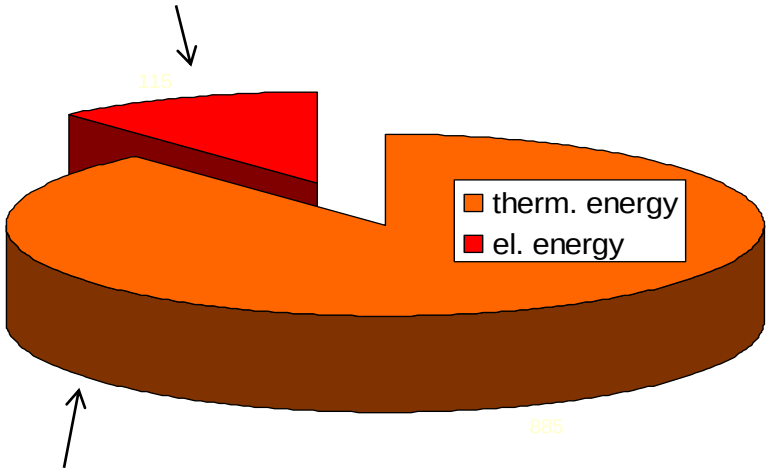
- It requires lots of energy!
  - 90 - 130 kWh per ton of water evaporated (depending on temperature level)
  - Thermal Energy Requirement
    - Natural Gas
    - Heating Oil

- Energy is typically derived from the burning of fossil fuels which yields:



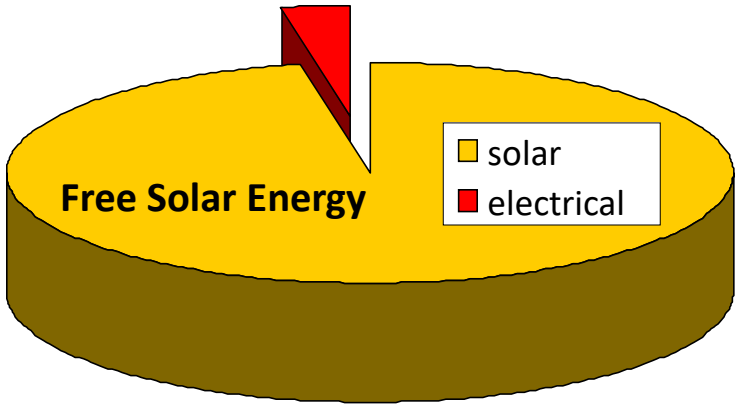
Energy Consumption – drying Biosolids

90-130 kWh_{el} / ton H_2O evaporated

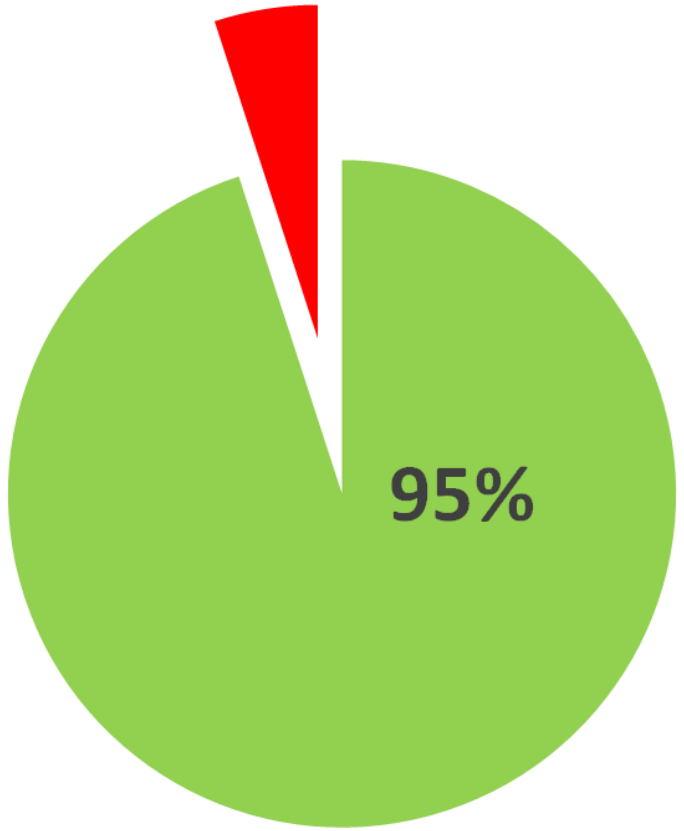


3.1 Million BTU/ ton H_2O evaporated

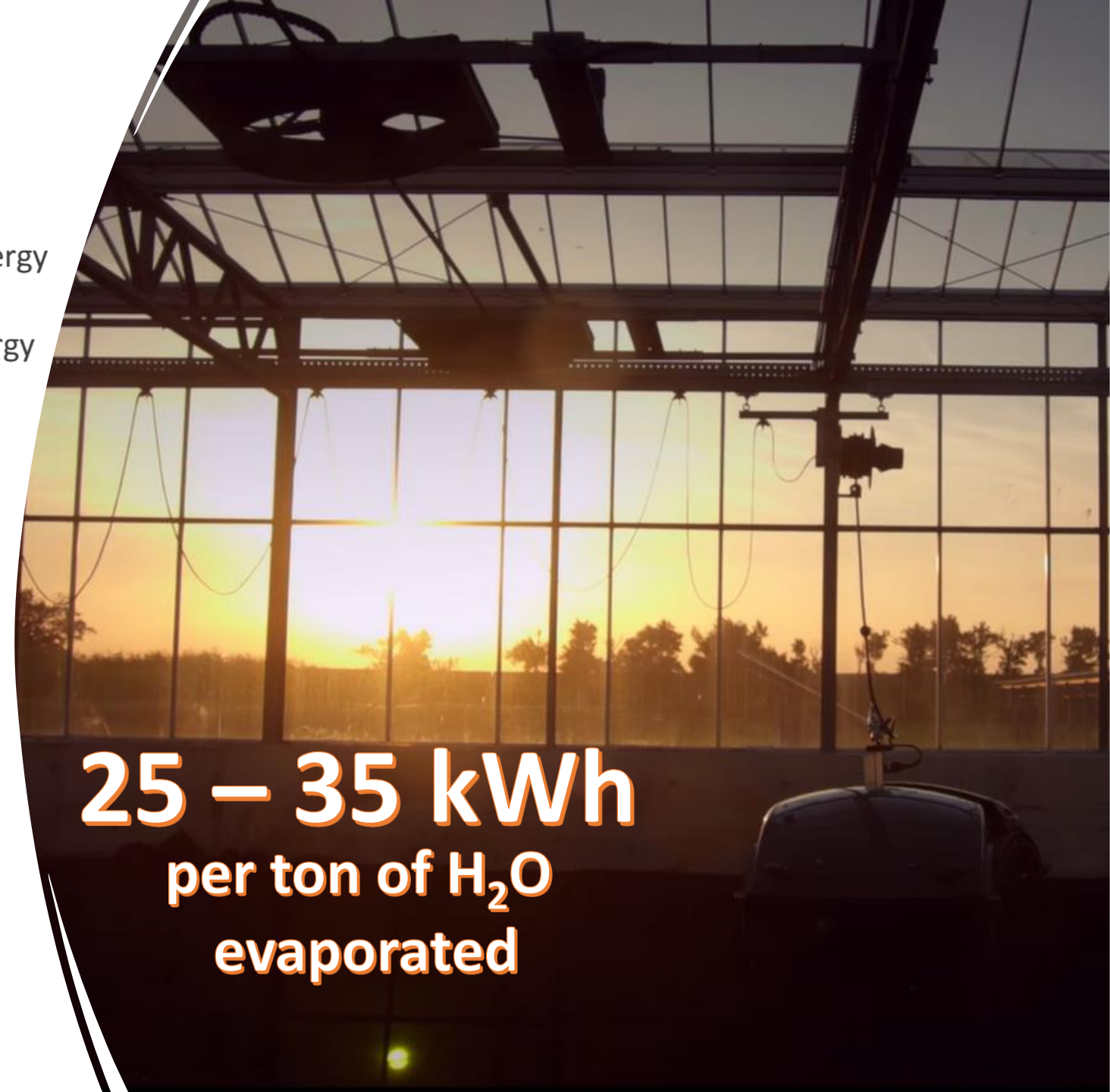
25 - 35 kWh_{el} / t H_2O evaporated



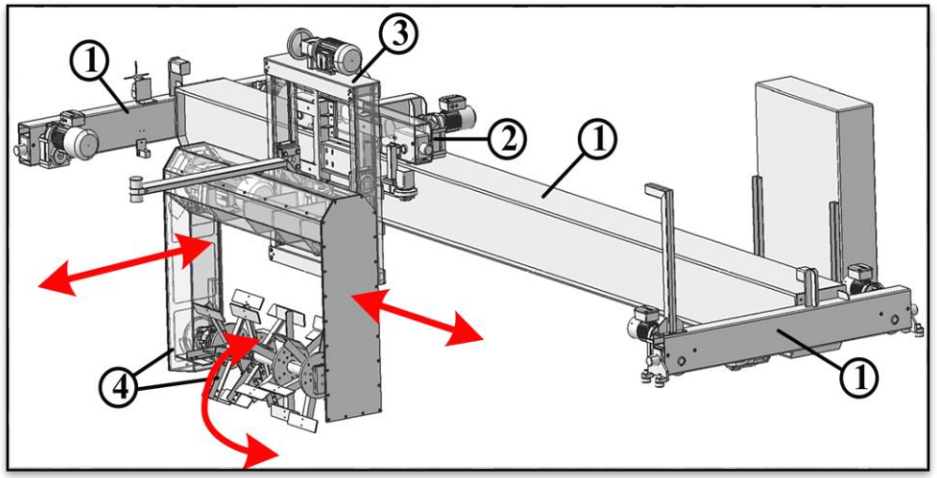
Thermal Dryers vs Active Solar Dryers



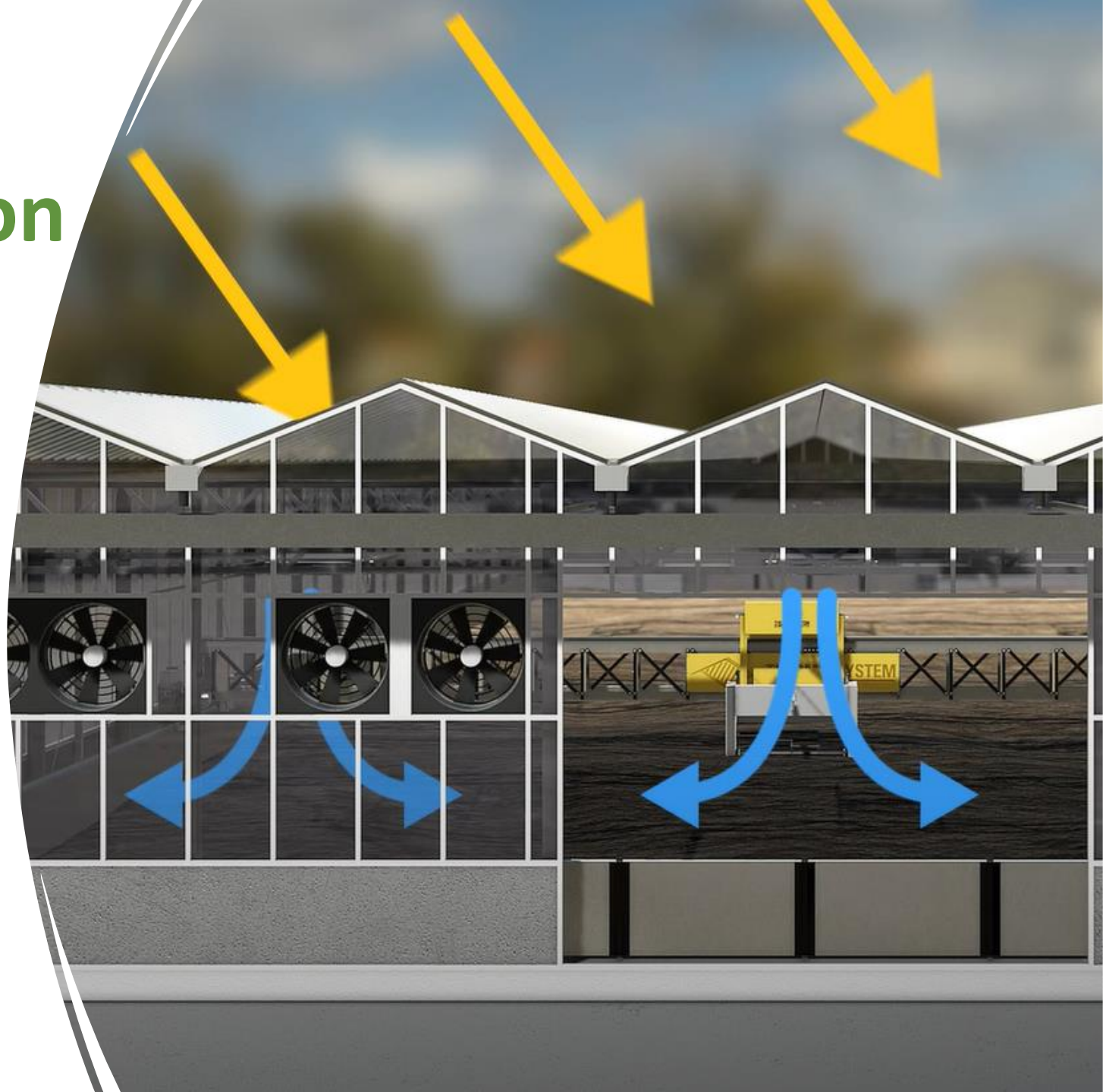
Source: LFU / LFW Report Fuessen



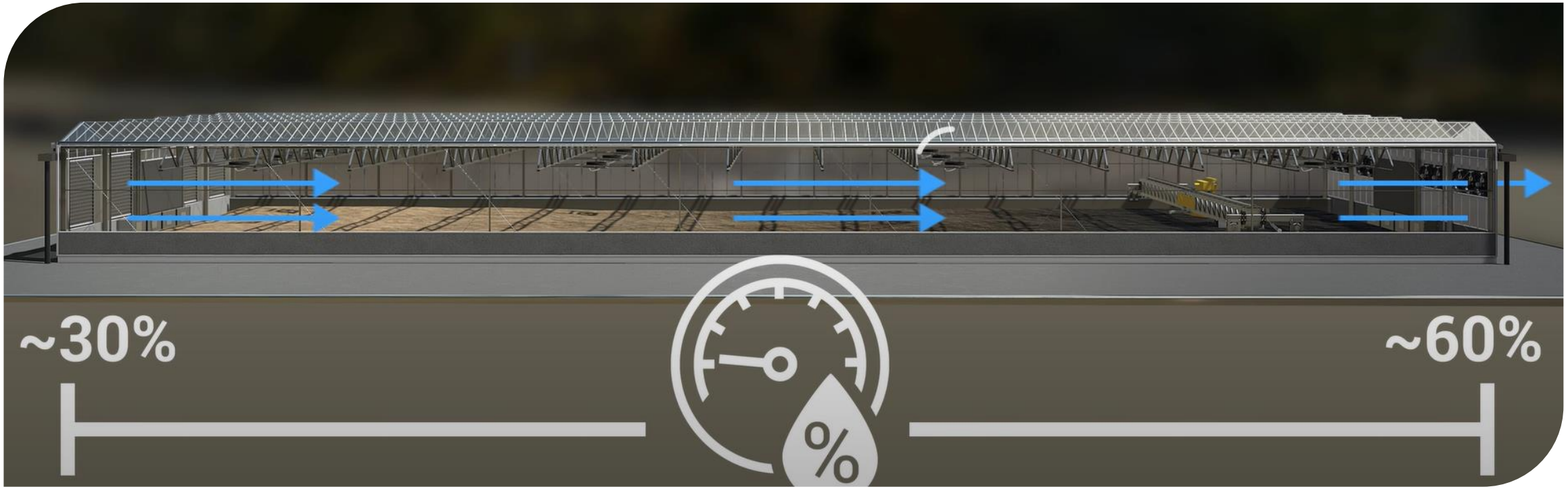
Solar Drying
Continuous Operation



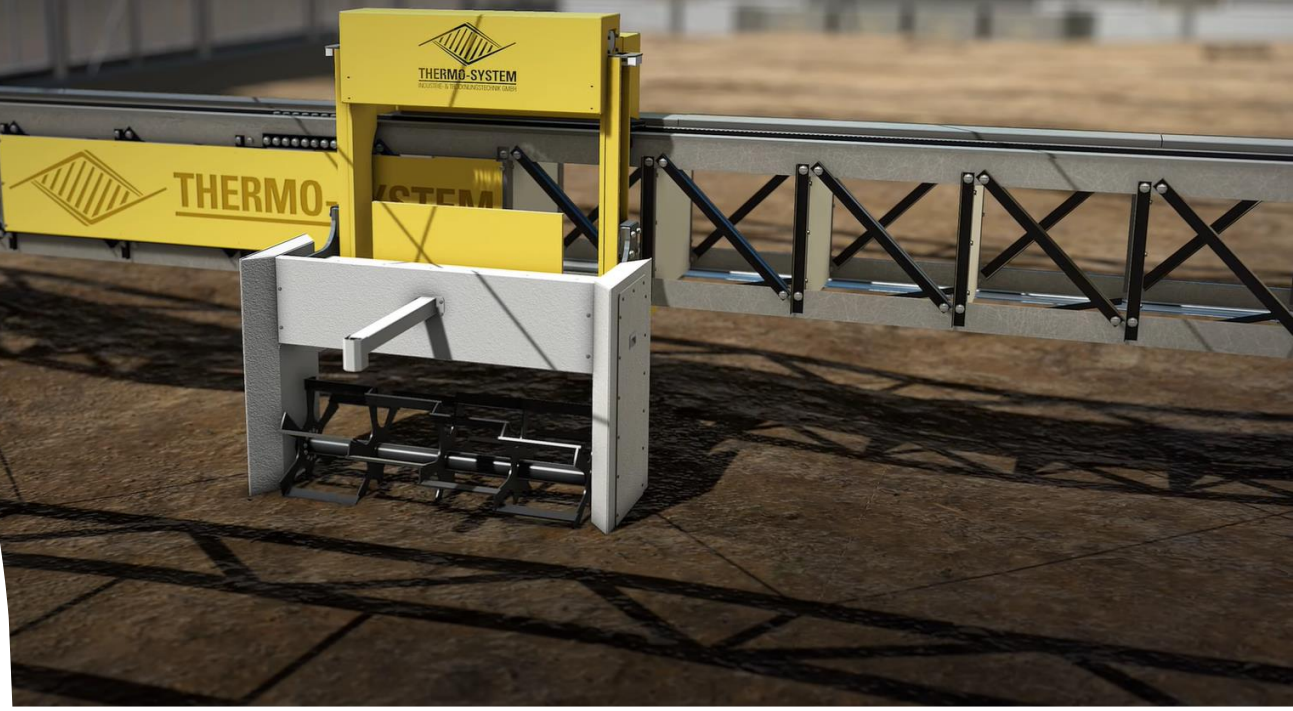
Tilling Device: SludgeManager™



Solar Drying | Continuous Operation

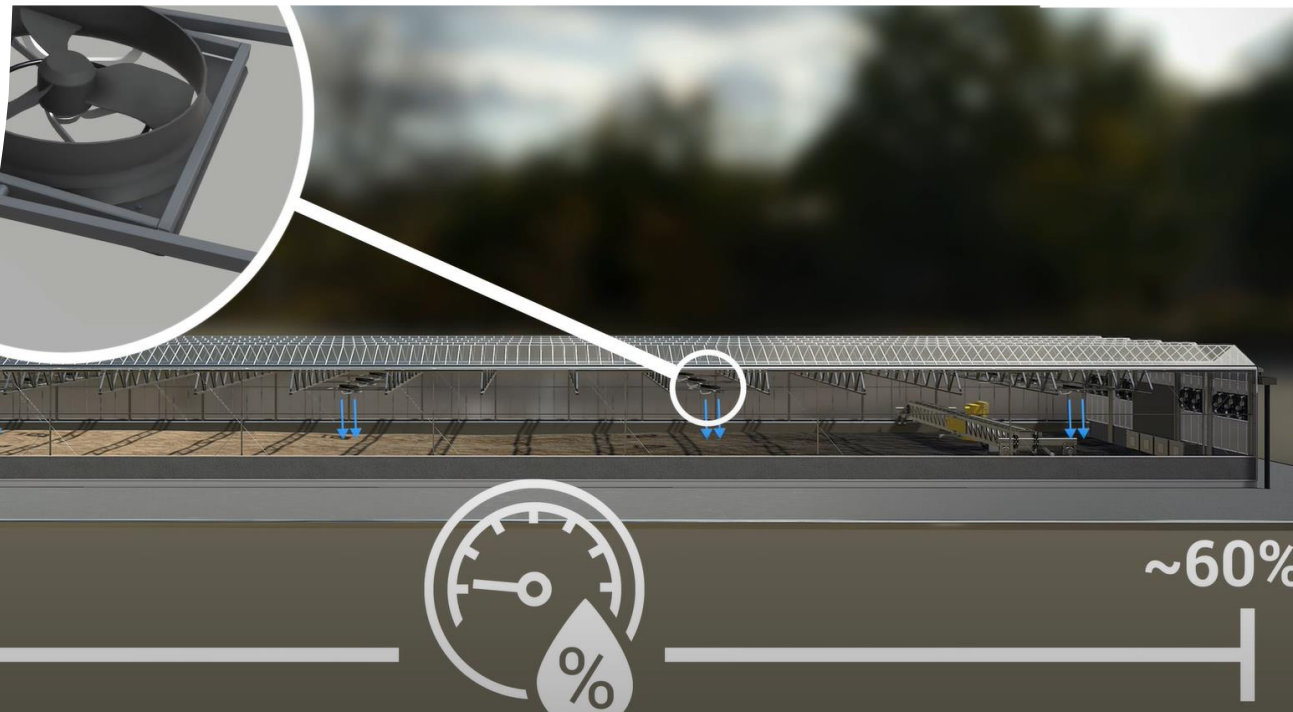


Solar Drying
Continuous Operation



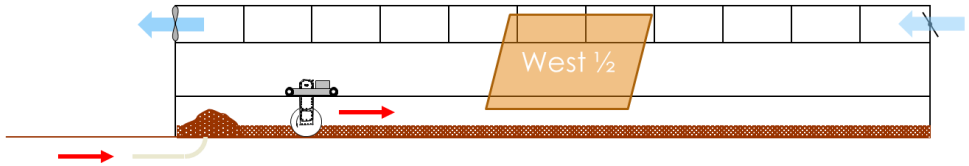
Features & Benefits:

- fully automated loading, drying and discharge process
- Point-to-point transport of the biosolids
- Effortless sludge handling even in the sticky phase
- Durable and low-maintenance technology
- Suitable for chamber widths of 30ft to 60ft and drying areas of up to 33,000 ft²
- AHC® (Automatic Height Control) automatic height mapping system ensures that the tilling device automatically adjusts to uneven ground and that the filling level of the hall is even

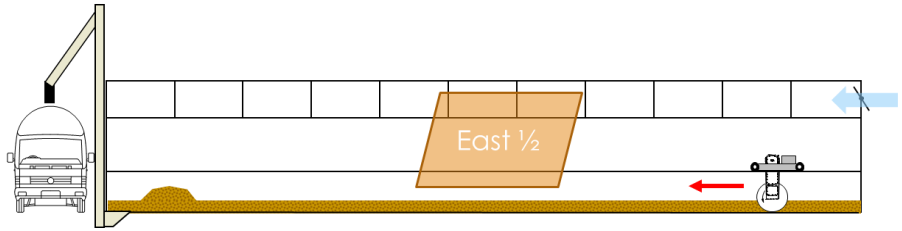


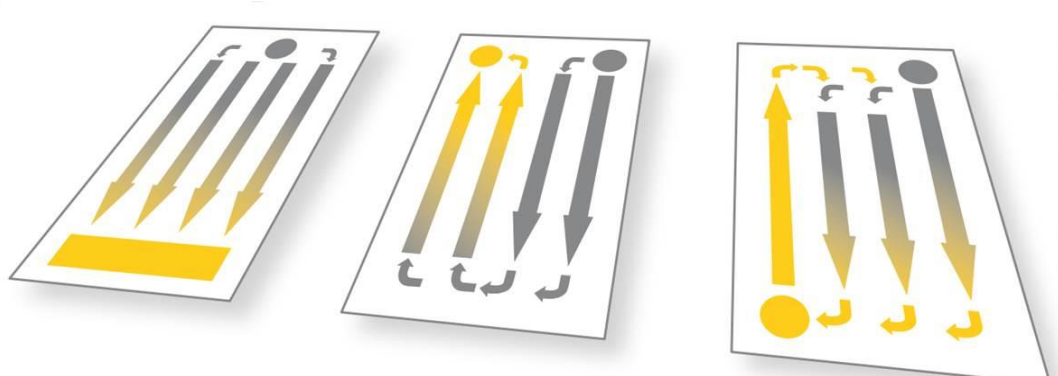
Solar Drying Continuous Operation

Biosolids <u>loading</u> at 15 - 28 %d.s. *fully automated*



Biosolids <u>unloading</u> at 75 - 90% d.s. *fully automated*







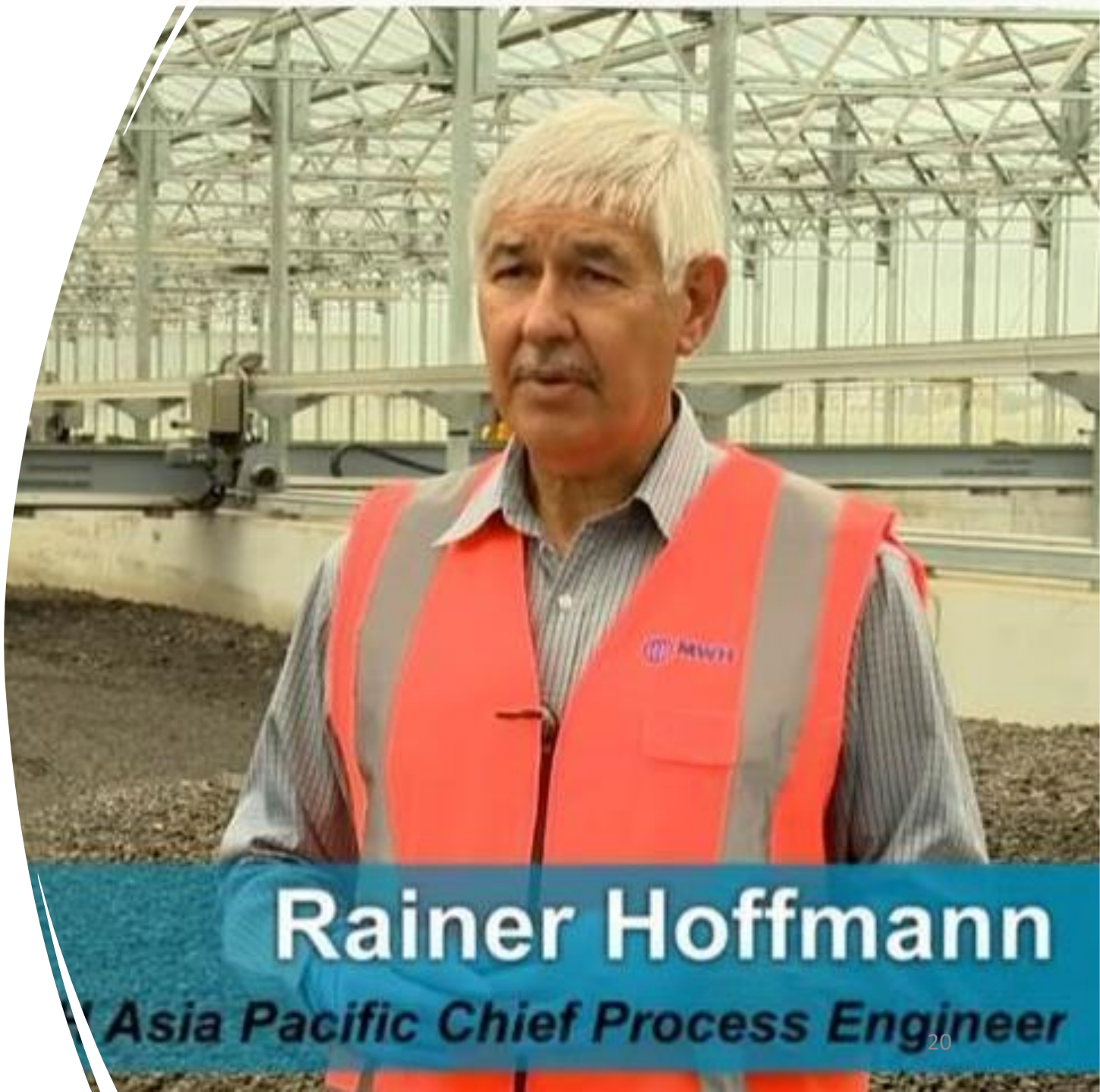



Murray Washington
Asset Manager Selwyn District Council


WWTP Christchurch/Rolleston
Pines Waste Water Treatment Plant

Solar Drying Continuous Operation

“The operational experience with the solar drying facility in New Zealand is very positive and the operator input has been minimal. The Solar Drying Facility is a fully automated system that is robust and reliable and has a low energy requirement of about 206 kWh/t dry solids to dry the dewatered sludge from 18 % dry solids to over 70 % dry solids.” – Mr. Rainer Hoffmann STANTEC/MWH Asia Pacific Chief Process Engineer at Christchurch, New Zealand – referring to the -> SludgeManager™



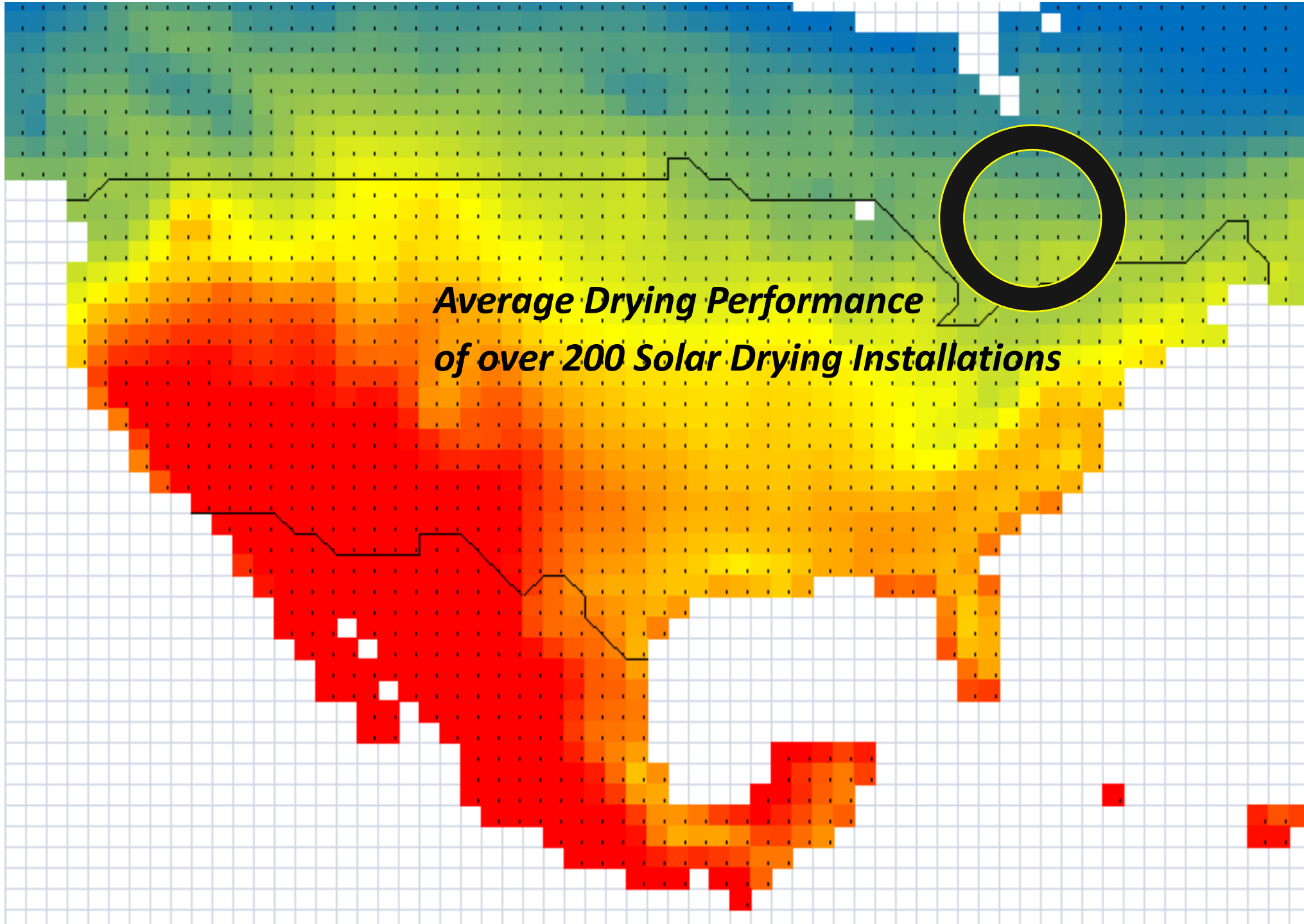
THERMO-SYSTEM® Active Solar Dryer™

- Most plants are located in Germany
- Located North of 49th parallel (US-Canada border)
- High cloud cover
- Cold, wet/snowy winters

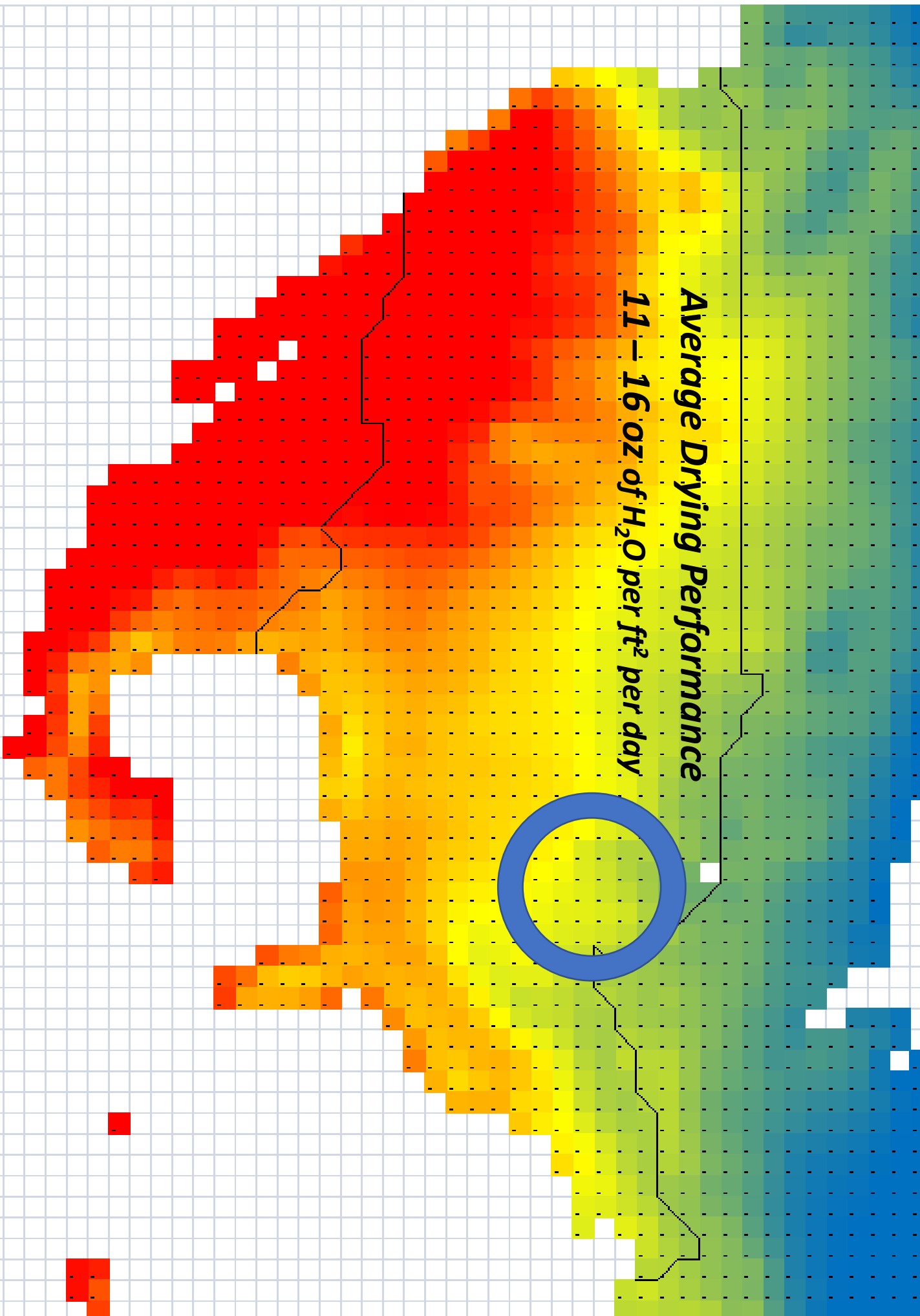
Germany/Austria:
> 50 plants

World:
> 200 plants

THERMO-SYSTEM®
Active Solar Dryer™



THERMO-SYSTEM®
Active Solar Dryer™



THERMO-SYSTEM®
Active Solar Dryer™

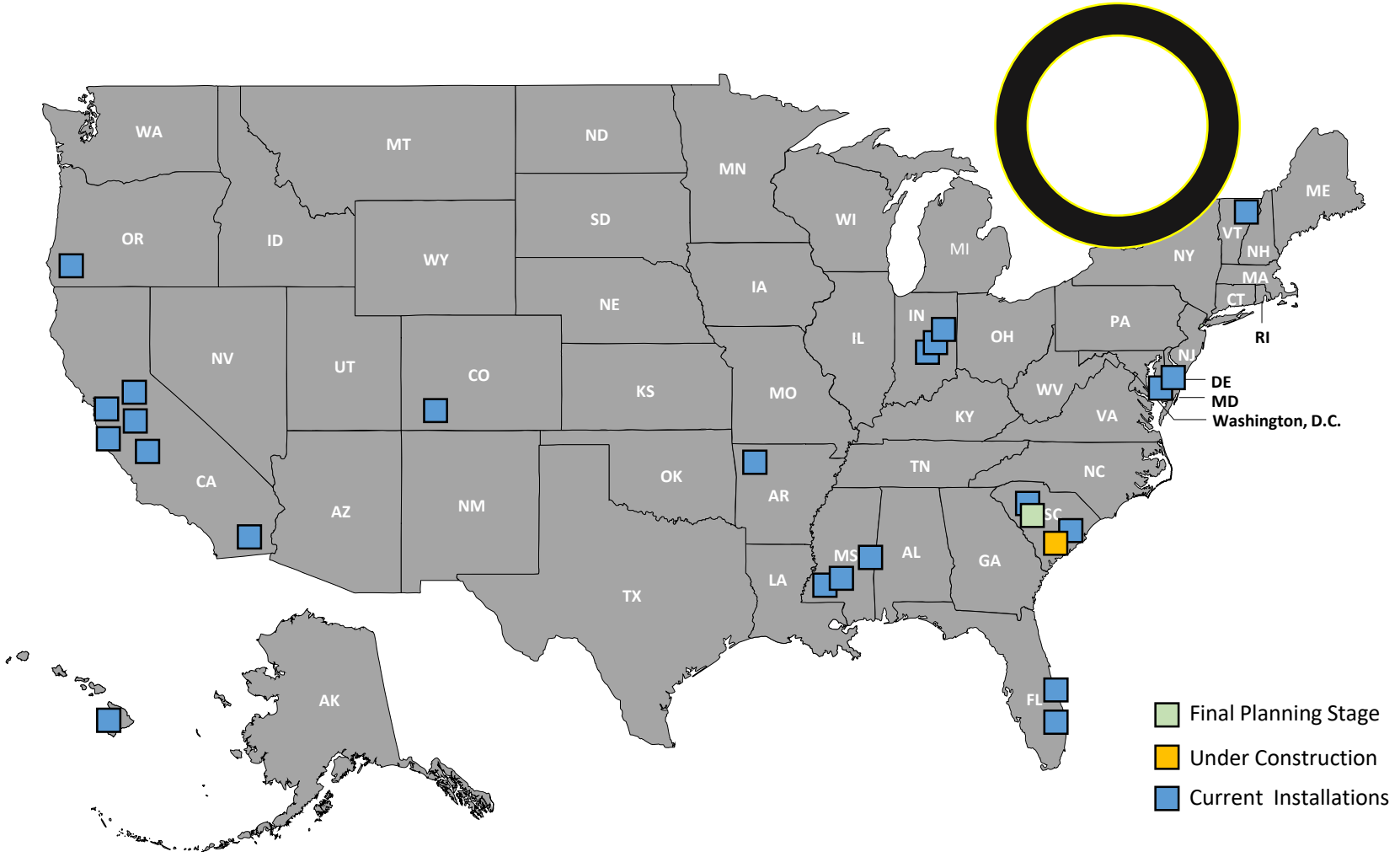
>200 ACTIVE SOLAR DRYER™ installations worldwide.

- Ranging from 0.2 MDG to 90 MGD

THERMO-SYSTEM®
Active Solar Dryer™

Installations USA

Average Drying Performance of over 200 Solar Drying Installations



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Active Solar Dryer™

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Active Solar Dryer™

THERMO-SYSTEM® Active Solar Dryer™

Palma de Mallorca

- 40 MGD Plant
- Different type of sludge
- 33,000 tons per year
- Footprint: 4.4 acres
- 12 Chambers

THERMO-SYSTEM®
Active Solar Dryer™

REGIONAL DRYING FACILITY

Sludge Loading into the Active Solar Dryers

Sludge Reformer From Lab-Scale to Piloting

Sludge Reformer

HARVEST TECHNOLOGY

Air Handling and Bagging System

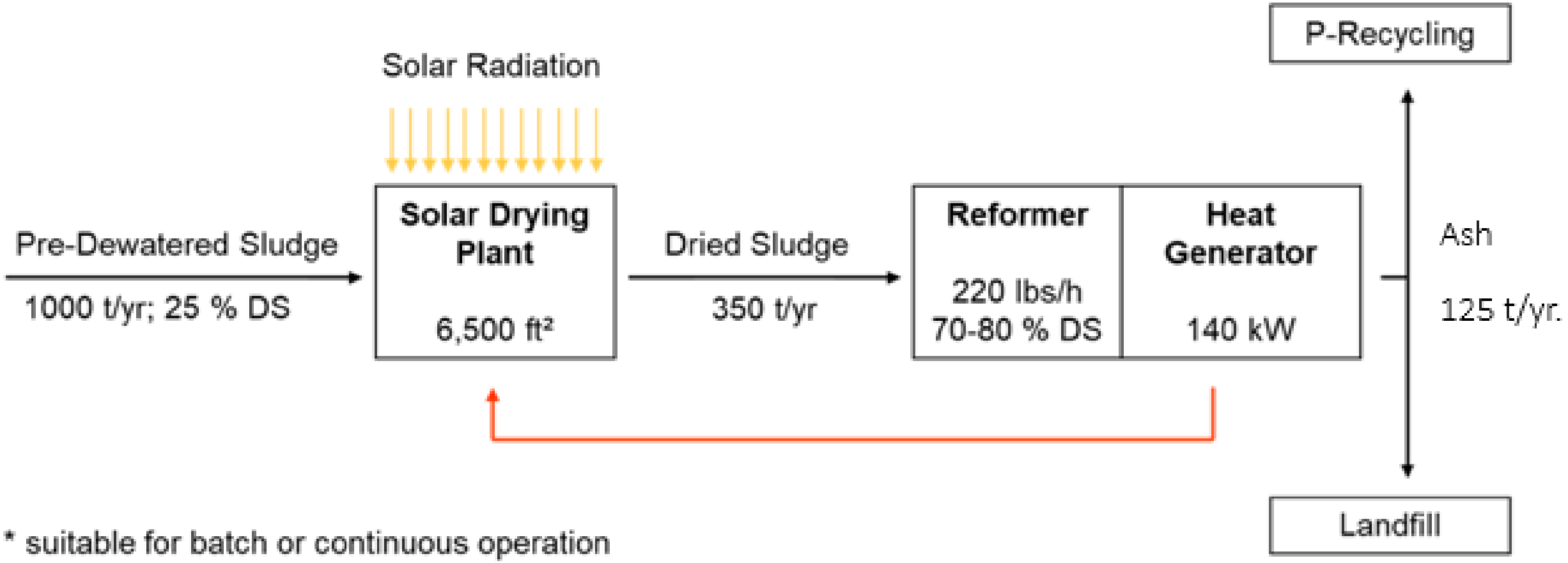
Case Study Renningen, Germany

SludgeReformer Installation		
Biosolids Input (dry)	850	tons per year
Dried Solids Concentration	75 - 90	% ds
Organic Content	45 - 60	% ds
Ash Amount	250 - 350	tons per year
Nominal Fuel Throughput	150	kilogram per hour
Nominal Combustion Heat Output	300	kW
Exhaustgas Cleaning	3	Phase
ORC-Turbine electrical power	20	kW
Wasteheat to Solar Dryer	200	kW
Footprint Reformer Building	300	m2

Case Study Renningen, Germany

Renningen Anaerobic Digestion 1.5 MGD

Example Renningen (20 000 PE – approx 1.5MGD)



* suitable for batch or continuous operation

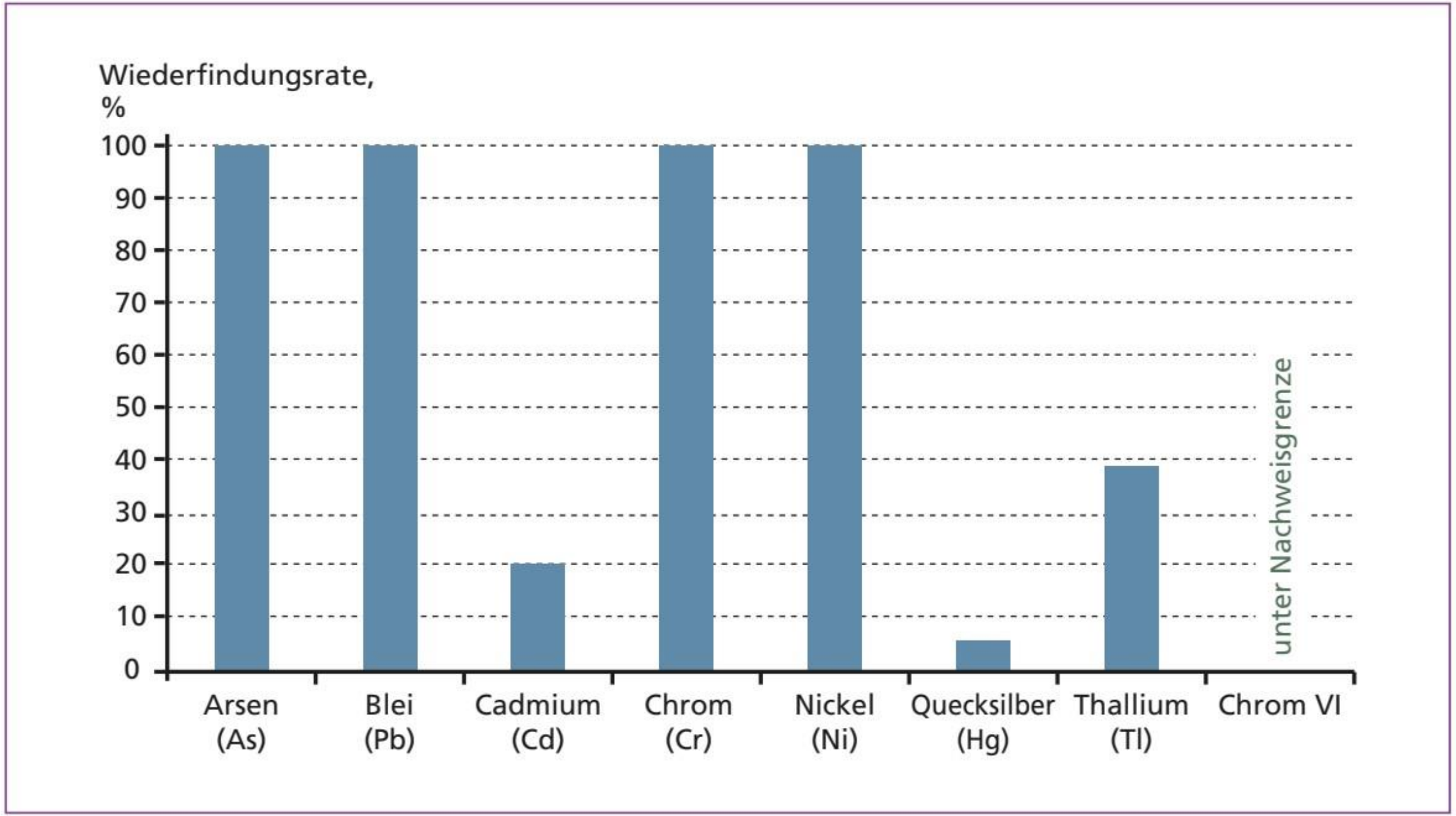
Dewatering to Drying to Ash

dewatered biosolids at 22% ds

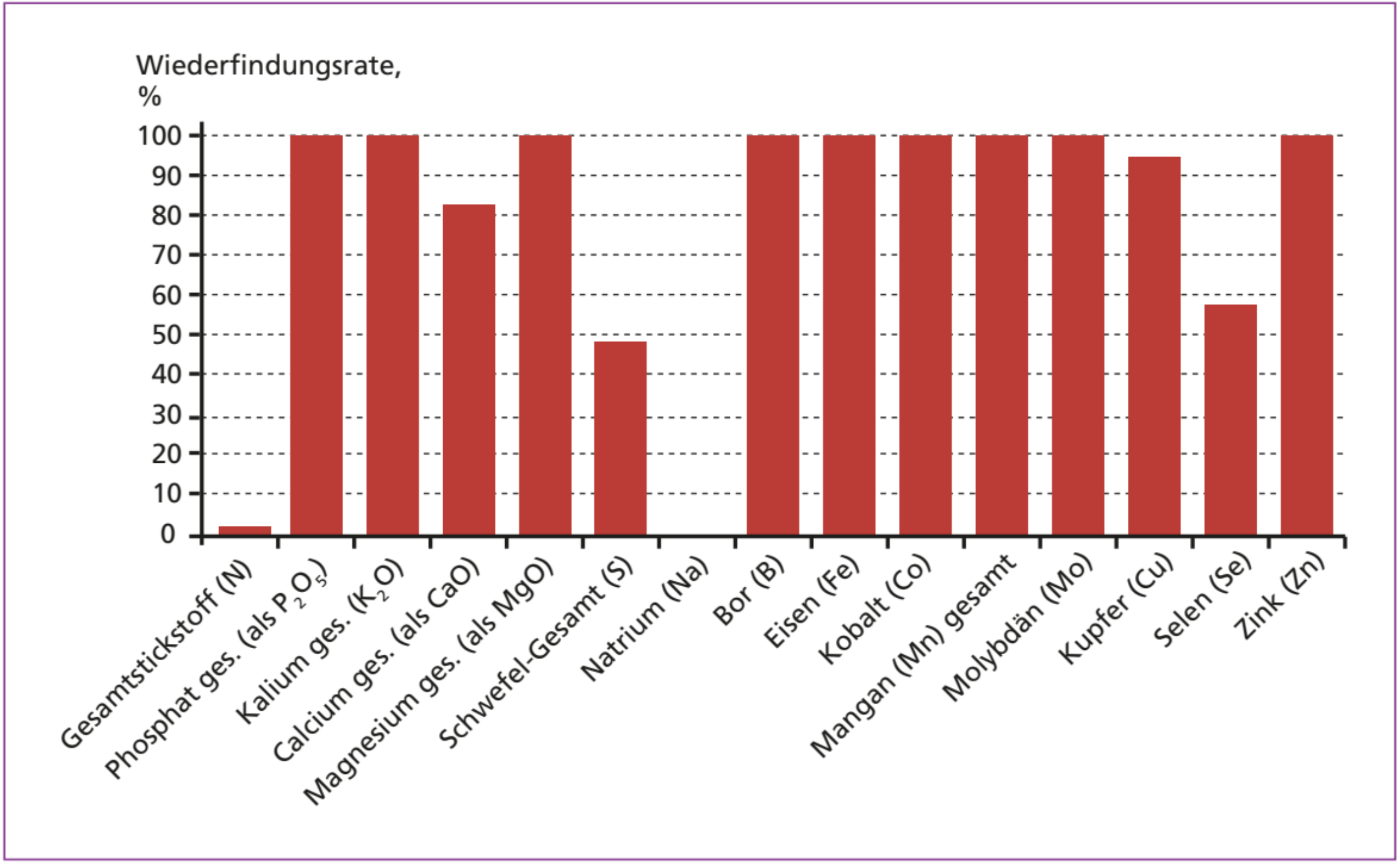
dried biosolids at 80% ds

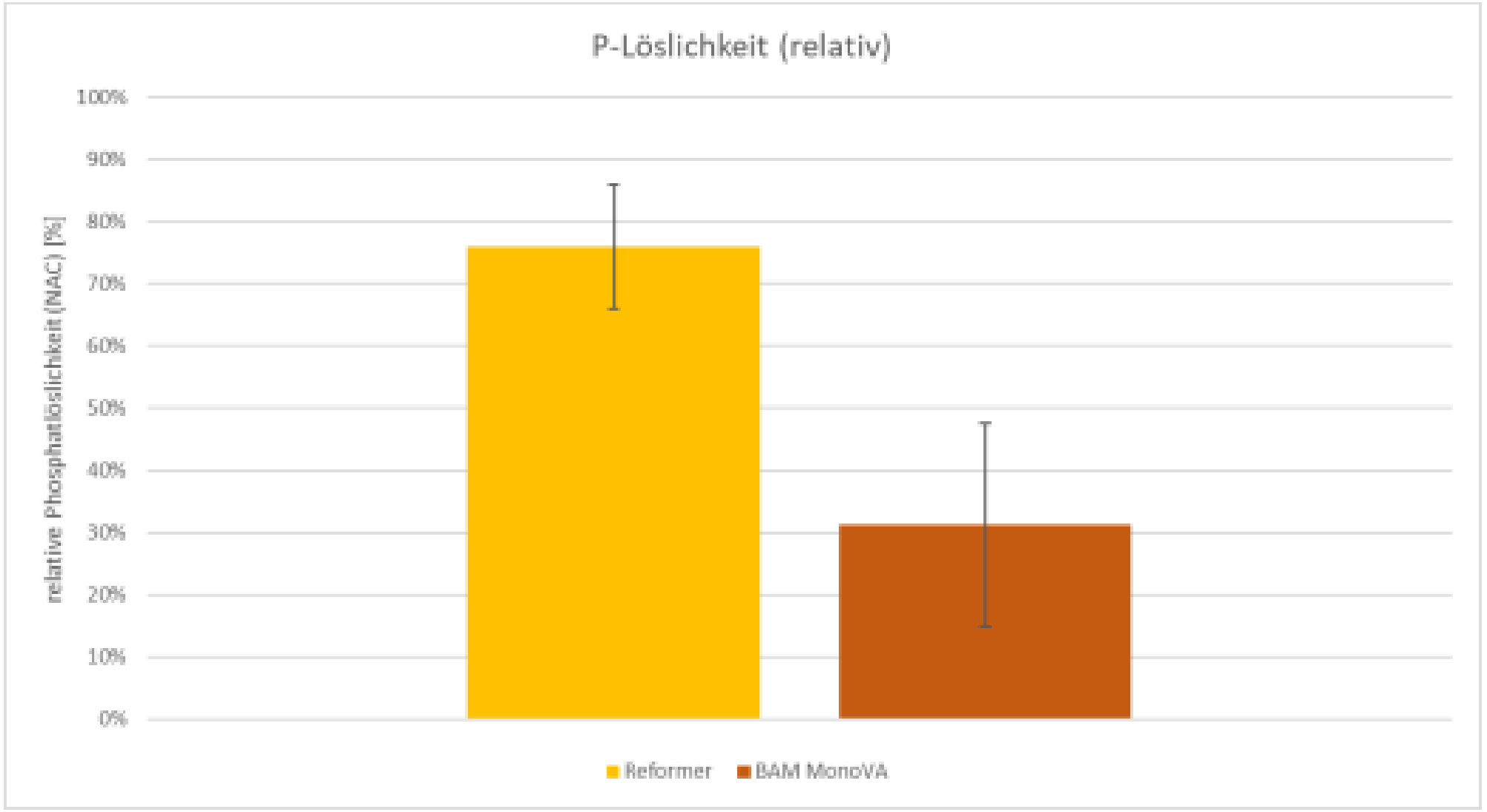
ash from the Reformer

Heavy Metals



Heavy Metals

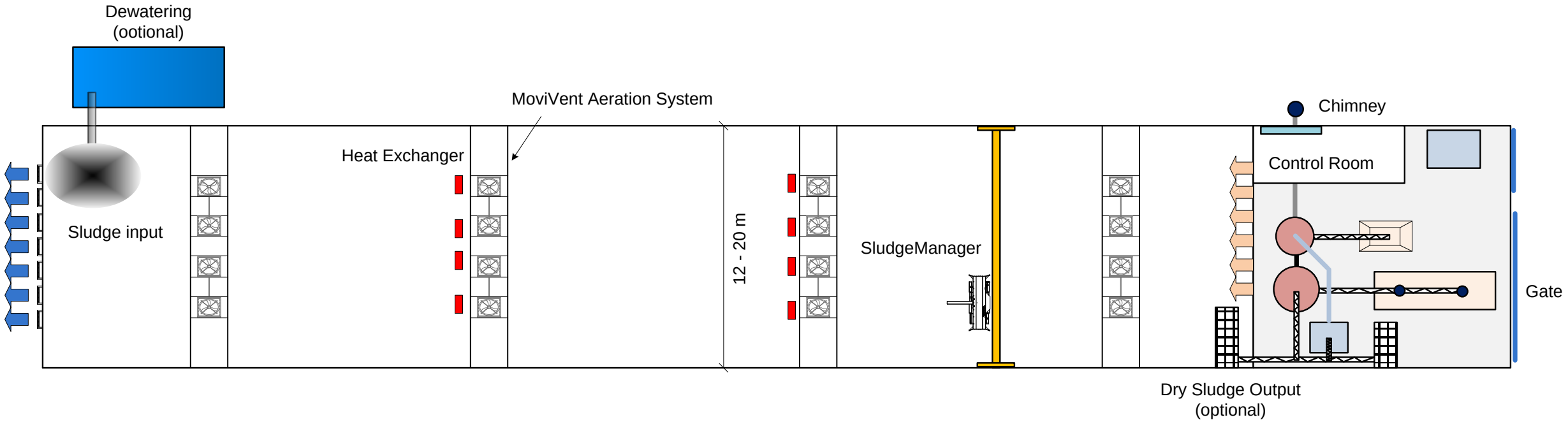




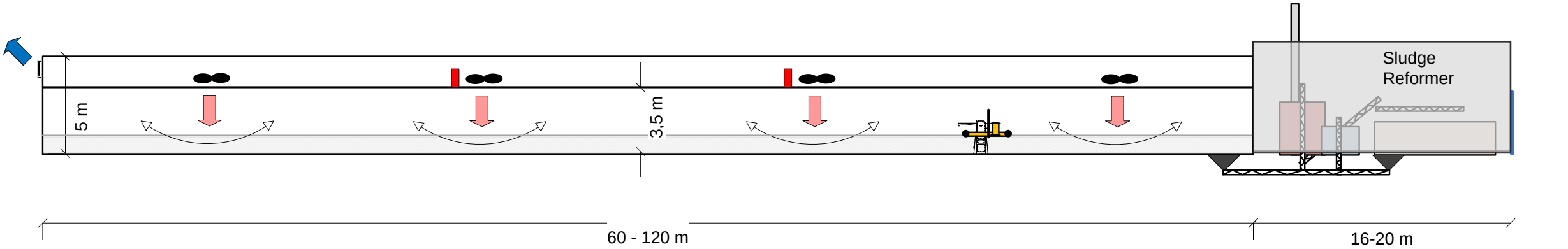
Comparison of the neutral ammonium citrate solubility (NAC) of ash from the SludeReformer and typical mono-incineration ash

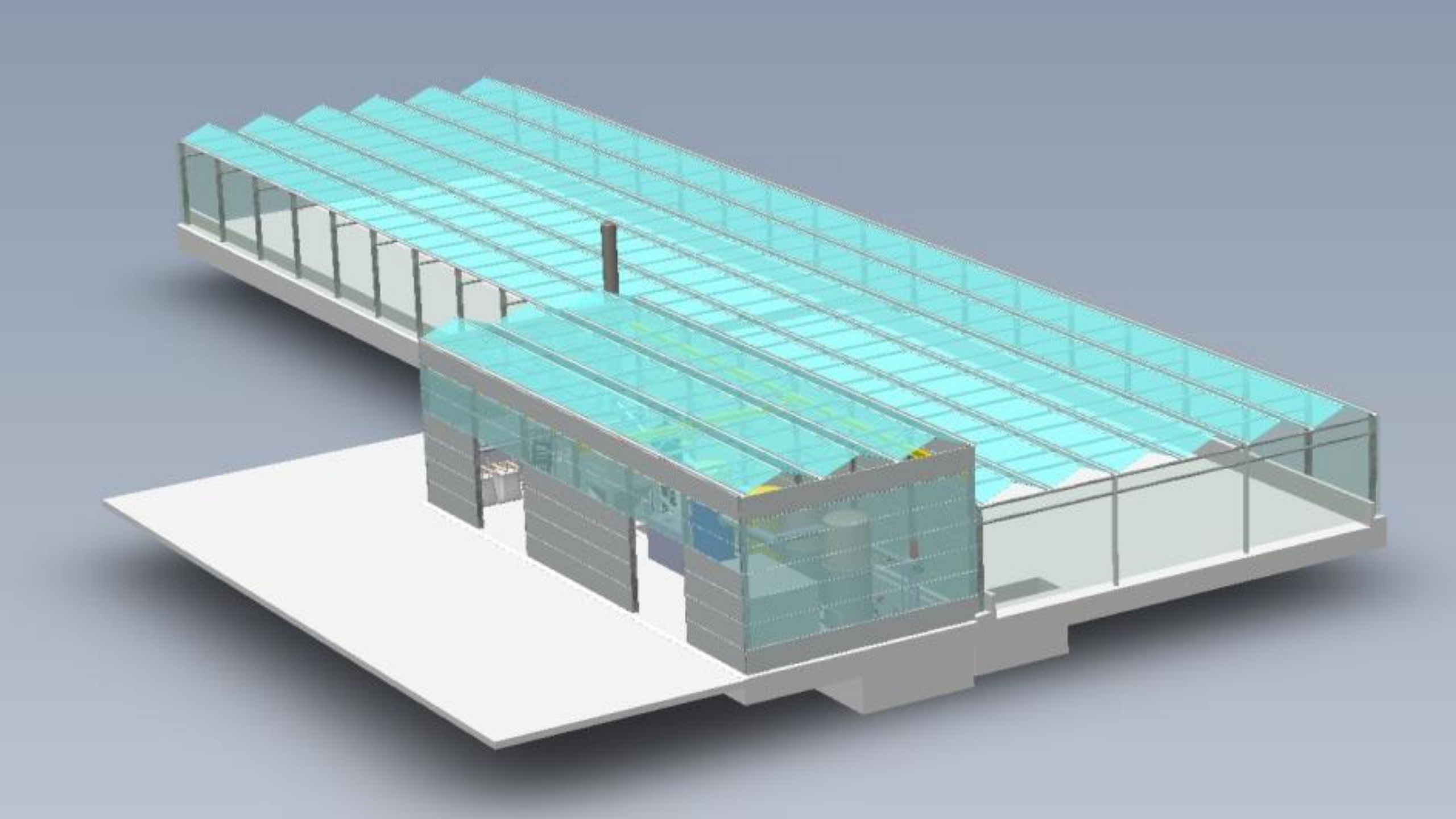
Future Design Option

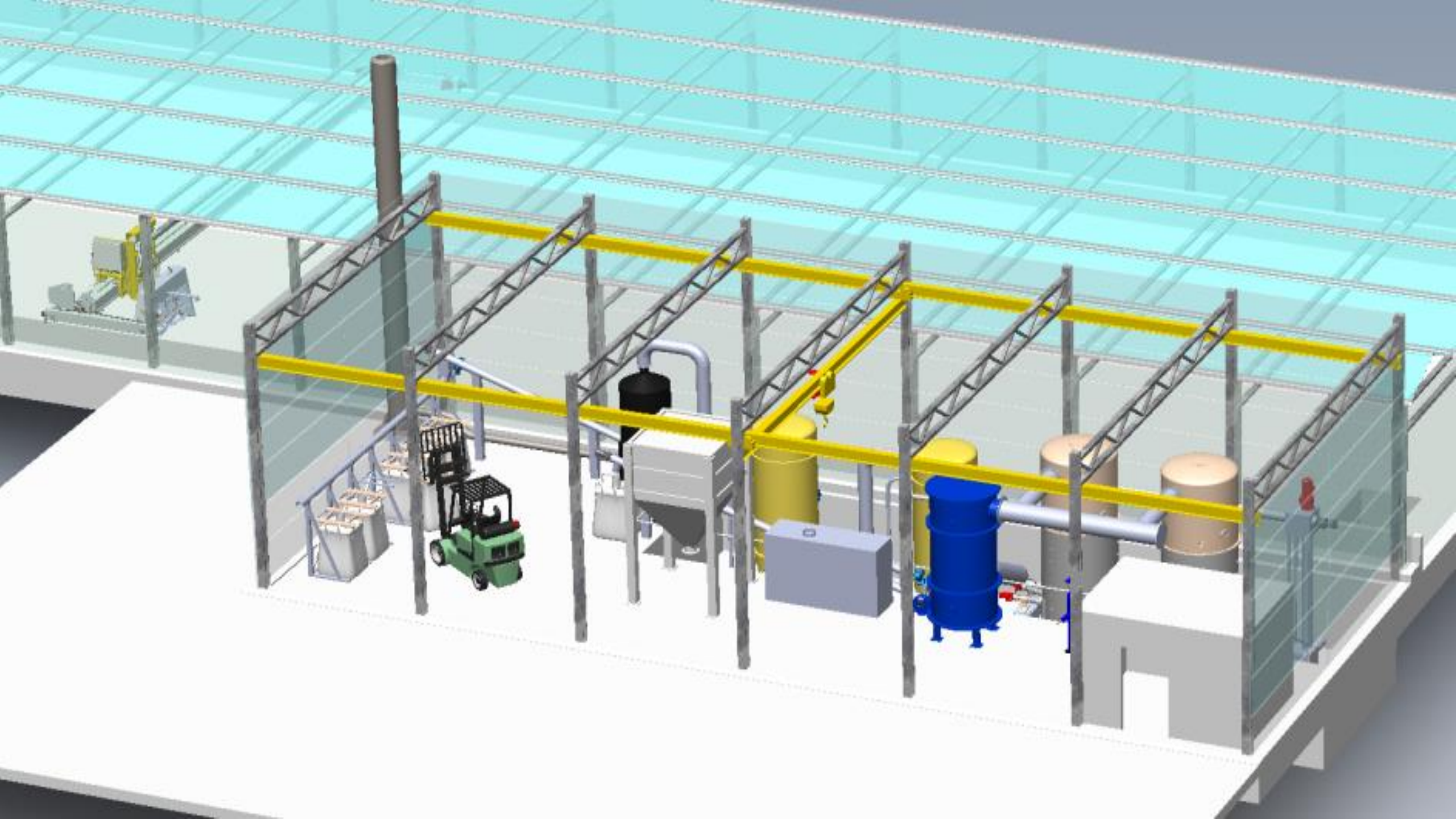
Top View

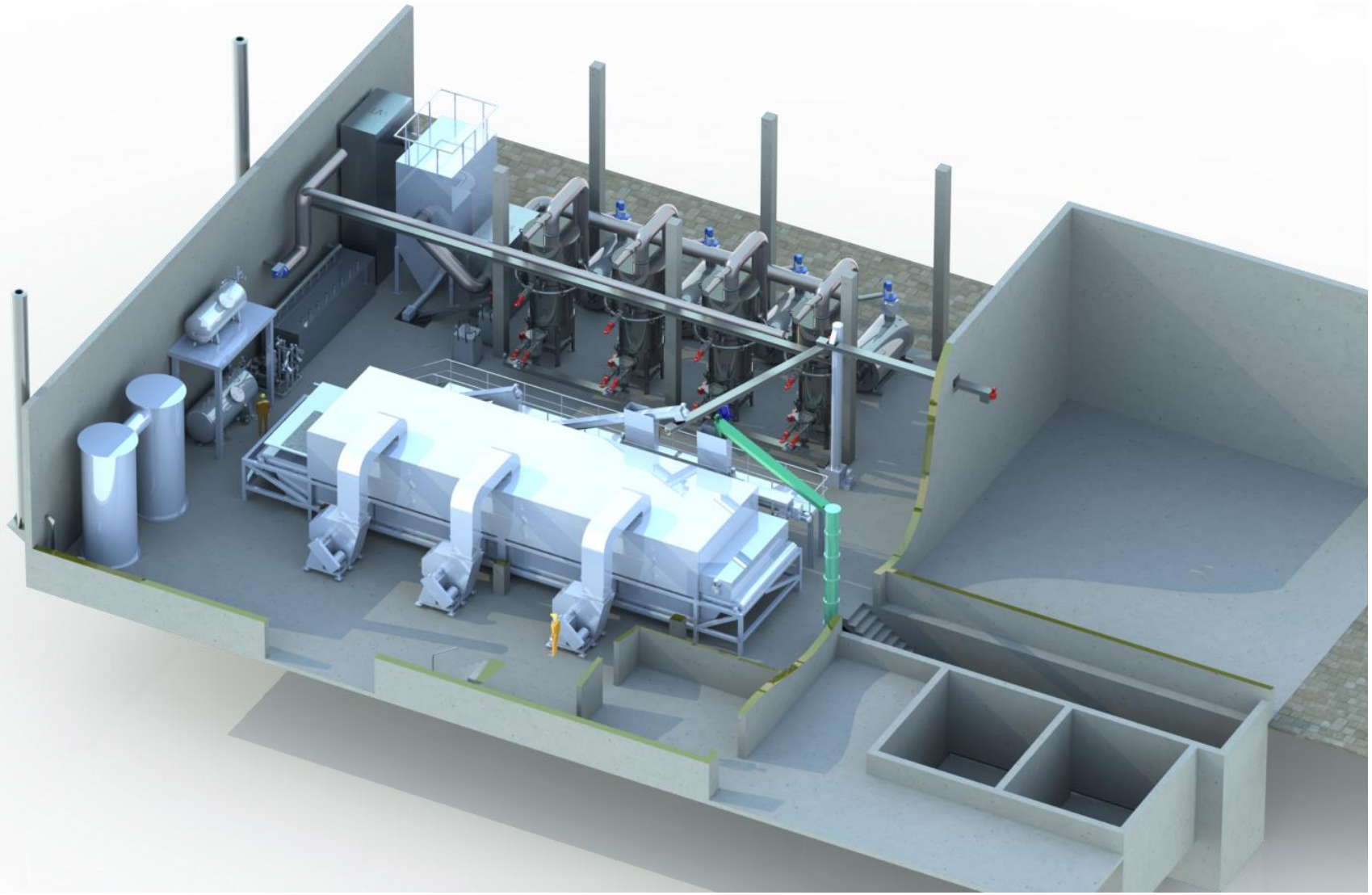


Side View










THERMO-SYSTEM

Thank you!

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Steffen Ritterbusch, PhD
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