

Waste is our Energy.



Engineering is our Business.



Sustainable Solutions are our Mission.

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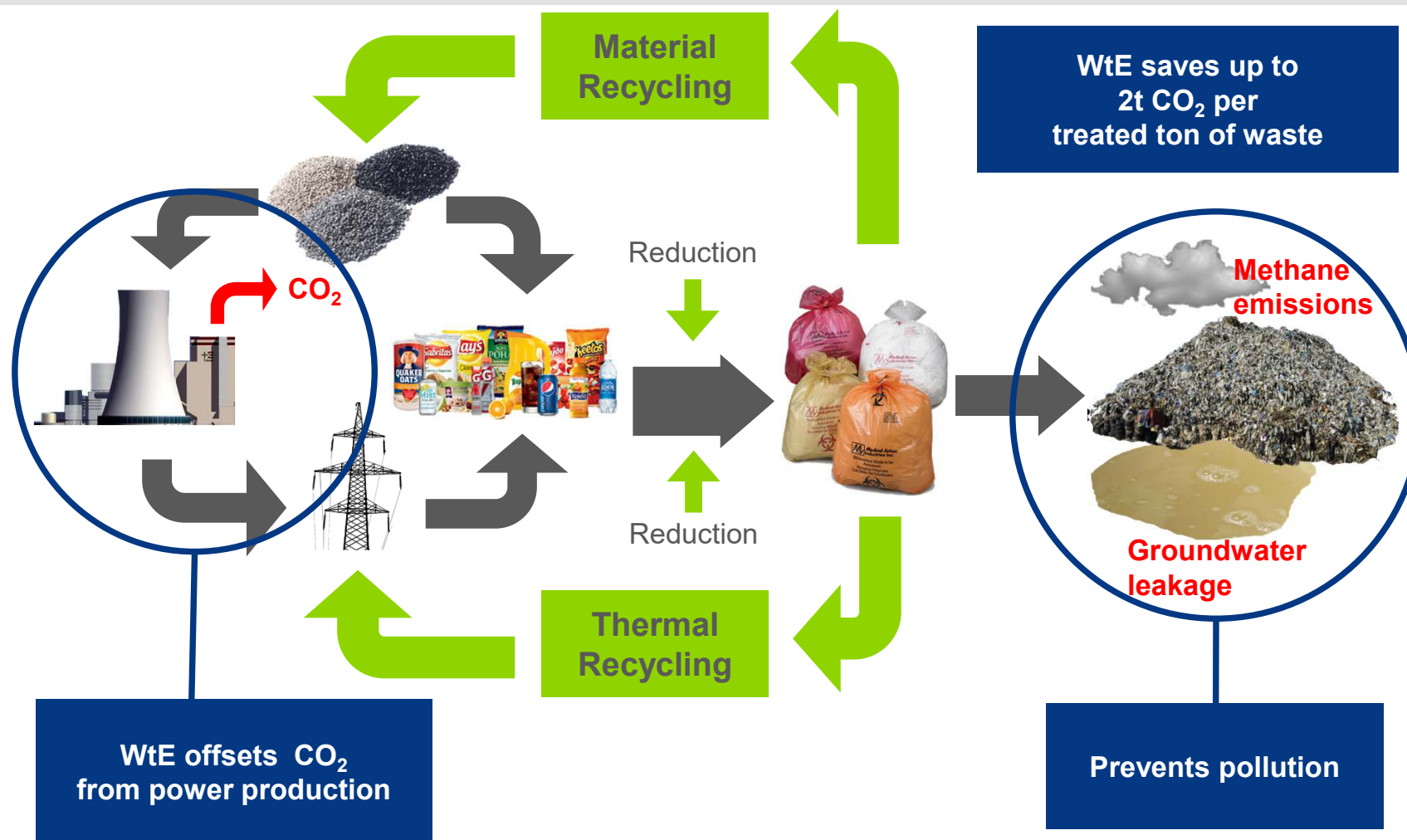
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## Technical and commercial requirements for global WtE solutions

WtERT Canada

March 8<sup>th</sup> 2022

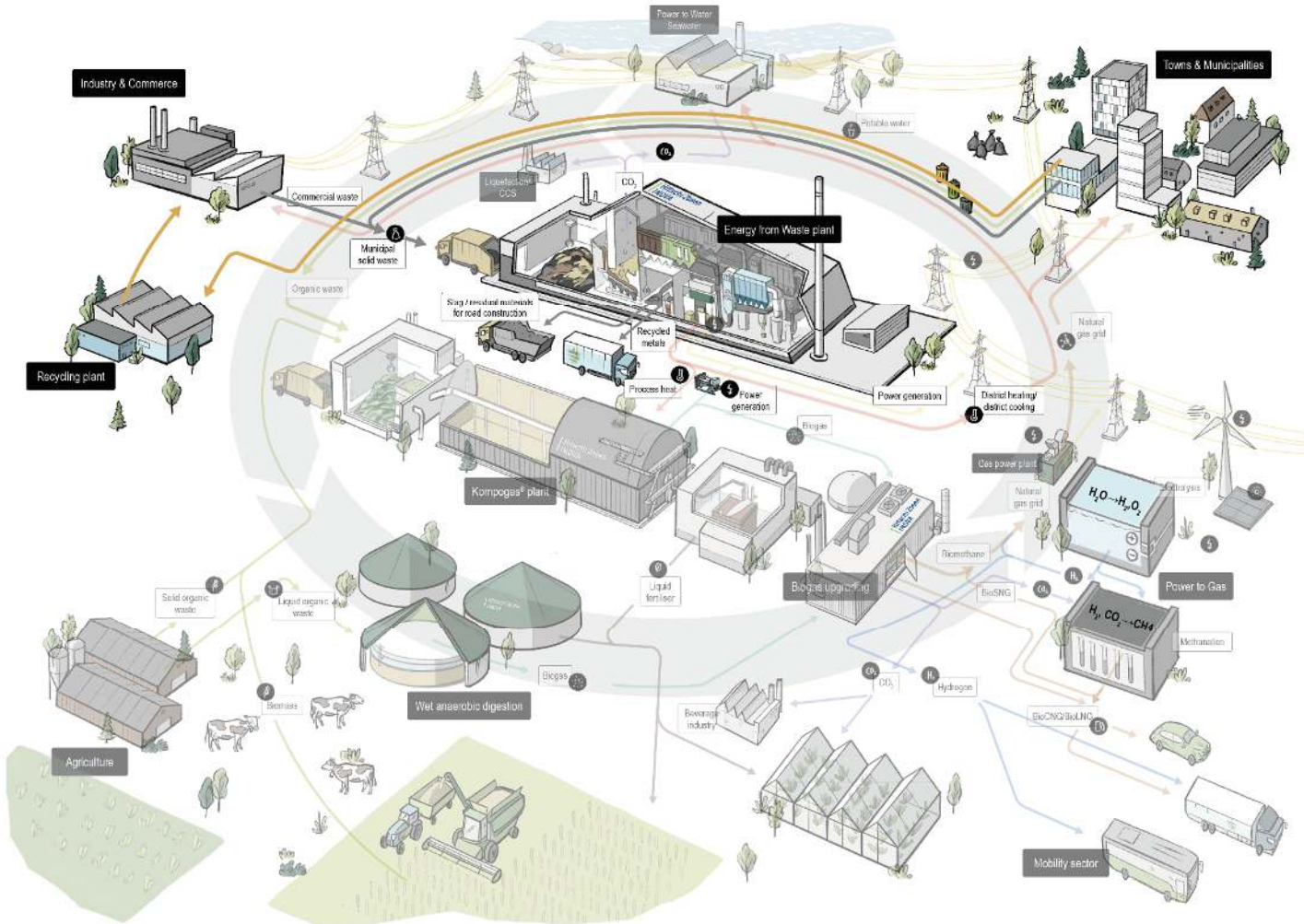
## Thermal WtE closes the Energy Cycle



# Solutions for Sustainable Waste Management

## Thermal Treatment - Waste to Energy

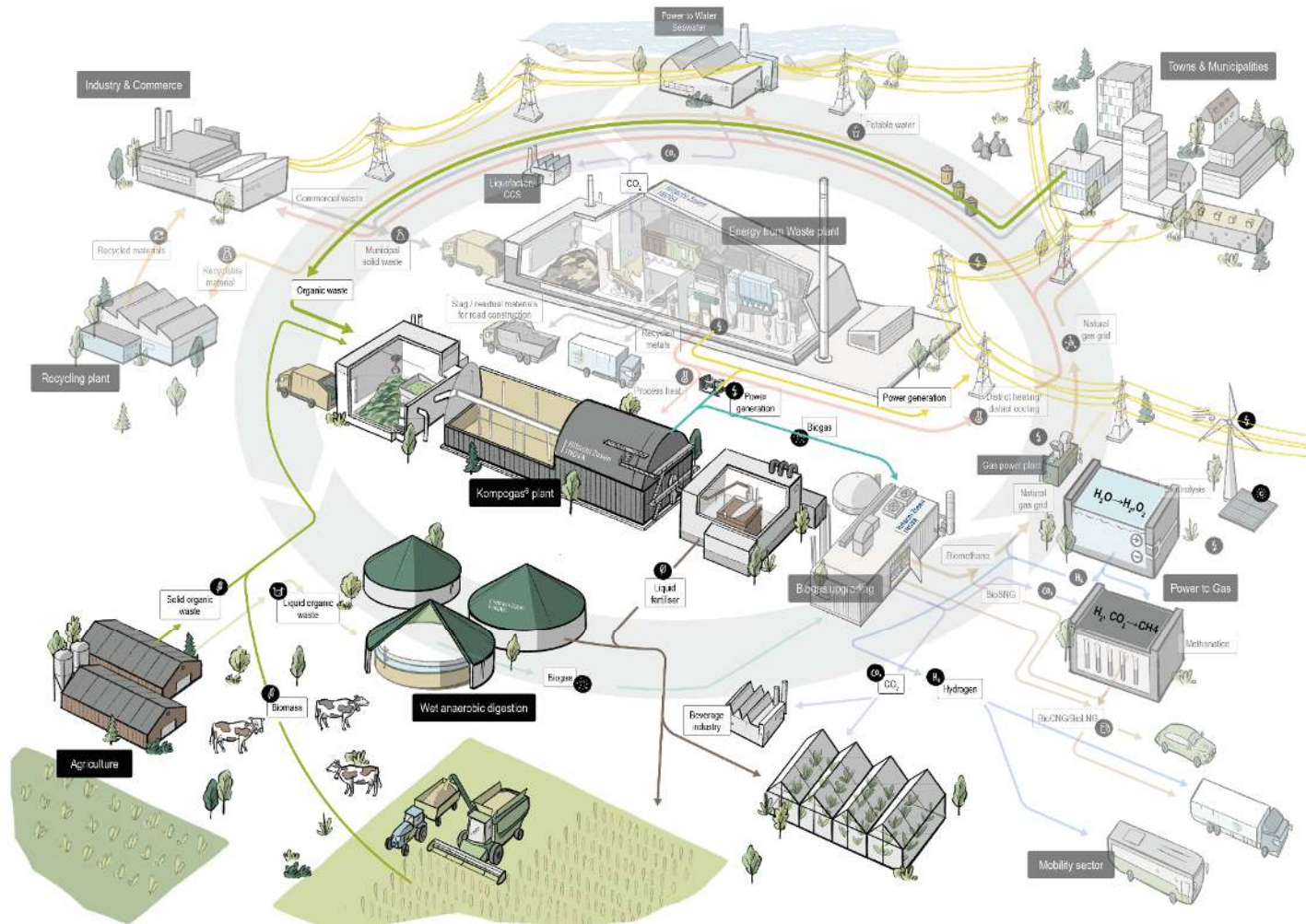
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# Solutions for Sustainable Waste Management

## Biological Treatment - Anaerobic Digestion

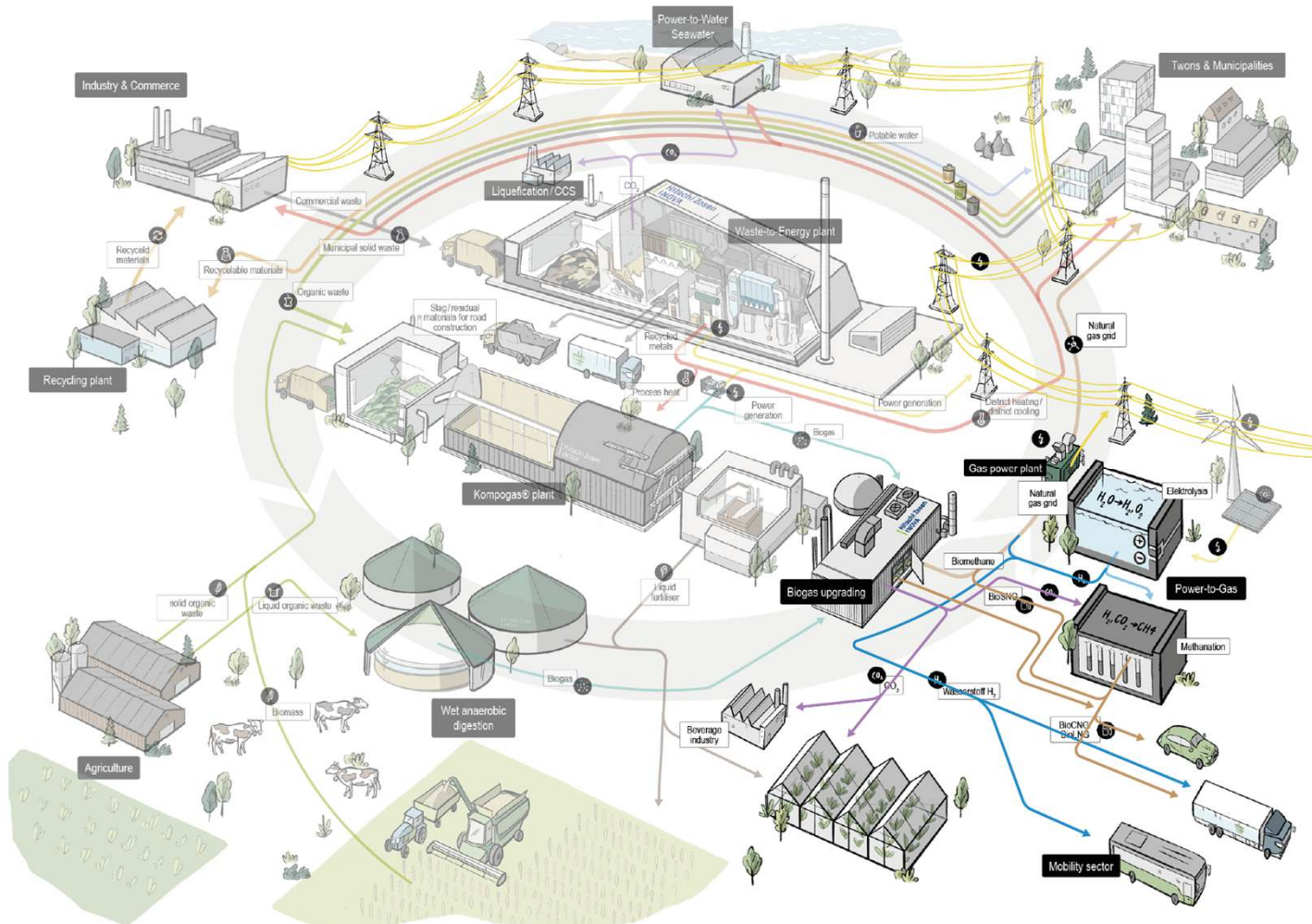
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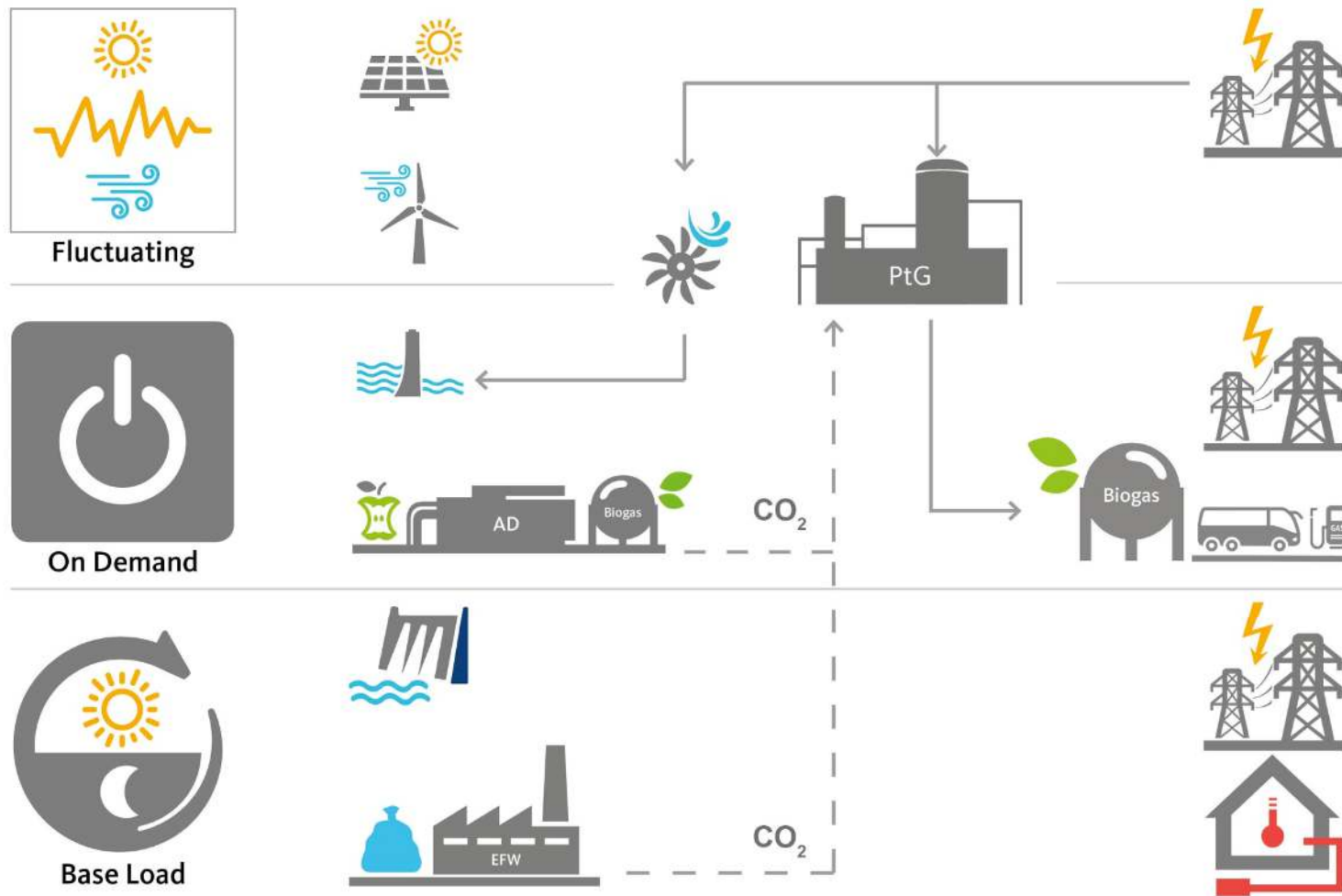
# Solutions for Sustainable Waste Management

## Biogas Upgrade and Power to Gas

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# HZI Technologies in the Context of Renewable Energy



# Hitachi Zosen Inova

## Global leader in Waste-to-Energy (WtE)

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### Waste is our Energy



● Hitachi Zosen Locations

- | Zurich / Switzerland-based Hitachi Zosen Inova is a global leader in Energy and Material from Waste solutions.
- | Proprietary technology and complete turnkey plant and system solutions.
- | Thermal treatment of solid waste, anaerobic digestion of biowaste and biogas upgrade.
- | Operation, Maintenance & Service business
- | More than 80 years experience
- | 1700+ employees in Switzerland, Germany, USA, UK, Slovakia, Poland, Sweden, Italy and France
- | A Hitachi Zosen Corporation subsidiary



# Group Core Competencies

## Development & Engineering

- Problem analysis
- Feasibility and concept studies
- Process evaluation and optimization
- Pre-engineering
- Engineering, Procurement and Construction Management services
- Project, site and commissioning Management
- Risk Management

## Financing Solutions

- Assessment of economic feasibility / preparation of cash flow models and projections
- Development of suitable project- and financing structures
- Preparation of project- and financing documentation
- Arranging funding for your project (provided by International Banks, Multilaterals, Export Credit Agencies, Dedicated Funds, Institutional Investors)
- Support during the entire financing process

## System, EPC or Turnkey

- Waste incineration with different boiler technologies
- Flue gas treatment
- Steam turbine/generator sets
- Handling of flue gas residues
- Balance of plant
- Life cycle costs
- Refurbishment of existing facilities

## Operation & Maintenance

- Spare part management
- Preventive / emergency maintenance plans
- Training operating personal
- Long term maintenance contracts
- Assisting in operation & maintenance 5 years
- Developing and implementing "SPV" structure
- Full operation and maintenance 5- 20 years



# High Demands on WtE Facilities

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## Waste to Energy – Sustainable Energy

### 1t Waste

CHV 9,5 MJ/kg  
2270 kcal/kg



heat-power of 230 kg Oil



**> 700 kWh** electricity  
net efficiency 27% - 31%

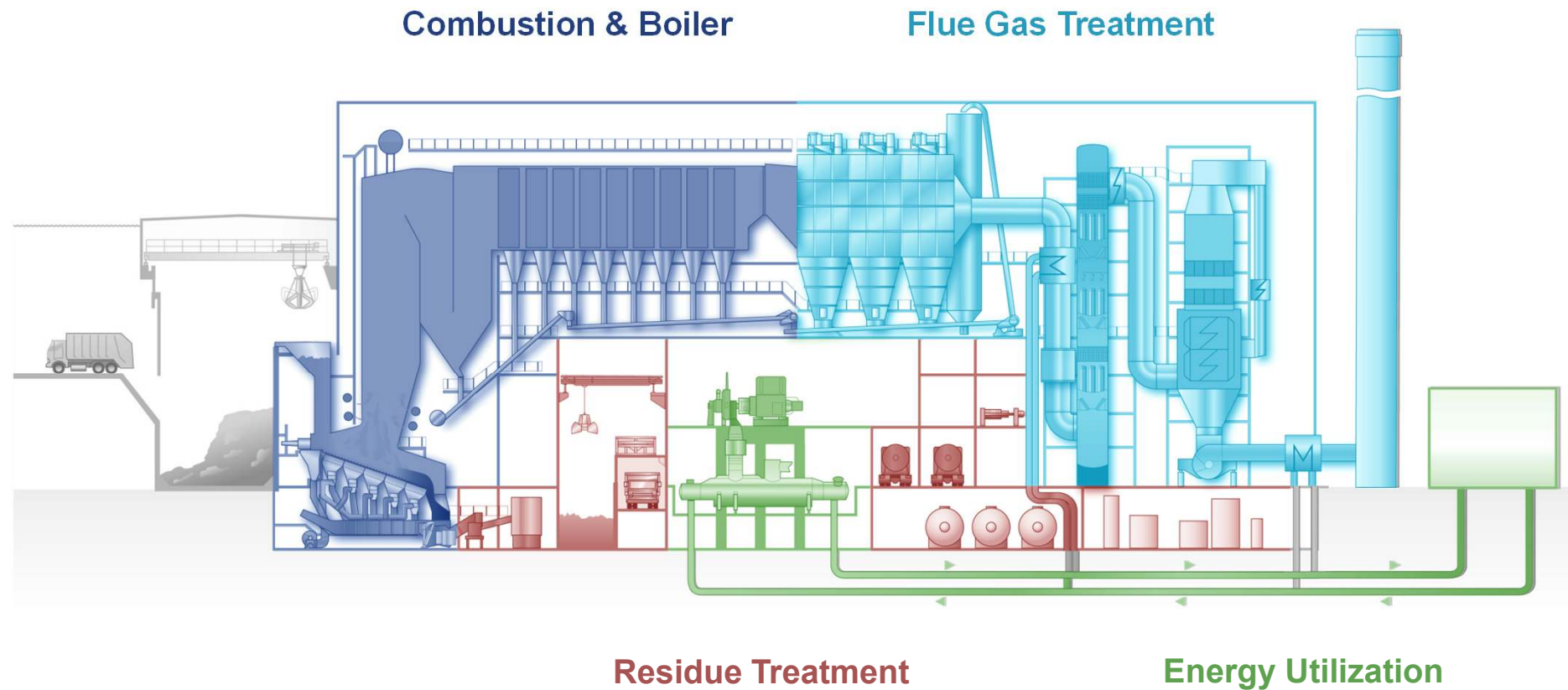
**up to 1 MWh**

with waste of higher calorific value

- WtE curbs greenhouse gas emissions
- Avoids Methane production from landfills
- Replaces fossil fuels in power plants
- Renewable Energy: More than 50% of waste is biomass which makes Energy from waste a sustainable energy.

# Proprietary Technologies for Waste-to-Energy

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# Combustion and Energy Recovery

## Flexible and reliable Grate Combustion System

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### Types of Waste

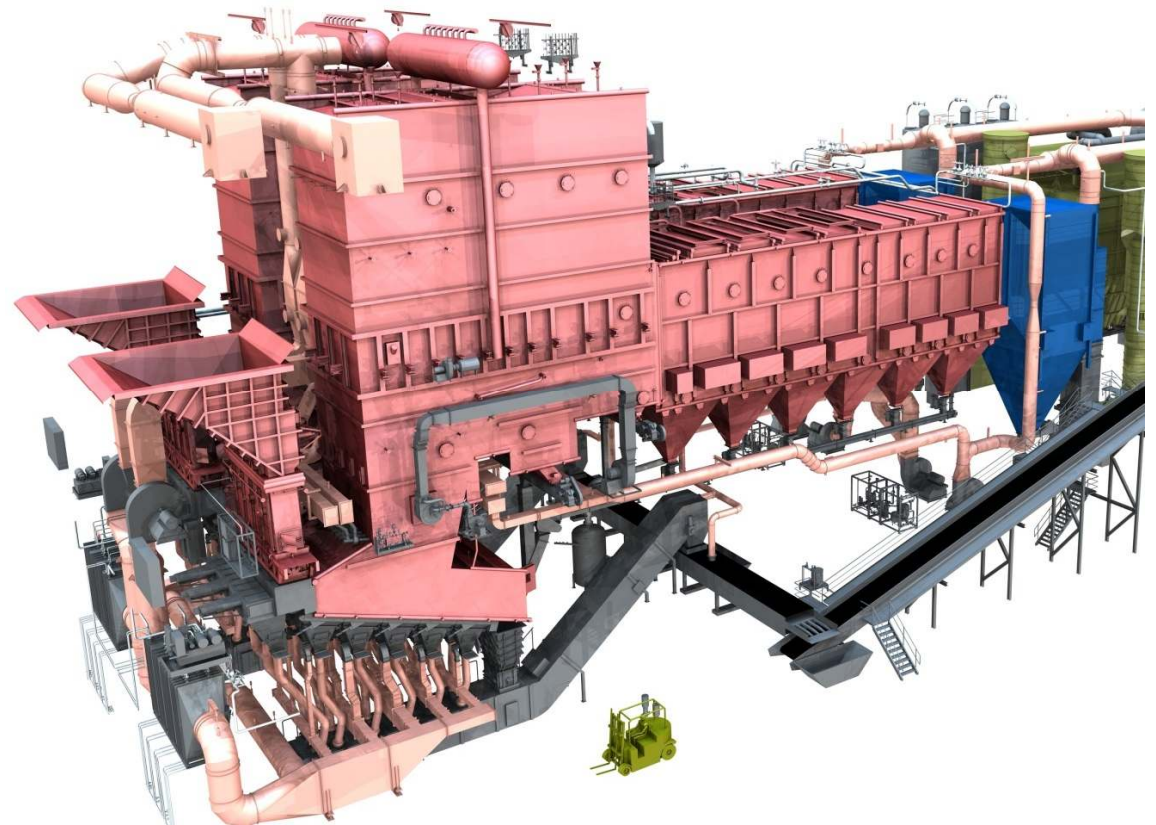
- | Municipal solid waste (non or pre-treated) and comparable industrial wastes
- | Refuse Derived Fuel (RDF)
- | Co-combustion (< 10%) of sewage sludge, hospital waste, shredded tires

### Range of Capacity

- | Throughput up to 55 t/h
- | Net calorific value 6 - 18 MJ/kg
- | Thermal capacity up to 125 MW / line

### Taylor-made Systems

- | 2 - 5 pass energy recovery boilers
- | Adapted steam parameters
- | Air and water-cooled grate furnaces



# Flue Gas Treatment Technologies and Solutions

## Proprietary Technology for different Concepts

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### XeroSorp



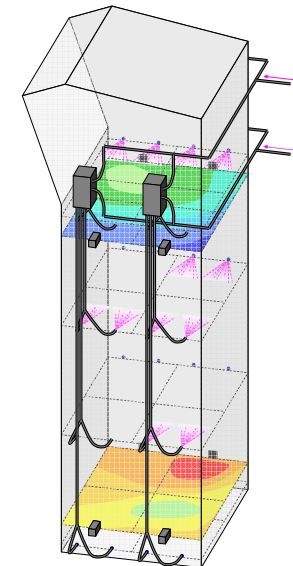
- ✓ WID compliance\*    ✓ No plume
- ✓ No water discharge    No flue gas condensation

### HZI SemiDry



- ✓ WID compliance\*    ✓ No plume
- ✓ No water discharge    No flue gas condensation

### HZI DyNOR®



Cost efficient solution to reach  
low NO<sub>x</sub> emissions below 80 mg/m<sup>3</sup>

### HZI SemiDry & Scrubber



- ✓ WID compliance\*    No plume
- ✓ No water discharge    ✓ Flue gas condensation

### HZI Scrubber



- ✓ WID compliance\*    No plume
- No water discharge    ✓ Flue gas condensation

# Most stringent Emission Limits for WtE Facilities

## Directive 2010/75/EU (IED)

Given in mg / m <sup>3</sup> (mg norm cubic metre exhaust gas)	Legislation	Measurement Line 1	Measurement Line 2	Measurement Line 1 & 2
Dust	10.0	< 1	0.2	0.3
Lead and zinc together	1.0	0.09	0.10	0.08
Cadmium	0.1	< 0.001	< 0.001	< 0.001
Mercury	0.1	< 0.005	< 0.005	< 0.005
Carbon monoxide	50.0	< 5.0	6.7	6.6
Nitrogen oxide	80.0	29	26.1	36.4
Sulfur dioxide	50.0	< 2.0	< 2.0	< 2.0
Inorganic fluorine compound	2.0	0.4	< 0.5	< 0.5
Inorganic chlorine compound	20.0	6.7	< 2.0	< 2.0
Ammonia	5.0	< 1.0	0.6	< 0.5
Gaseous organic compound	20.0	< 2.0	< 2.0	< 2.0
PCDD/PCDF (Dioxine and Furane)	0.1 ng/m <sup>3</sup>	0.005 ng/m <sup>3</sup>	< 0.01 ng/m <sup>3</sup>	< 0.01 ng/m <sup>3</sup>

Actual measurement of WtE plant with 2 Lines

## Waste Treatment BREF 2020

Compound / unit	WID	BREF	Averaging period	Remark / impact on FGT
Dust [mg/m <sup>3</sup> N *]	10	2 ... 5	Daily average	Lifetime filter bags
Cd + TI [µg/m <sup>3</sup> N *]	50	5 ... 20	Sampling period (1 h)	Dust correlated
Σ Sb – V [µg/m <sup>3</sup> N *]	500	10 ... 300	Sampling period (1 h)	Dust correlated
HCl [mg/m <sup>3</sup> N *]	10	< 2 ... 6	Daily average	Analysed: +/- 4 mg/m <sup>3</sup>
HF [mg/m <sup>3</sup> N *]	< 1	< 1	Daily average	
SO <sub>2</sub> [mg/m <sup>3</sup> N *]	50	5 ... 30	Daily average	
NO <sub>x</sub> [mg/m <sup>3</sup> N *]	200	50 ... 120	Daily average	
NH <sub>3</sub> [mg/m <sup>3</sup> N *]		2 ... 10	Daily average	
CO [mg/m <sup>3</sup> N *]	50	10 ... 50	Daily average	
TVOC [mg/m <sup>3</sup> N *]	10	< 3 ... 10	Daily average	
PCDD/F [ng/m <sup>3</sup> N **]	0.1	< 0.01 ... 0.04 < 0.01 ... 0.06	Sampling period Long time average	Aver. over sampling period Start-up procedure matters
PCDD/F & PCB [ng/m <sup>3</sup> N ***]		< 0.01 ... 0.06 < 0.01 ... 0.08	Sampling period Long time average	Aver. over sampling period Start-up procedure matters
Hg [µg/m <sup>3</sup> N *]	50	< 5 ... 20 1 ... 10	Daily average Long term sampling	Continuous analyser

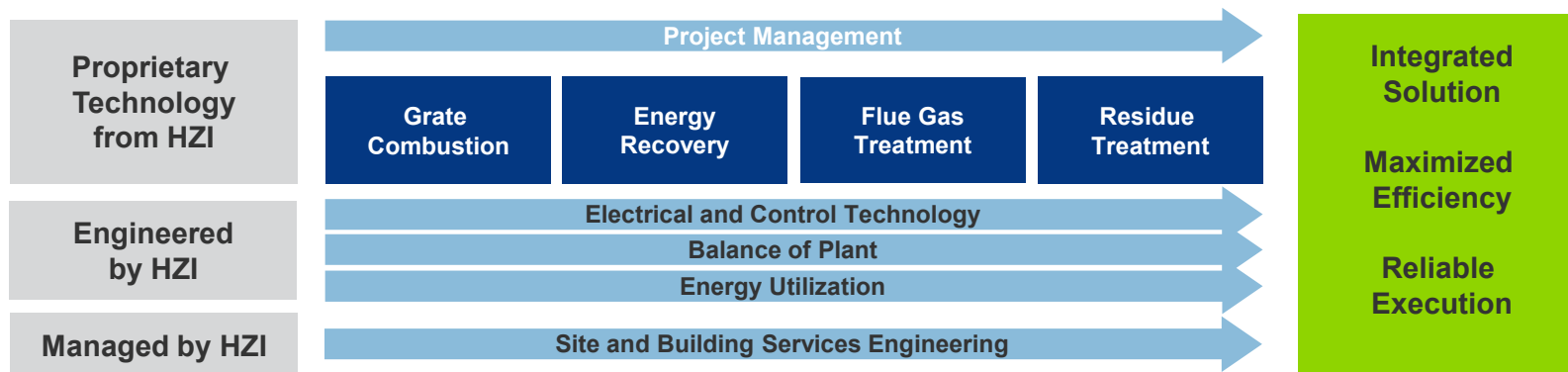
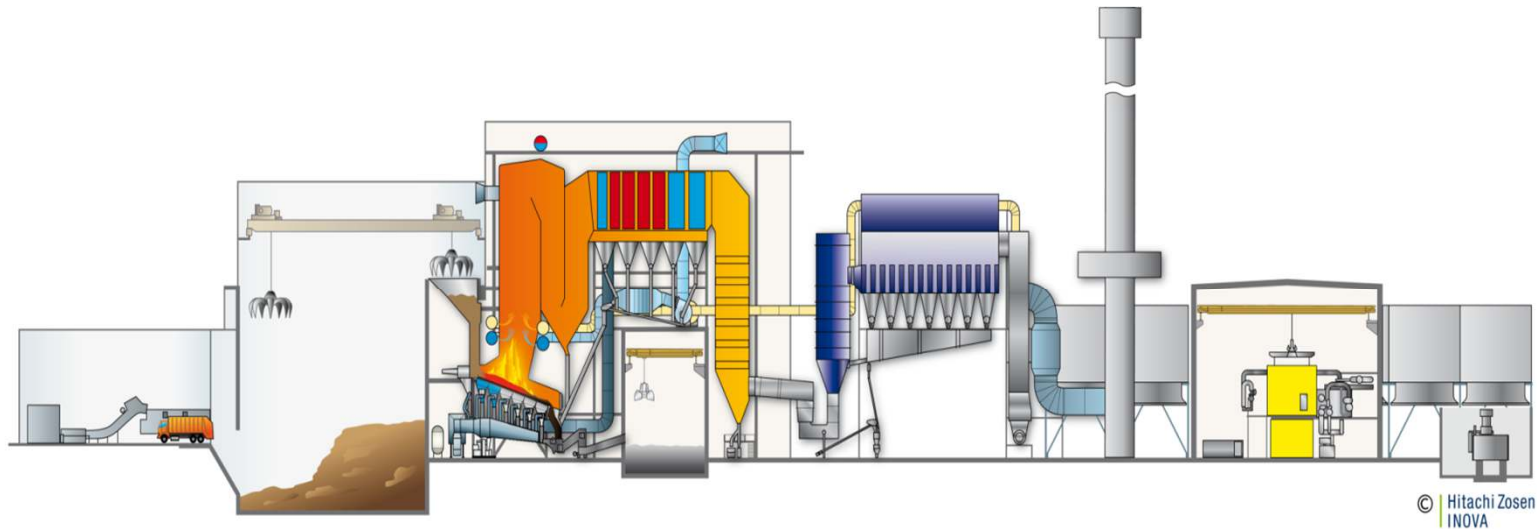
The current state of the art technology meets all known emission standards

## Issy-les-Moulineaux – Paris, France



# HZI is a World Leading Expert in WtE Integrated Solutions and Turnkey Capability

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# Extensive Experience as EPC Turn-Key Contractor

## 17 Plants built or in construction in UK and Ireland

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Cleveland 3 x 46MW

2009 /  
2013



Newhurst 1 x 126MW

2023



Slough 2 x 92MW

2024



Skelton Grange 2 x 73MW

2025



Newhaven 2 x 36MW

2011



Dublin 2 x 103MW

2017



Severnside 2 x 63MW

2016



Rookery 3 x 65MW

2022



Westfield 79MW

2017



Edinburgh 50MW

2018



H&W 68MW

2017



Buckinghamshire 102MW

2015



Riverside 3 x 80MW

2011



North London 2 x 122MW

2011

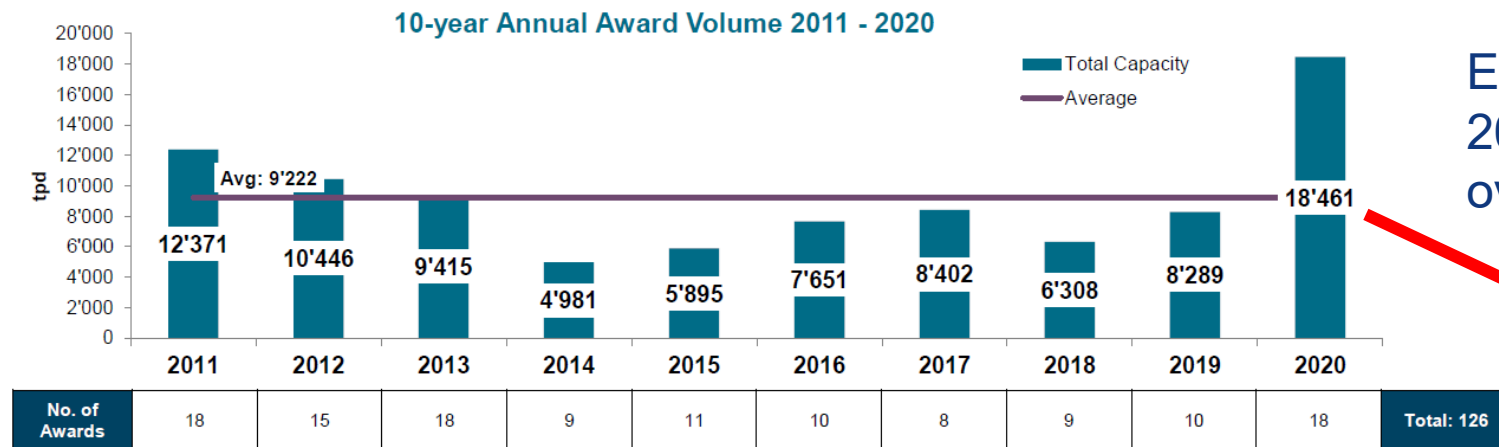


# EMEA EfW Market

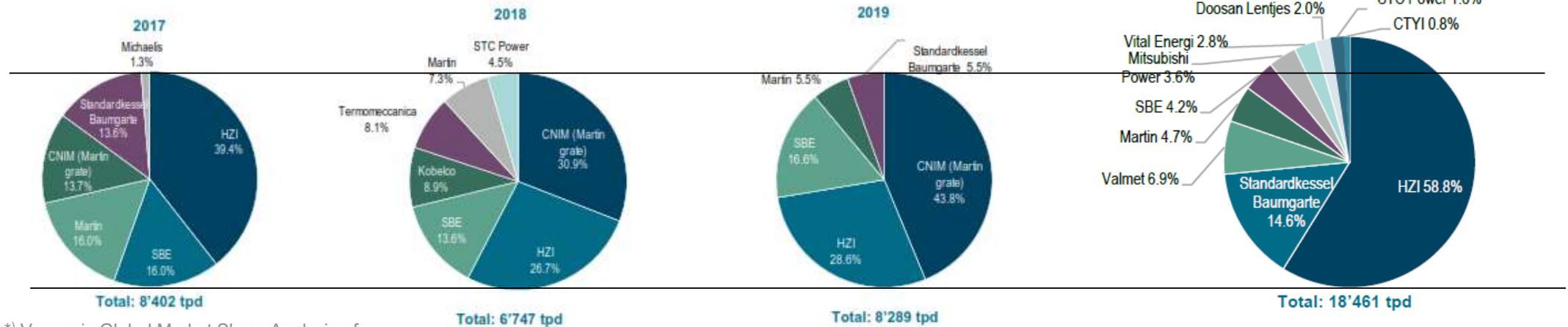
## HZI protects its Leading Market Position

# No.1

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EMEA WtE Market Share\*  
2011 - 2020: 36.4%  
over 3 years: HZI 45.5%



\*) Vaccani: Global Market Share Analysis of Thermal Waste Treatment Plants, 2021 Edition

# Your Reliable Partner for Complex WtE Projects

## Example Rookery South, UK

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| check at  for:

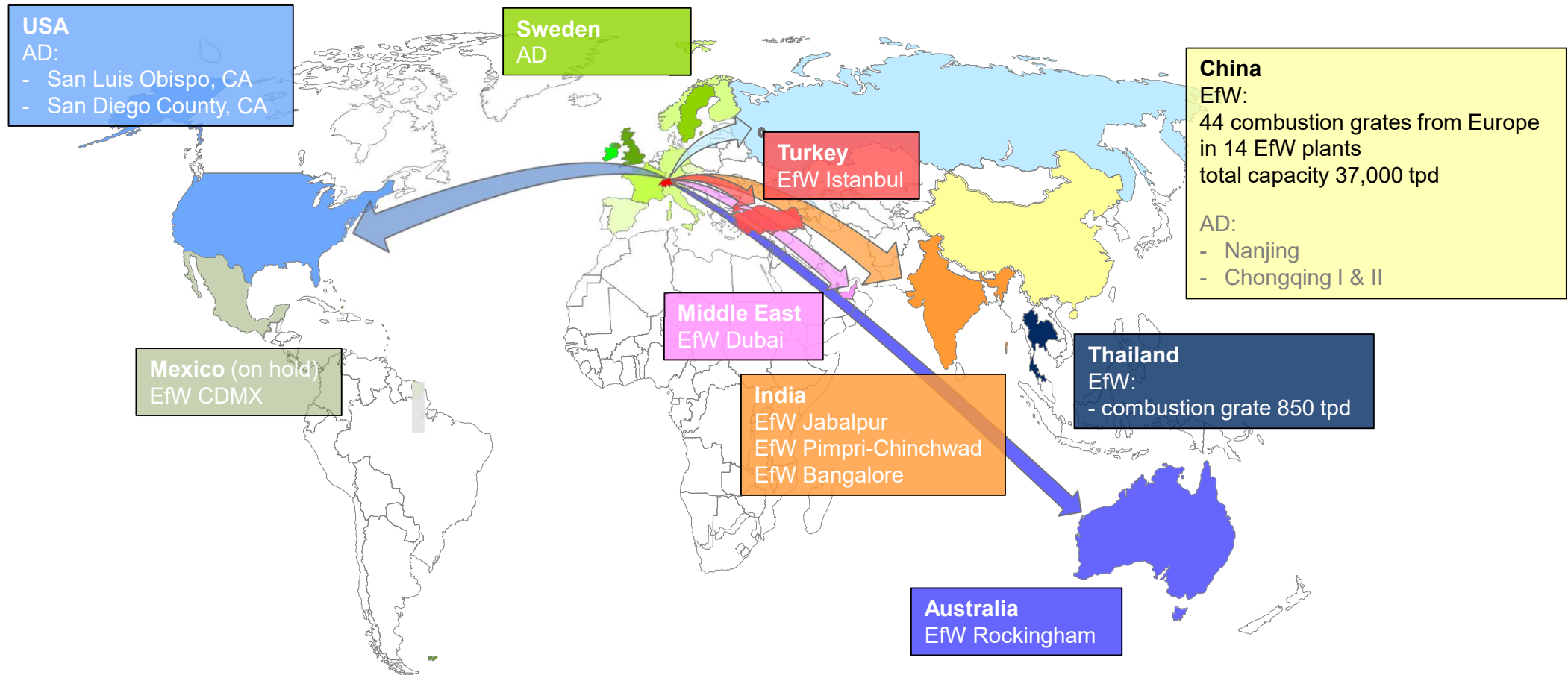
| Rookery South ERF Construction Progress

| from September 2019 to September 2021



# International Market Development by Hitachi Zosen Inova (exclusive HZC)

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# Istanbul, Turkey



<b>Client</b>	Istanbul Metropolitan Municipality (IMM)
<b>Start-up</b>	2021
<b>Technology</b>	
Furnace	Grate furnace (air-cooled)
Energy Recovery	4-pass vertical boiler, turbine
Flue gas treatment	Dry with SNCR
<b>Technical Data</b>	
Fuel	Municipal and industrial waste
Waste capacity	1,000,000 t/a in 3 lines
Thermal capacity	3 * 87 MW
Steam	72 bar / 426 °C
Net efficiency	28,7 % @ 20 °C

- | EPC turnkey contract for complete plant incl. civil works and O&M for one year
- | Project executed by a consortium of Hitachi Zosen Inova and its Turkish partner Makyol
- | Largest energy-from-waste plant for municipal solid waste in Europe
- | With 1 Mio t/a largest turnkey project ever awarded in Europe
- | Besides electricity the plant provides economical value for the region: One fifth of all components will be produced locally and construction work will be executed by local work forces only
- | designed for waste with low CHV of 6,8 to 7,7 MJ/kg at MCR (1620 - 1840 kcal/kg)

# East Rockingham, Australia



<b>Client</b>	Consortium of HZI, New Energy Corporation and Tribe Infrastructure
<b>Start-up</b>	2022
<b>Technology</b>	
Furnace	Grate furnace (air-cooled)
Energy Recovery	5-pass boiler, turbine
Flue gas treatment	Dry with SNCR
<b>Technical Data</b>	
Fuel	Municipal solid waste
Waste capacity	300,000 t/a
Net calorific value	9.8 MJ/kg
Thermal capacity	101.8 MW
Steam	66 bar / 431 °C

- | First EfW plant in Australia by HZI and among the first ones of its kind in the country
- | Developed by a consortium consisting of HZI, New Energy Corporation and Tribe Infrastructure
- | Designed, built and commissioned by the EPC consortium HZI and Acciona Industrial with HZI's scope 'chute-to-stack'.
- | Plant will process up to 300,000 t/a of domestic and industrial waste from the area and generate 28.9 MW electricity for the agglomeration around Perth
- | Driver: Average landfill cost in Western Australia 150 A\$/t (103 US\$/t)

# Dubai, UAE



<b>Client</b>	Dubai Municipality
<b>Start-up</b>	2025
<b>Technology</b>	
Furnace	Grate furnace (air-cooled)
Energy Recovery	4-pass horizontal boiler, turbine
Flue gas treatment	Dry with SNCR
<b>Technical Data</b>	
Fuel	Municipal and industrial waste
Waste capacity	1,888,000 t/a (5 x 47.2 t/h / max 53.6 t/h)
Net calorific value	7 – 14 MJ/kg
Thermal capacity	5 x 124.6 MW
Steam	77 bar / 432°C
<b>Net efficiency</b>	31,1 % @ 25 °C

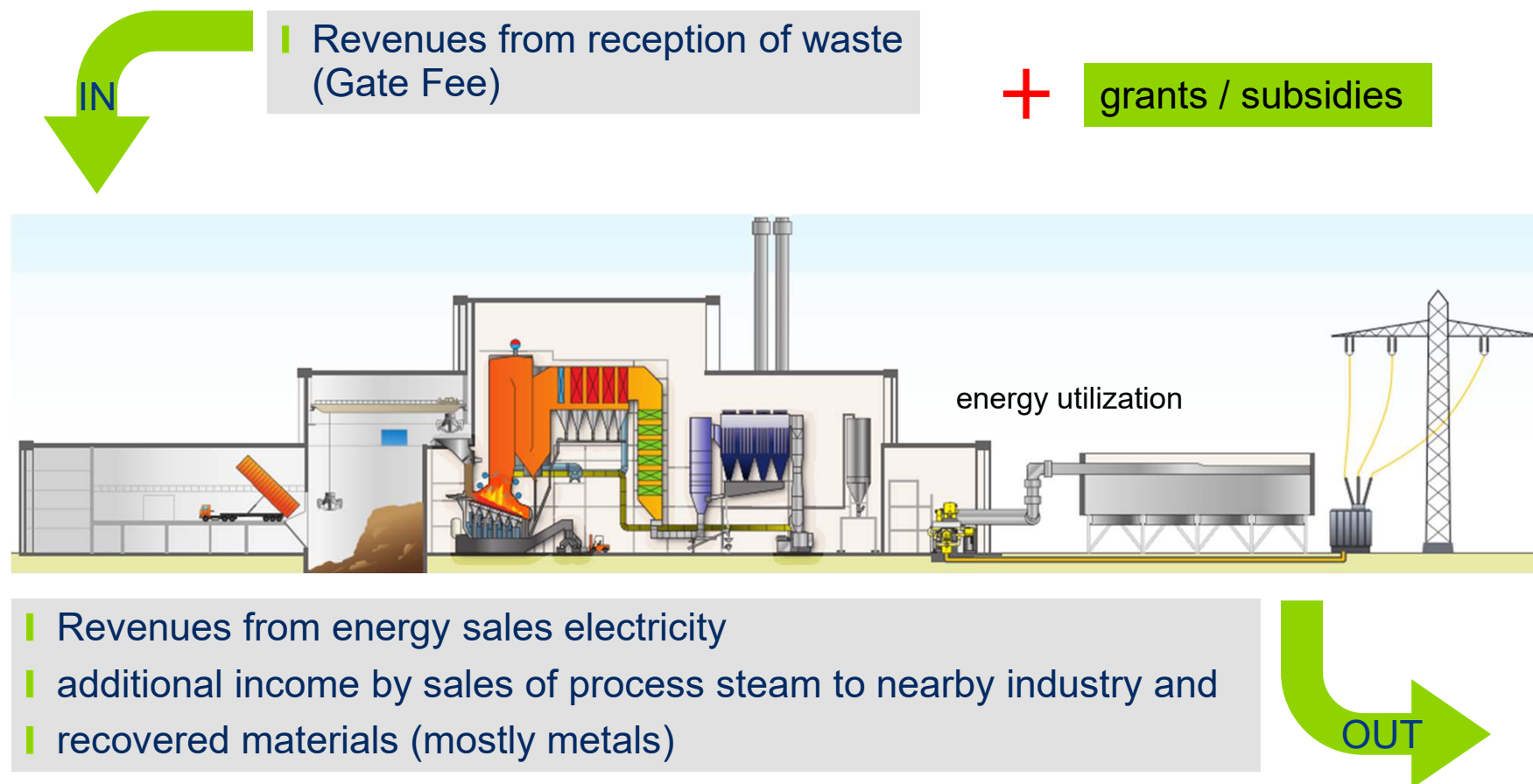
- | The largest Resource Recovery Facility worldwide
- | Build, Operate and Transfer (BOT) project for 35 years Operation
- | EPC and O&M joint venture formed by Hitachi Zosen Inova and BESIX (Belgium)
- | The facility will convert approximately 2 million tonnes of waste per year into baseload renewable energy, producing 194 MW of electricity at full capacity
- | Driver: Sustainable City

# Key Elements for a Successful Implementation of a WtE Project



# Combined Heat and Power Production Increases Economical Feasibility

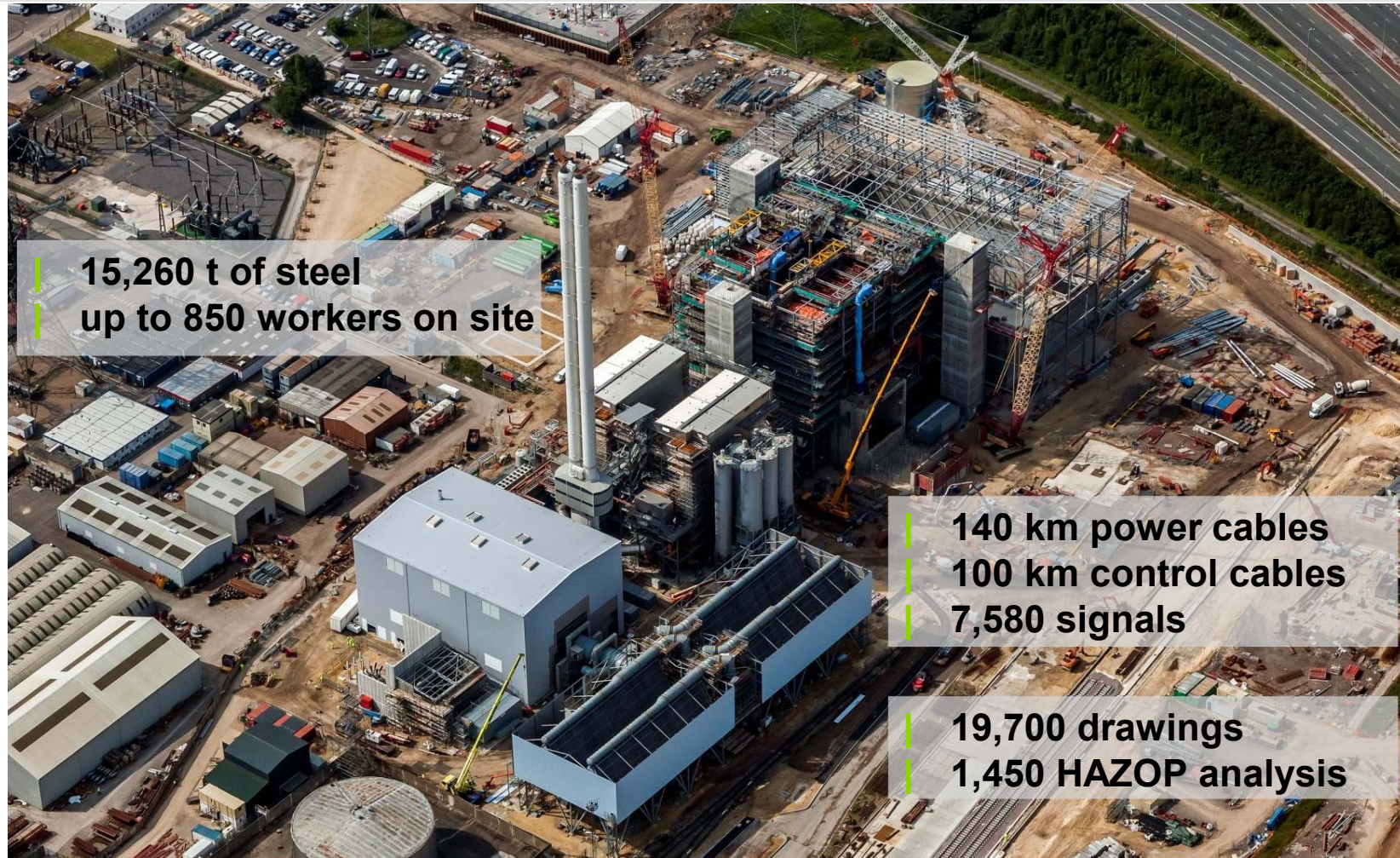
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without combined heat production revenue from Gate Fee is in Europe typically more than 60%

# Tendering - Permitting - Financing - Construction takes at least 5 years

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# Bankability of WtE Projects

## Key Factors that Financiers consider

Risk Analysis	High Risk	Low Risk
Technology	<ul style="list-style-type: none"> <li>Proven / mature technology</li> </ul>	<ul style="list-style-type: none"> <li>Unproven / new technology</li> </ul>
Plant Construction	<ul style="list-style-type: none"> <li>Experienced contractor/suppliers with: significant balance sheet and completion guarantee</li> <li>Fixed price EPC</li> </ul>	<ul style="list-style-type: none"> <li>Contractor/suppliers with limited experience</li> <li>Unclear responsibilities &amp; many interfaces (→ major completion risk)</li> </ul>
Offtake	<ul style="list-style-type: none"> <li>Long-term offtake contracts with no / limited market exposure</li> </ul>	<ul style="list-style-type: none"> <li>No offtake agreements</li> <li>Market &amp; foreign exchange exposure</li> <li>«Low quality» counterparties</li> </ul>
Waste Supply	<ul style="list-style-type: none"> <li>Clear definition of quantity, quality and type of waste</li> </ul>	<ul style="list-style-type: none"> <li>Fluctuations in waste quality and quantity</li> <li>Large number of waste providers</li> </ul>
Regulatory Environment	<ul style="list-style-type: none"> <li>Well-defined regulatory framework (incl remuneration scheme) for waste management / treatment services</li> </ul>	<ul style="list-style-type: none"> <li>No regulatory framework for waste management / treatment services</li> <li>Policy uncertainty (e.g. changing gate fee)</li> </ul>
Project Sponsors	<ul style="list-style-type: none"> <li>Financially viable sponsors</li> </ul>	<ul style="list-style-type: none"> <li>Unclear ownership and control structure</li> <li>Compliance risks</li> </ul>
O&M	<ul style="list-style-type: none"> <li>Experienced O&amp;M provider</li> </ul>	<ul style="list-style-type: none"> <li>No experience</li> </ul>
Credit Support	<ul style="list-style-type: none"> <li>Government / region / municipality support</li> </ul>	<ul style="list-style-type: none"> <li>No support</li> </ul>

Source : AIL Structured Finance

## Development and Construction Considerations

### Issues to consider

- | What is the best contracting model?
- | Is it a proven technology?
- | What is the track record of the technology supplier?
- | What are the capability, capacity and track record of potential contractors?

Key is to make the right decision, not just for the project delivery phase but the lifetime of the facility.



Selecting proven technology, the right contractor and contracting model is crucial for successful plant delivery



Thun, Switzerland

Thank you for your attention.

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We deliver. Check our references.