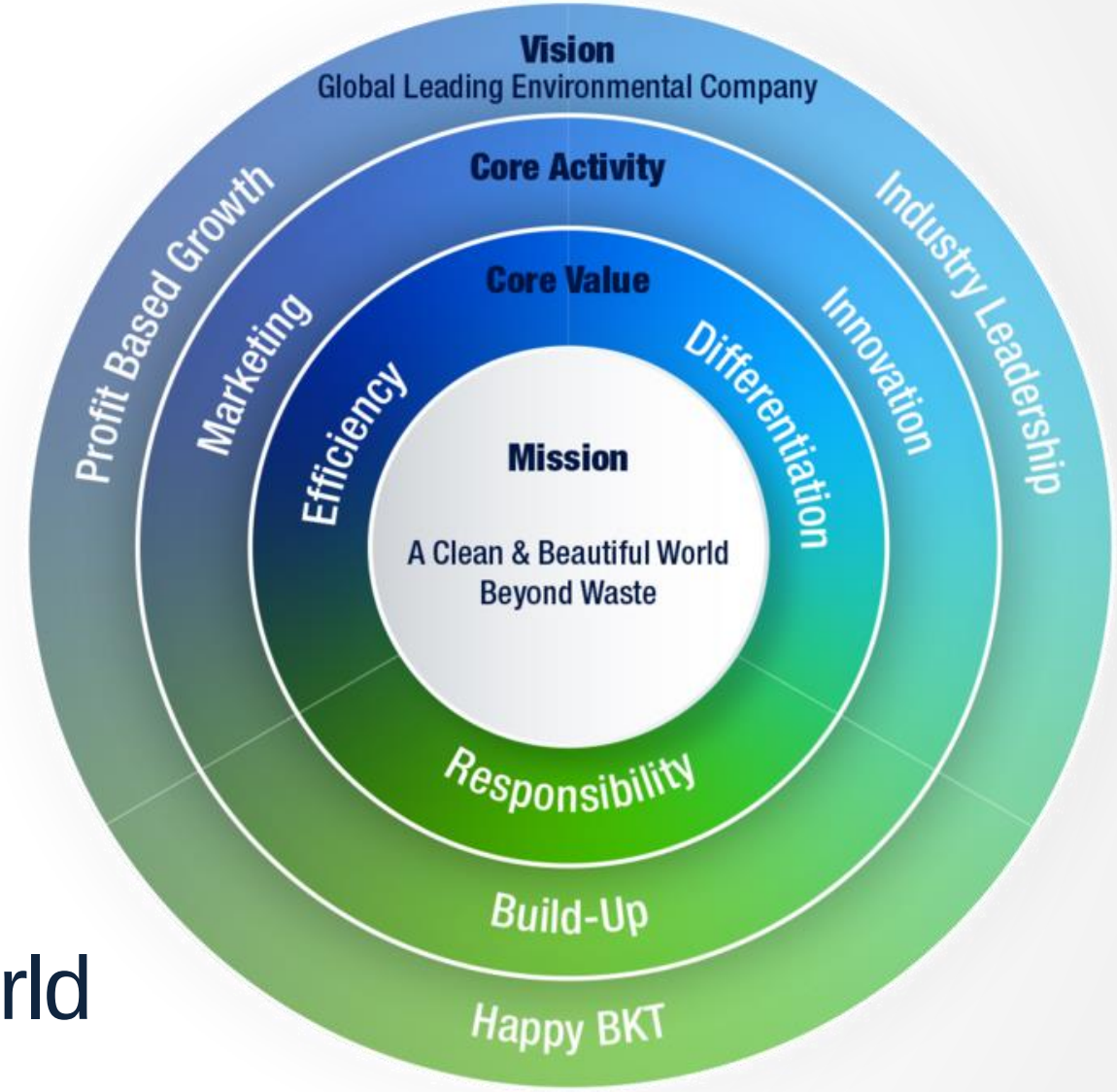
About Us

August 16, 2019

I. Introduction

BKT Way



"A Clean & Beautiful World Beyond Waste"

BKT Presence

1995 BKT Co. Korea

Daejeon, South Korea
R&D and Engineering
Corporate Headquarters

2008 Tomorrow Water
DBA BKT United

Anaheim, California, USA
Global Sales & Marketing
Headquarters

2014 BKT Vietnam

Hanoi, Vietnam
Manufacturing

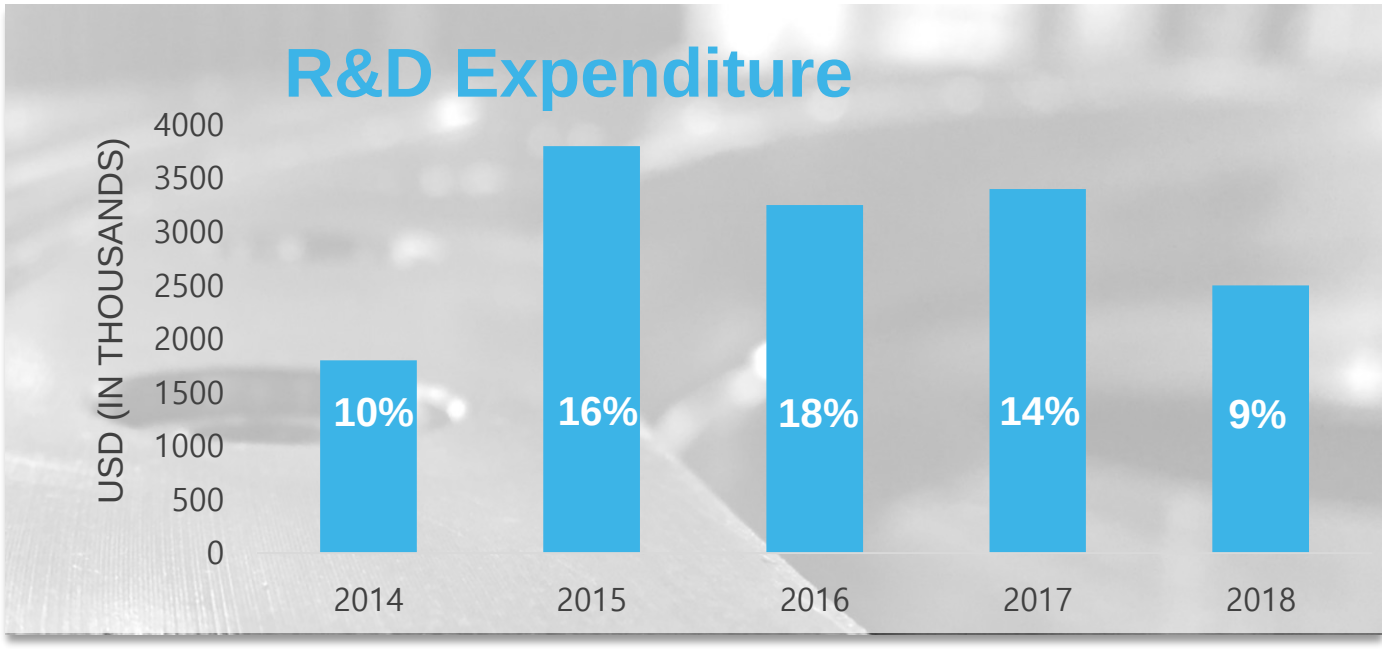
Intellectual Resources

143 Registered Patents

40+ Government Funded R&D Projects

13% R&D Spending of Total Budget (5-year average)

Over **40%** Hold a Masters or PhD (of 109 employees)



EPRI ELECTRIC POWER RESEARCH INSTITUTE

SRI International

U.S. DEPARTMENT OF ENERGY

STATE OF CALIFORNIA ENERGY COMMISSION SINCE 1975

Dozens of Awards (Korean Top Tech Co, Best Workplace, Etc.)

Organizational Structure

Team **Tomorrow**

Team **Today**

BBF
AMX
Energy
vMixer
Clean Air
FMX

Business Portfolio

Today

Municipal | Livestock | Industrial Wastewater

Energy Production | Savings | Recovery

Biogas Plant | Energy Optimization Solutions, Turbo Blower

Organic Waste, Thermal Hydrolysis

Manufacturing Process (Membrane System)

Bio, Chemical, Food & Beverage

Tomorrow

Tomorrow Water
From Cost Stream To Profit Stream

Smart Water City
Water Adds Value to Cities

Water AI
AI for Sustainable Water Infrastructure

Go Together Project
Sustainability for the Livestock Industry

I. Introduction – Business Portfolio

Ⅱ .Tomorrow Business

4 Core Strategy Initiatives

Tomorrow Water Process

From Cost Stream to Profit Stream

Smart Water City

Water Adds Value to Cities

Water AI

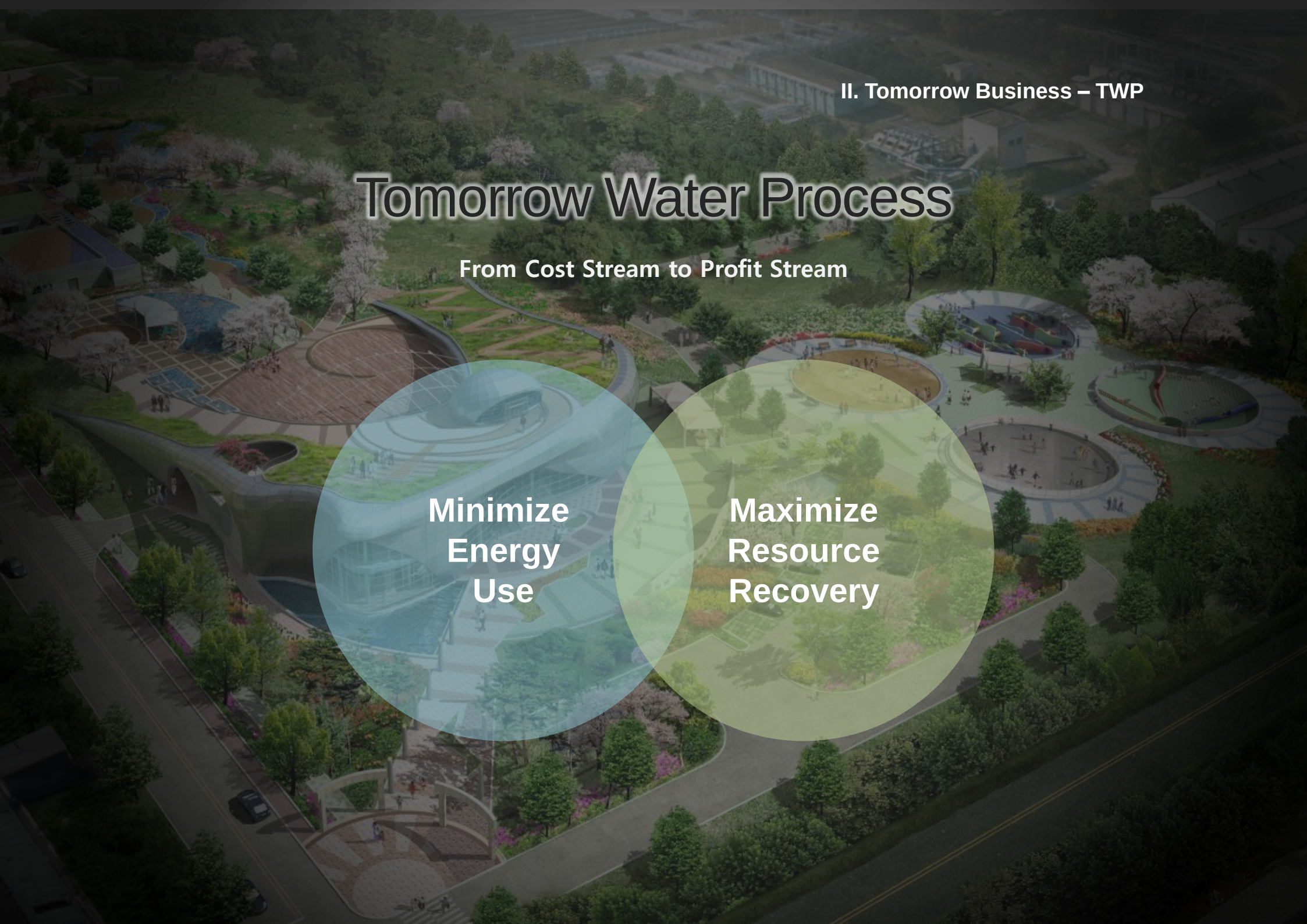
AI for Sustainable Water Infrastructure

Go Together Project

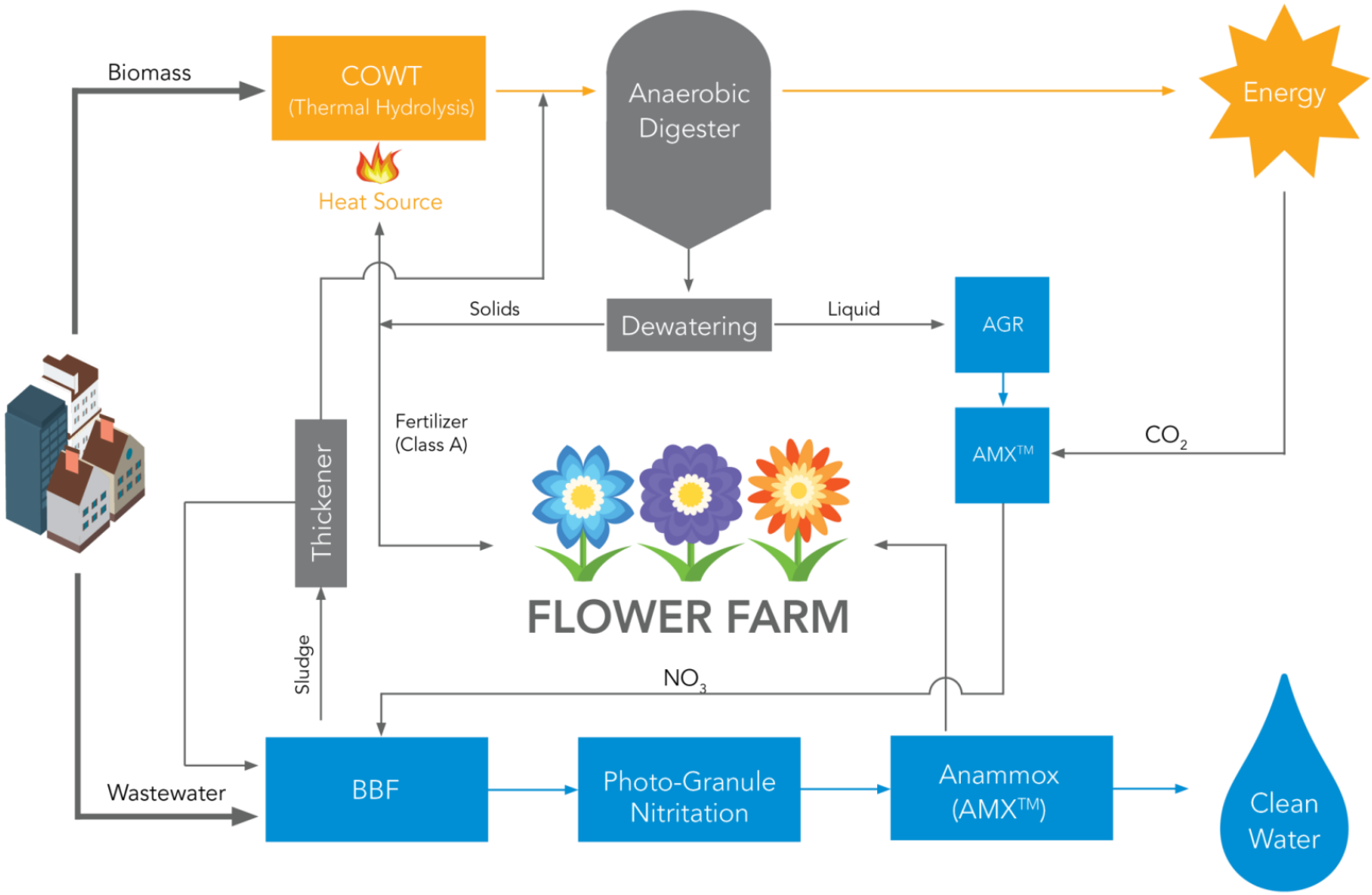
Sustainability for the Livestock Industry

Tomorrow Water Process

From Cost Stream to Profit Stream



Tomorrow Water Process



Tomorrow Water Process

SUSTAINABLE DEVELOPMENT GOALS

Officially registered as the
Tomorrow Water Initiative #12177

UN Partnership for the SDGs Platform

PARTNERSHIP EXCHANGE

Accepted 2016 UN ECOSOC
High-Level Segment

UNITED NATIONS

ECOSOC

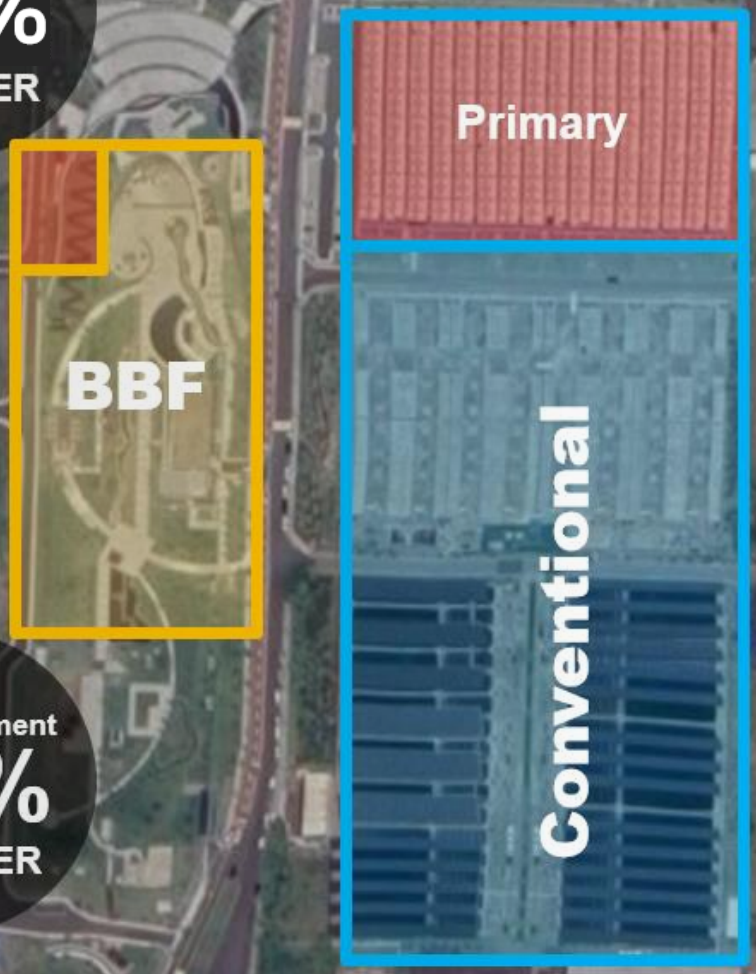
Smart Water City

Water Adds Value to Cities

BBF
Bio-filtration

Primary Treatment
85%
SMALLER

Main Treatment
50%
SMALLER



Retrofitting the world's aging water infrastructure for resource recovery to save energy, land and water.

Unlock Hidden Space by Replacing Existing Primary Clarifiers

Water Reuse & Revitalization

Using treated wastewater for mandmade lakes, streams, and services

+

Property Values

Recreation & Amenities

Energy Savings

Irrigation Management

Green Spaces

More Wildlife

−

Heat Island Effect

Air Pollution & Fine Dust

Seonam – City Cleaning

Incheon – Artificial Lake

Dangjin – Stream

Qufu – Cooling Water for Power Plant

Water AI

AI For Sustainable Water Infrastructure

Proposal & Design

IoT
Big Data
AI

Construction

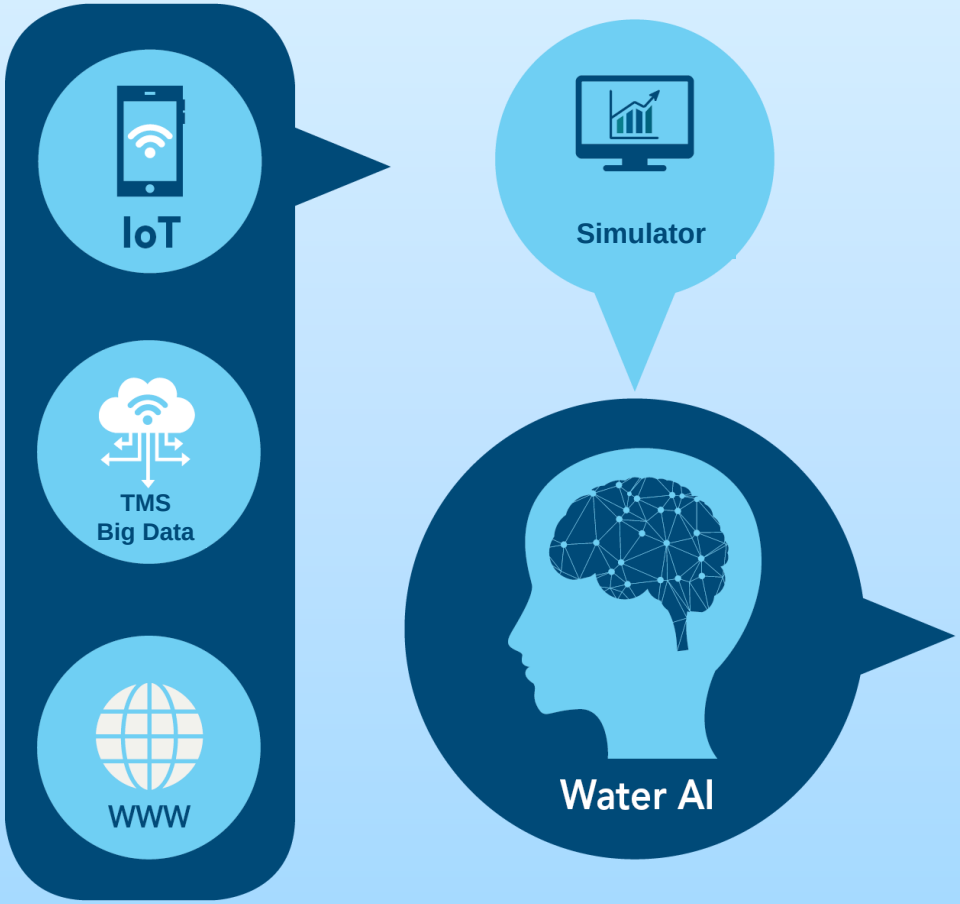
3D Printing

Operation

Digital Twin

Water Industry 4.0

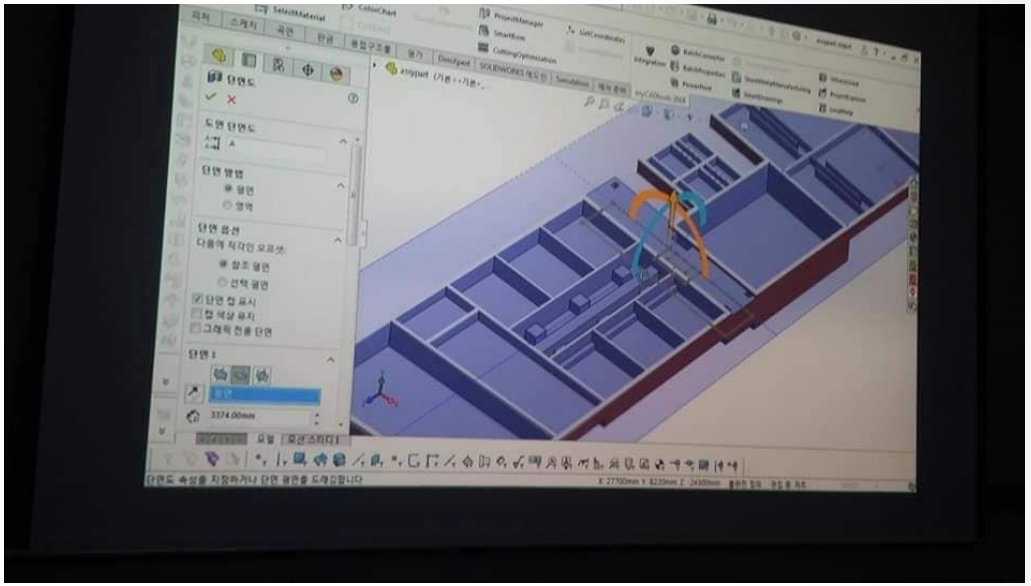
Proposal & Design

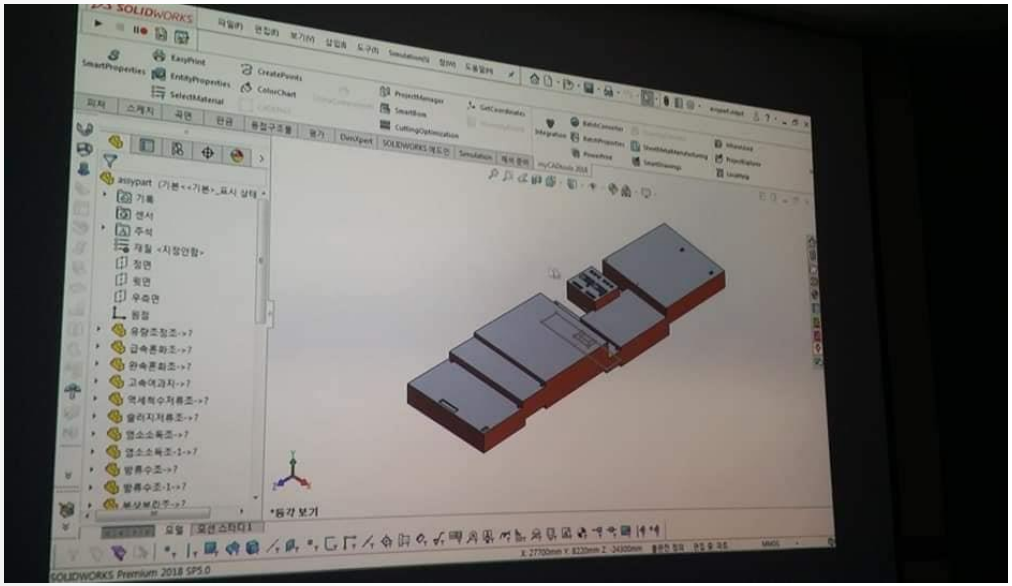


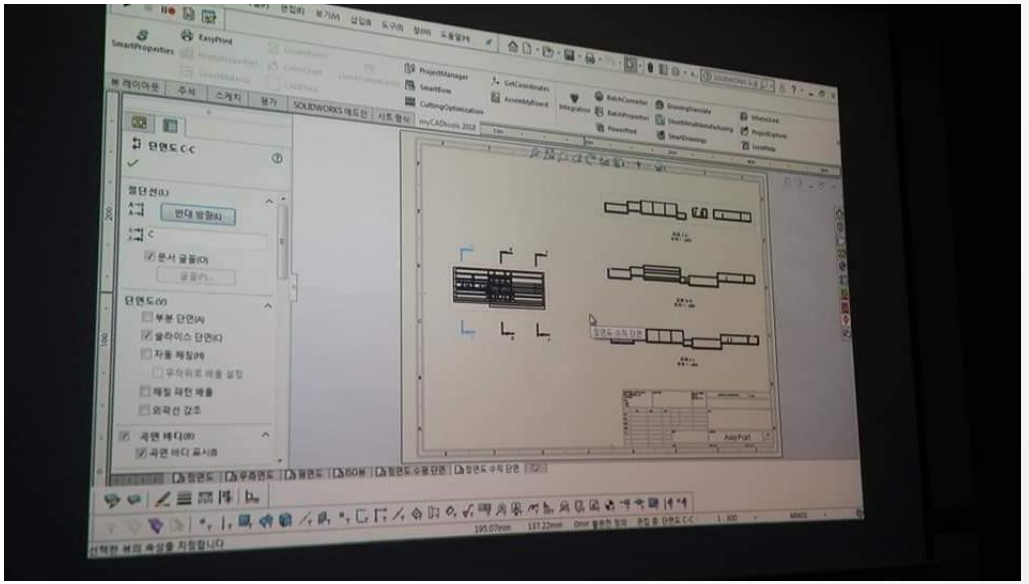
Construction

Operation

Water AI







Sustainability for the Livestock Industry

Go Together Project

II. Tomorrow Business - GTP

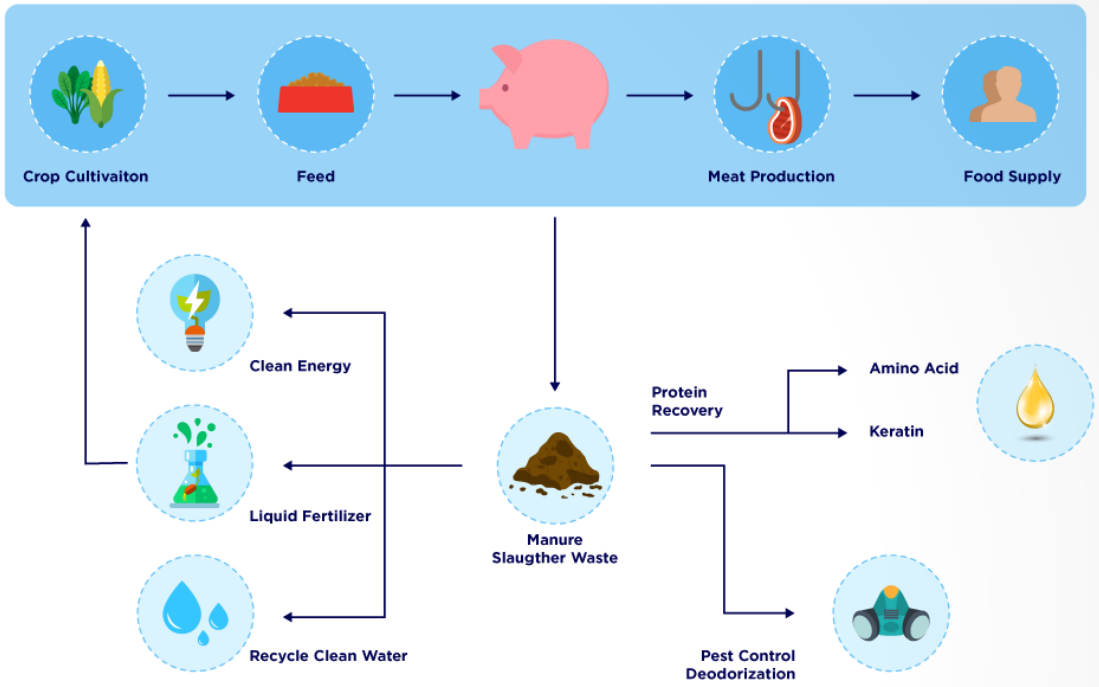
Would you throw it out if it was PureGold?

The Stark Reality of the Livestock Industry

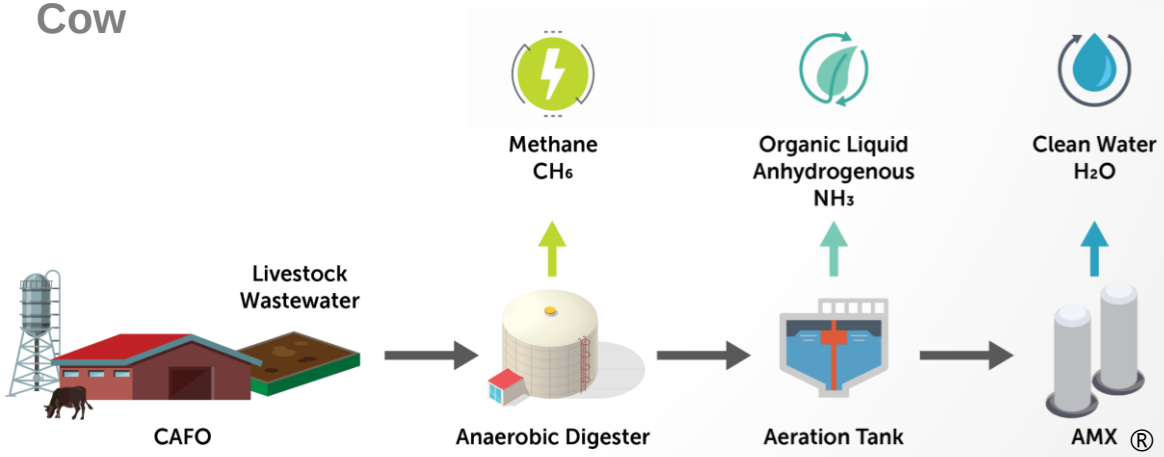
GTP

Sustainable livestock production in the circular economy

Hog



Cow



PureGOLD
GREEN OPTIMIZED LIVESTOCK DESIGN

GTP

Develop high-value co-products (Amino Acid, Keratin)

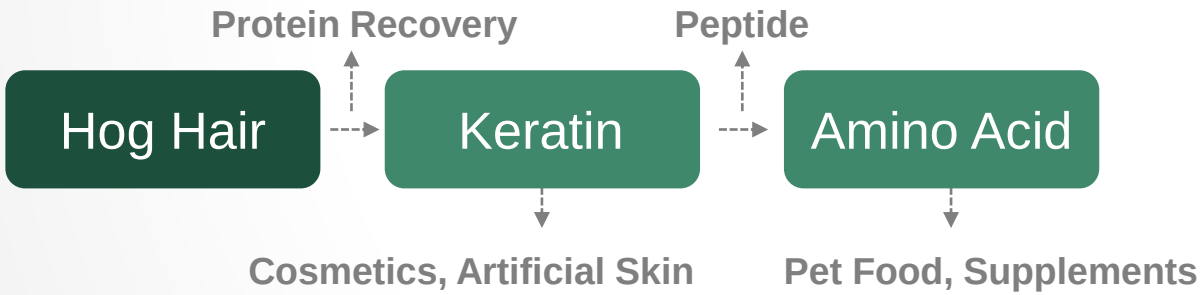


Figure 1 Dose Response Curve for 19-0228/19-0229

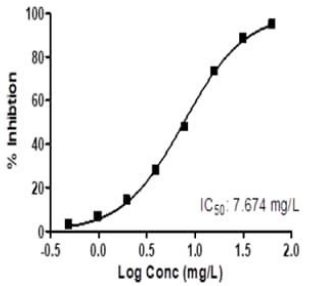
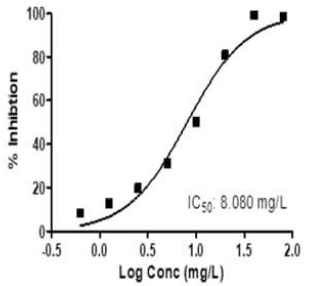
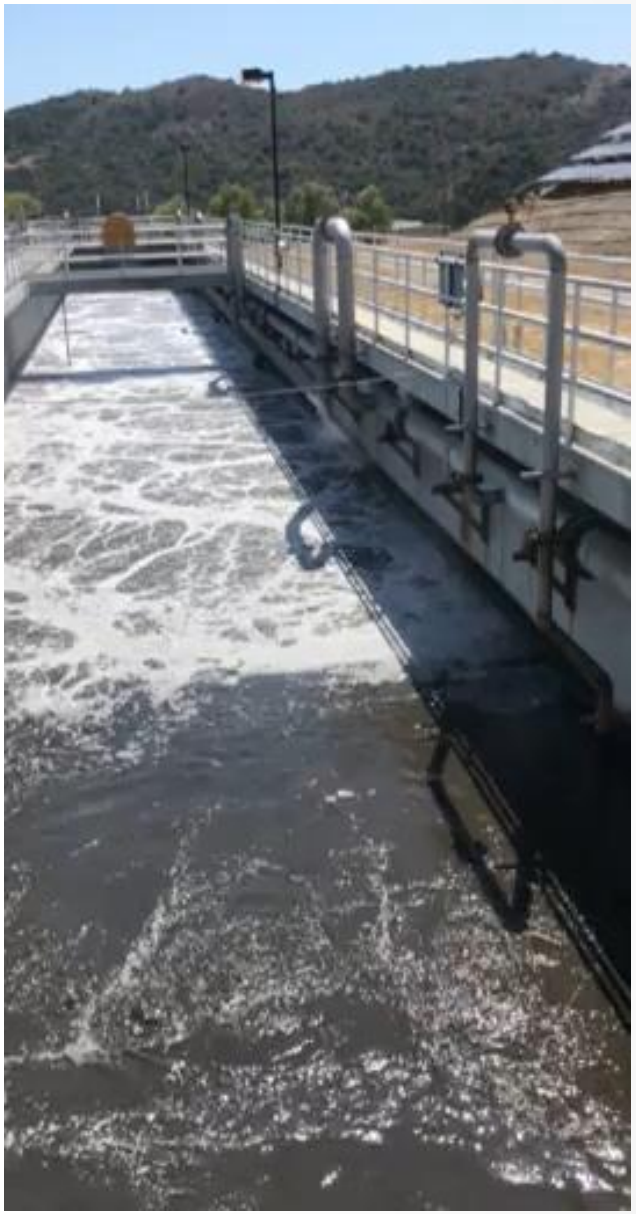


Figure 2 Dose Response Curve for Trolox

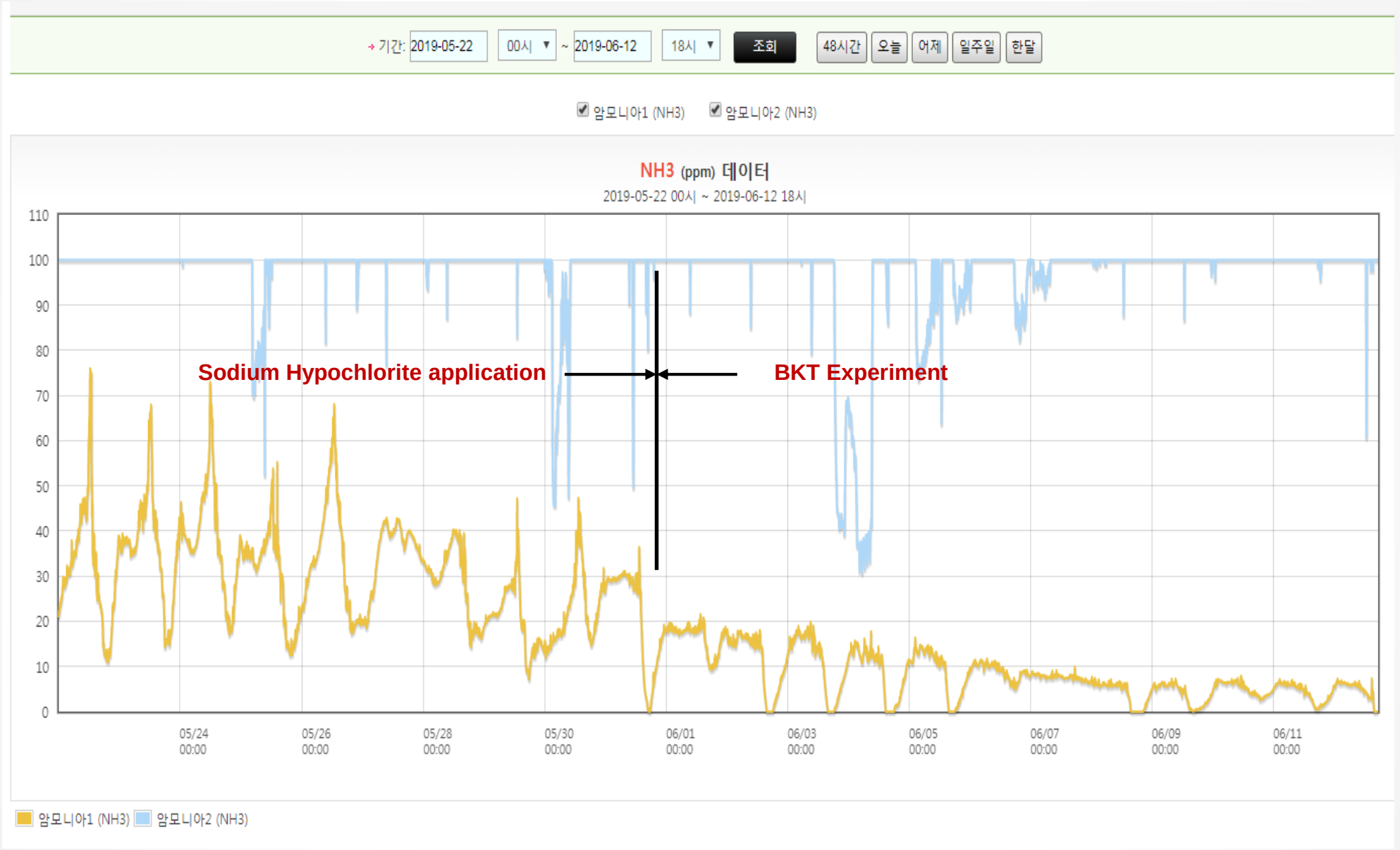


IC_{50}: The half maximal inhibitory concentration.

Proven & Safe Odor Control

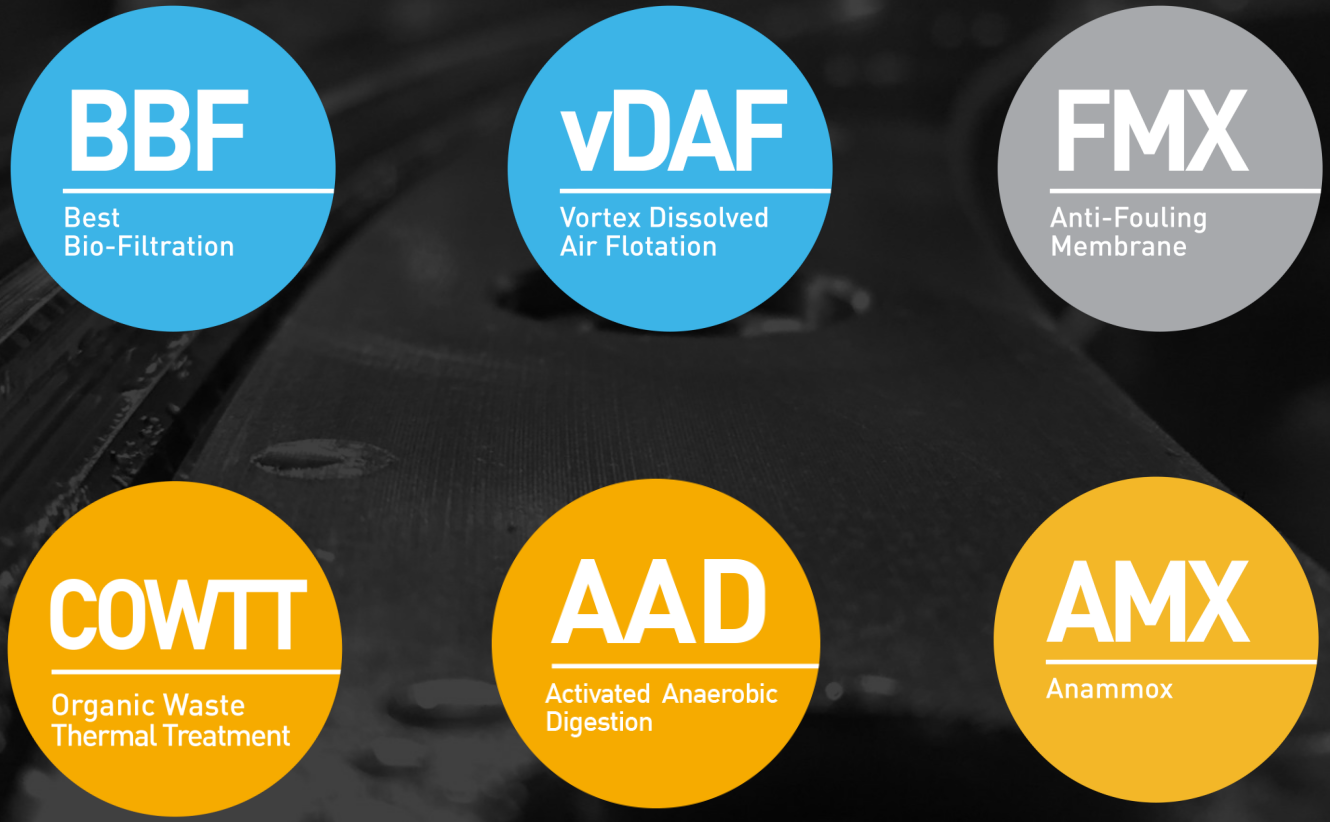


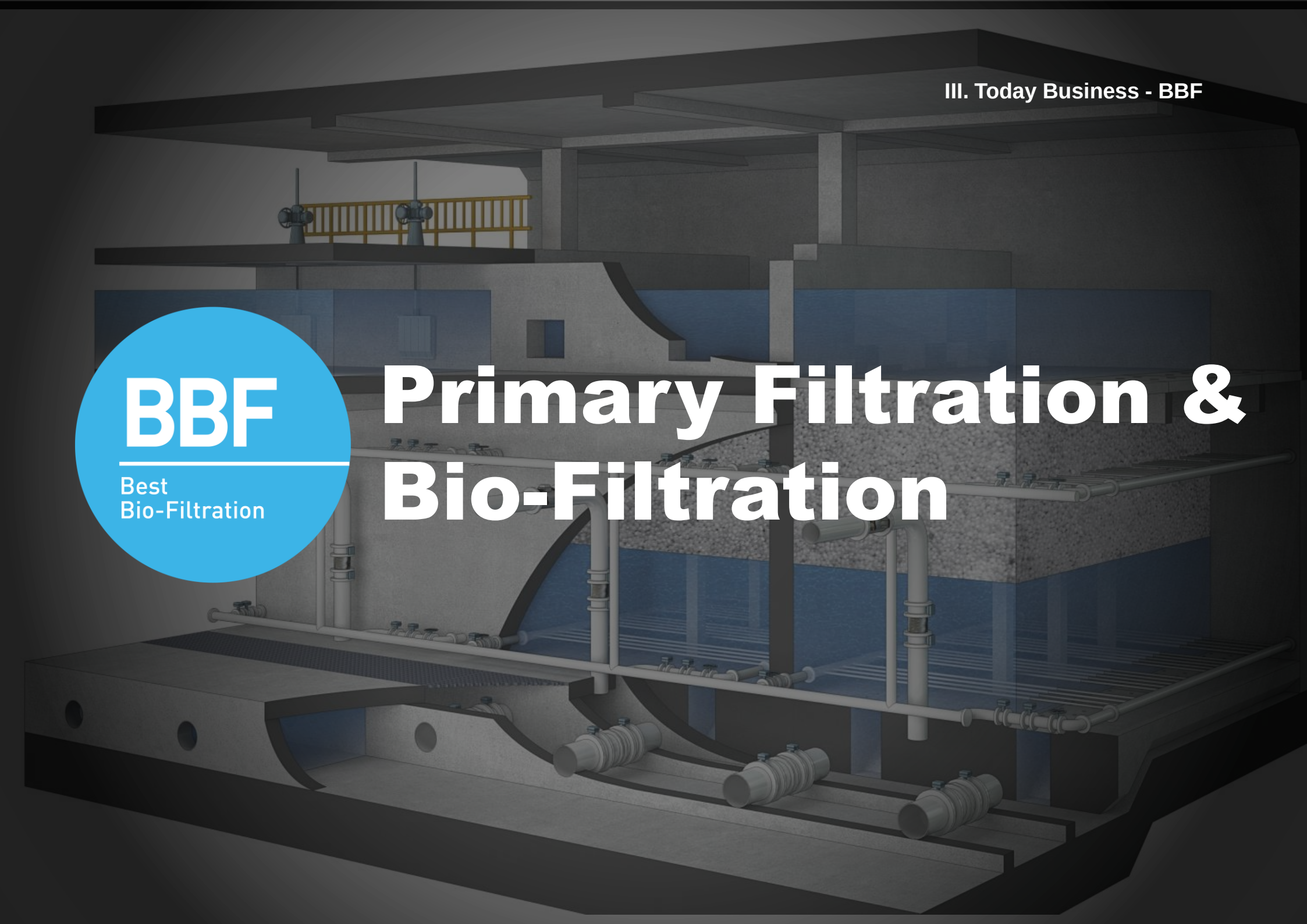
Odor Control Outcome



Ⅲ . Today Business

Technology Portfolio





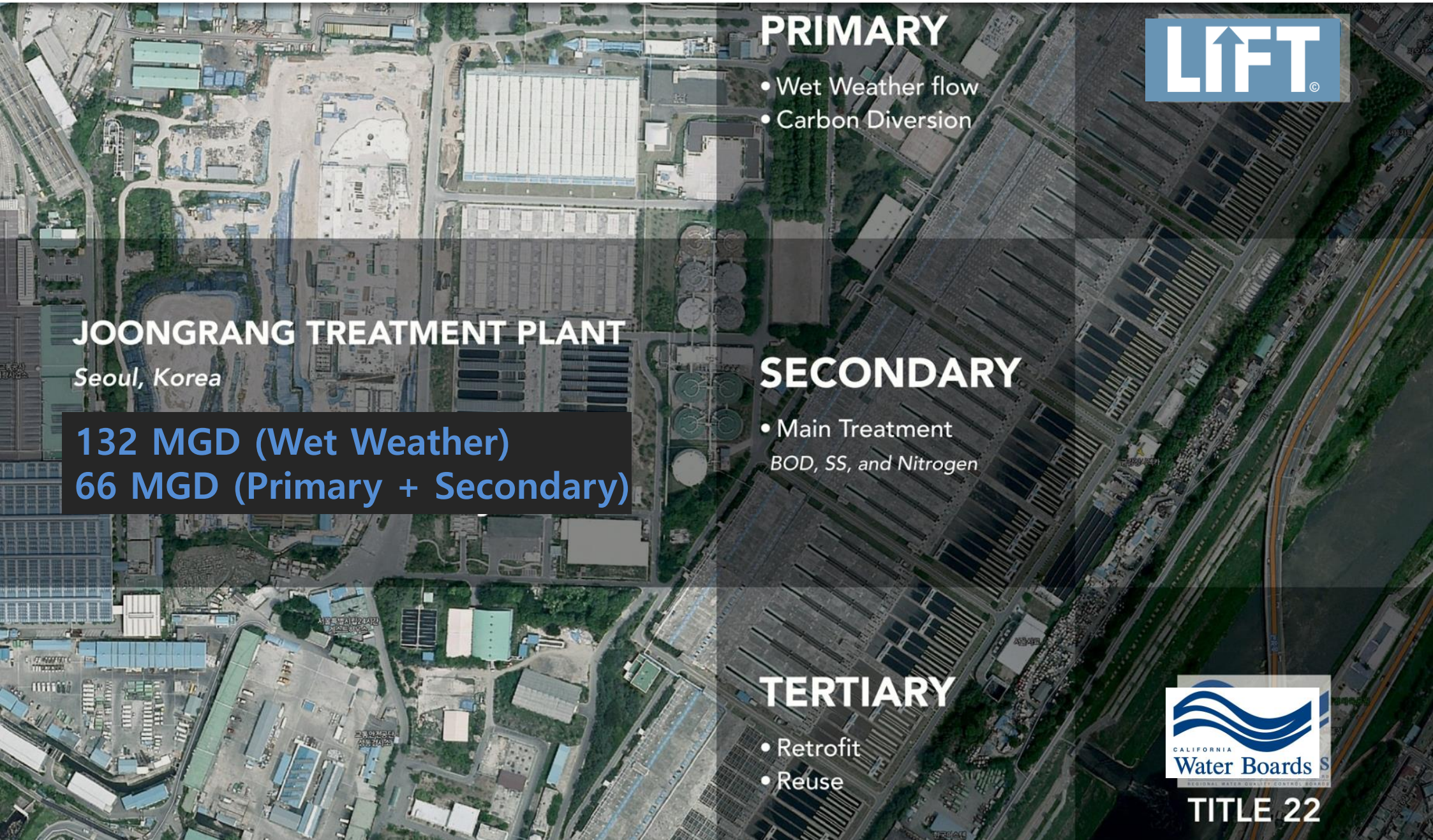
BBF

Best
Bio-Filtration

Primary Filtration & Bio-Filtration

Proven & Versatile Solutions for Municipalities

BBF Best Bio-Filtration



Wet Weather Flow

BBF Best Bio-Filtration

Genesee County Drain Commissioner

High Rate Solids Removal

- **Small Footprint, Rapid Startup (reduces EQ required)**
- **Consistent TSS output**
  - Reduces chlorine demand & contact time
  - Less chlorine dosing swings, less violations

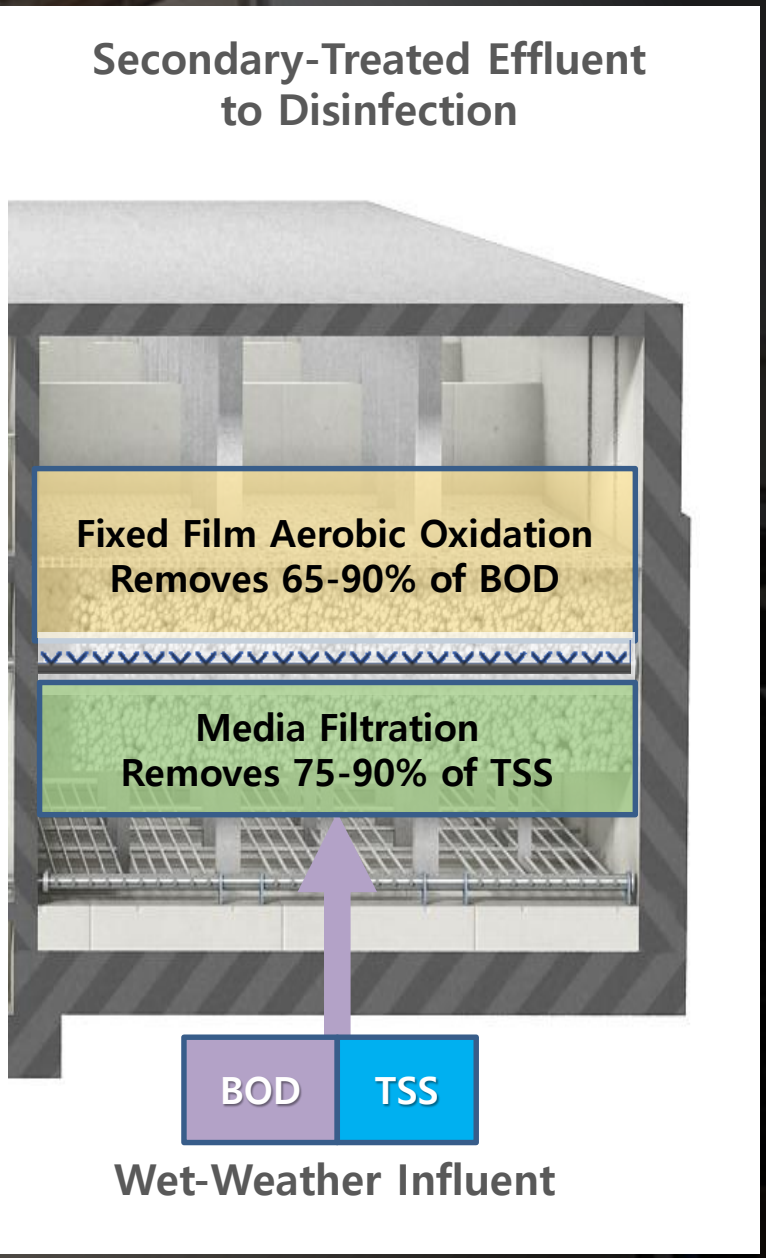
Rapid Biological Treatment:

- **Short HRT, Small footprint:**
  Filtration + Biological in 15-30min EBCT

Soluble BOD removal 50-90%

Maximum peak flow flexibility

- Peaks of 4X design flow can still be filtered to achieve TSS & total BOD removal



Groundwater Treatment

BBF
Best Bio-Filtration

Groundwater Remediation Project

City of Barstow, CA

→ Simultaneous removal of Nitrate, Perchlorate, and Dissolved Organics

→ Energy-efficient biological filtration

→ No brine disposal required

Media

BBF
Best
Bio-Filtration

Expanded Polypropylene (EPP) Media

→ Cost-Effective

→ Long Lifespan (>100yr)

Primary Filtration

→ Patented Cross-shaped Media Design

→ Maximizes Void Ratio

→ High Solids Loading Rate

→ Minimizes Head Loss

→ Easy Backwashing, Low Attrition (3%)

Secondary & Tertiary Biofiltration

→ Maximizes Surface Area for Biofilm Development

→ Simultaneous Oxidation, N/DN and Filtration

BBF Reference Sites Worldwide

APPLICATION	CLIENT	CAPACITY (m^3/d)	CAPACITY (MGD)
Tertiary (Advanced WWT)	GEOMDAN WWTP	40,000	10.6
Tertiary (Advanced WWT)	DEAJUK WWTP	12,000	3.2
Tertiary (Advanced WWT)	POCHEON WWTP	24,000	6.3
Tertiary (Advanced WWT)	CHUNGBUK WWTP	15,200	4
Tertiary (Polishing)	POHANG WWTP	9,000	2.4
Tertiary (Polishing)	MUNMAK WWTP	200	-
Tertiary (Polishing)	PYEONGCHANG WWTP	200	-
Tertiary (TMDL control)	BORYUNG WWTP	30,000	7.9
Tertiary (TMDL control)	GWANGJU WWTP	25,000	6.6
Tertiary (TMDL control)	OHPO WWTP	14,000	3.7
Tertiary (TMDL control)	DOCHEOK WWTP	4,000	1.1
Tertiary (TMDL control)	JEUNGPYUNG WWTP	25,000	6.6
Tertiary (Water reuse)	QUFU WWTP (CHINA)	40,000	10.6
Tertiary (Water reuse)	DANGJIN WWTP	30,000	7.9
Tertiary (Water reuse)	SEONAM MAGOK WRP	20,000	5.3
Tertiary (Water reuse)	SONGDO WRP	20,000	5.3
Advanced WWT	JUNGRANG WWTP	250,000	66
Advanced WWT	GWANGJU2 WWTP	20,000	5.3
Advanced WWT	SAMRI WWTP	5,000	1.3
Advanced WWT	PYEONGTAEK WWTP	33,000	8.7
Advanced WWT	JULPO WWTP	1,600	0.4
CSO/SSO control	SEONAM WWTP	720,000	190
CSO/SSO control	JUNGRANG WWTP	500,000	132
Polishing & Tertiary	OTHER 16 LSWWTPS	40~700	-
Water reuse	OKJUNG WWTP	22,000	5.8
WW treatment	MITAN WWTP	200	-
WW treatment	HAMAN PASU WWTP	300	-

BBF Reference Sites Worldwide

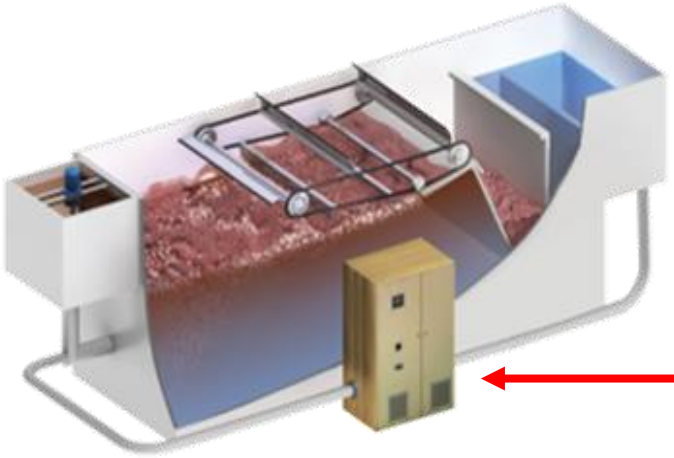
APPLICATION	CLIENT	CAPACITY (m^3/d)	CAPACITY (MGD)
Livestock Wastewater Treatment	POCHEON LWWT	120	0.032
Livestock Wastewater Treatment	BORYUNG LWWT	80	0.021
Livestock Wastewater Treatment	BOEUN LWWT	80	0.021
Livestock Wastewater Treatment	YEONGAM LWWT	70	0.019
Livestock Wastewater Treatment	SACHEON LWWT	40	0.011
Livestock Wastewater Treatment	SEONGJU LWWT	80	0.021
Livestock Wastewater Treatment	IMSIL LWWT	130	0.034
Livestock Wastewater Treatment	IKSAN LWWT	700	0.185
Livestock Wastewater Treatment	DANGJIN LWWT	95	0.025
Livestock Wastewater Treatment	HWASEONG LWWT	190	0.05
Livestock Wastewater Treatment	GIMJE LWWT	100	0.026
Livestock Wastewater Treatment	GIMHAE LWWT	200	0.053
Livestock Wastewater Treatment	GORYEONG LWWT	150	0.04
Livestock Wastewater Treatment	GOCHANG LWWT	95	0.025
Livestock Wastewater Treatment	YECHEON LWWT	80	0.021
Livestock Wastewater Treatment	CHANGYEONG LWWT	98	0.026
Livestock Wastewater Treatment	DEUNGGOK LWWT	105	0.028
Livestock Wastewater Treatment	DANGJIN LWWT	130	0.034
Livestock Wastewater Treatment	CHEONGWON LWWT	140	0.037
Livestock Wastewater Treatment	BORYUNG LWWT	150	0.04
Livestock Wastewater Treatment	JINCHEON LWWT	150	0.04
Livestock Wastewater Treatment	KYUNGJU LWWT	150	0.04

vDAF
Vortex Dissolved
Air Flotation

Vortex Dissolved Air Flotation

High-efficiency dissolved air flotation with the help of vGEN and vMIXER.

Compact size => Minimized footprint

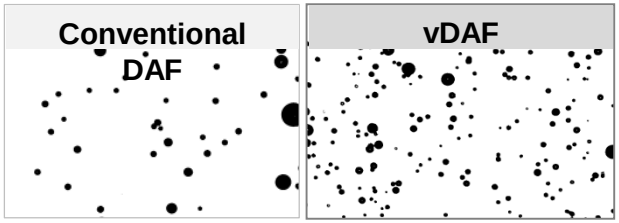


vGEN Vortex Generator

Generates fine bubbles with impact plate & vMIXER

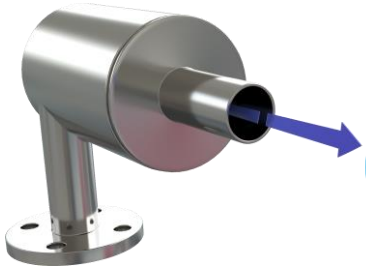
Fine bubbles (10-60㎛ bubble diameter)

Bubble Density: More than 120,000 bubbles/ml



Applications

DAF (Retrofit)
Seawater Desalination
Livestock Manure Treatment/Concentration
Primary/Secondary/Tertiary Treatment
O3 Dissolve: removal of NBDCOD
CO2 dissolve: pH adjustment (substitute for sulfur), Re-mineralization
Agriculture, Farming



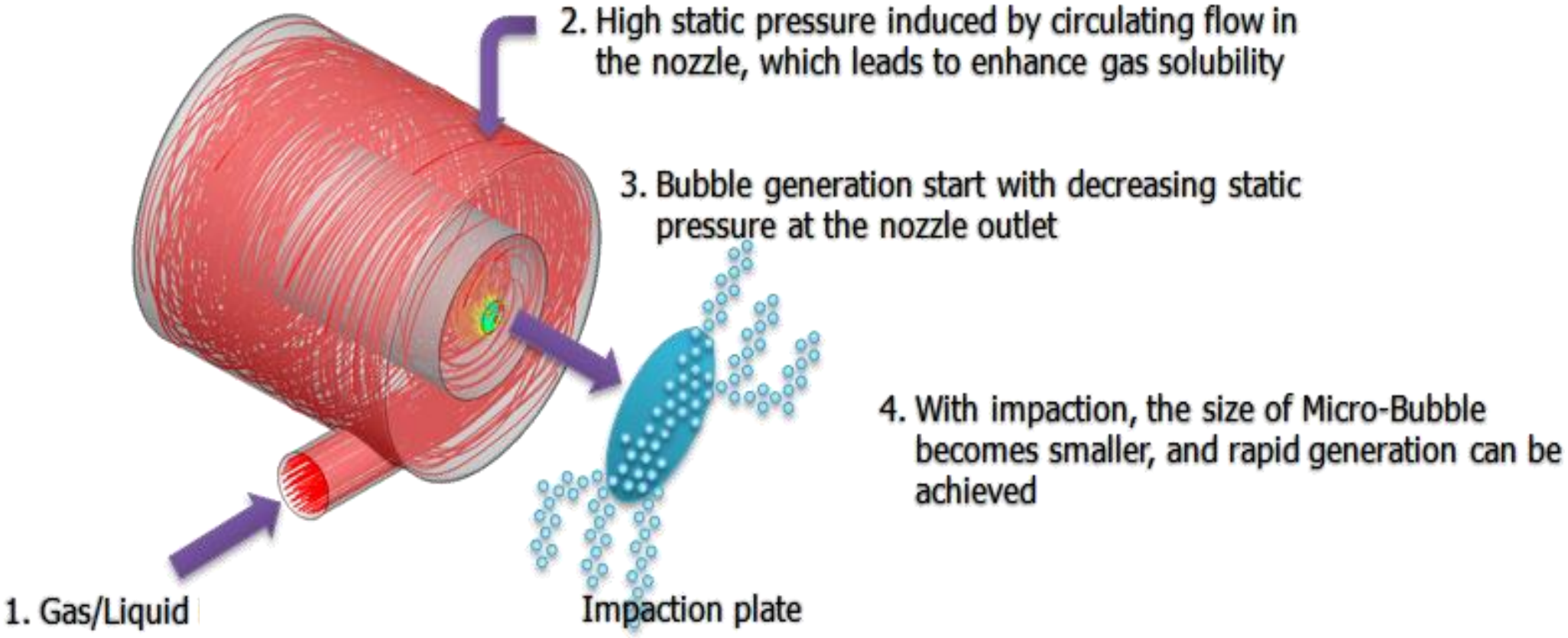
vMIXER Vortex Mixer

Mixes gas into liquid

Applicable to various kinds of gases

Generating Fine Bubbles

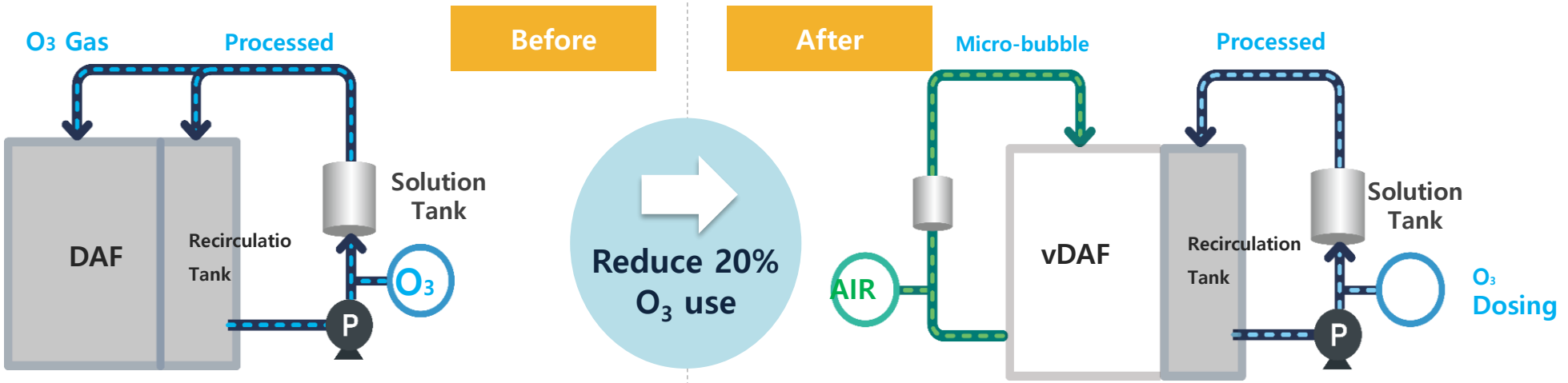
vDAF
Vortex Dissolved Air Flotation



* [Patented 10-1284266 in Korea] Fine bubble generator based on spiral flow unit

Case Study: Advanced Oxidation Process

Combining Ozone (O_3) Generator With vDAF



→ Large O_3 bubbles mean low ozone contact time reduced separation efficiency
→ Inconvenient O&M due to closed cover

Issues

→ Unstable bubble pattern
→ Chemical & ozone overdoses
→ Mechanical corrosion by ozone

→ Higher **SS removal** rates
→ Higher **ozone contact** time
→ Easy **O&M:** open cover

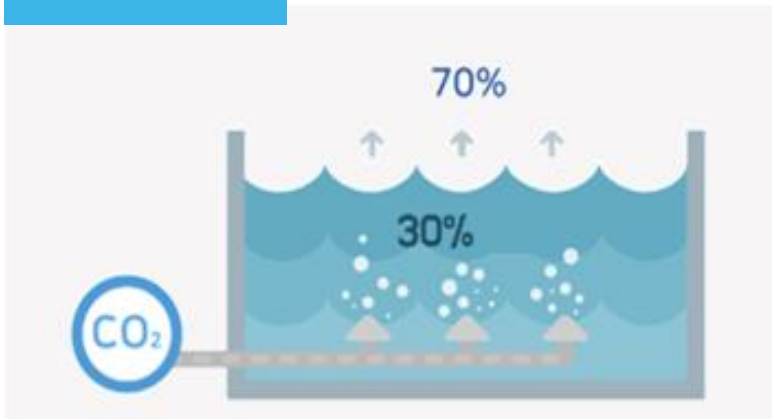
Improvement

→ Increased process capacity (x1.5)
→ O&M cost saving (50% less polymer, 20% less ozone)

Case Study: pH Control

Steel Mill (vDAF-Mixer)

Before

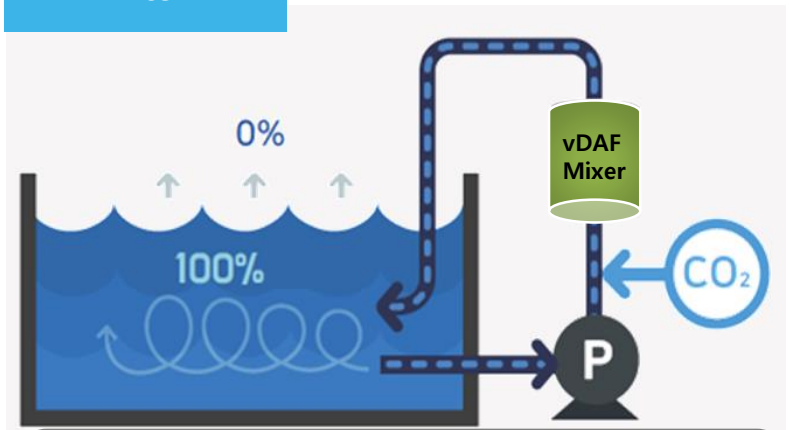


MEMBRANE DIFFUSERS

Low CO_2 solubility

Reduced 70% CO_2 use

After



vDAF-MIXER

Complete mix emits 0% CO_2

Issues

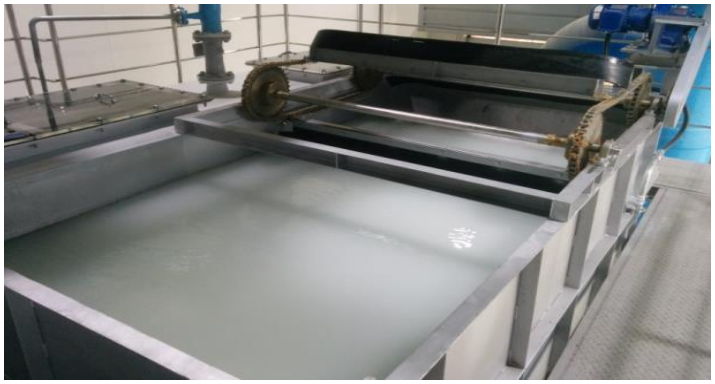
→ Wasted 70% of total CO_2 applied to the system
→ High O&M cost
→ Short pH tenacity (less than a day)

Improvement

→ Achieve 0% CO_2 emission
→ Save CO_2 use by 70%
→ Longer pH tenacity (more than two days)

vMIXER Reference Sites

Dangjin
Livestock Manure Treatment Facility
(DAF Retrofit)



Boeun-gun
Livestock Manure Treatment Facility
(Secondary Treatment)

Steel Mill in Korea
Treatment of Industrial wastewater
(Replacing Sulfur)

Anti-Fouling Membrane

FMX Technology Overview

Anti-Fouling Membrane Filtration

FMX is an anti-fouling membrane filtration system specialized for difficult applications beyond the capability of conventional systems.

Pre-treatment for Down stream Processes

Anti-Fouling

Anti-Scaling

Volume Reduction

Modular System
Easily scalable, easy maintenance

MF, UF, NF Capable
For filtration of a wide range of particle size needs as well as TDS

FMX Technology Overview

FMX Anti-Fouling Membrane

FMX Membrane Filtration Technology allows for:

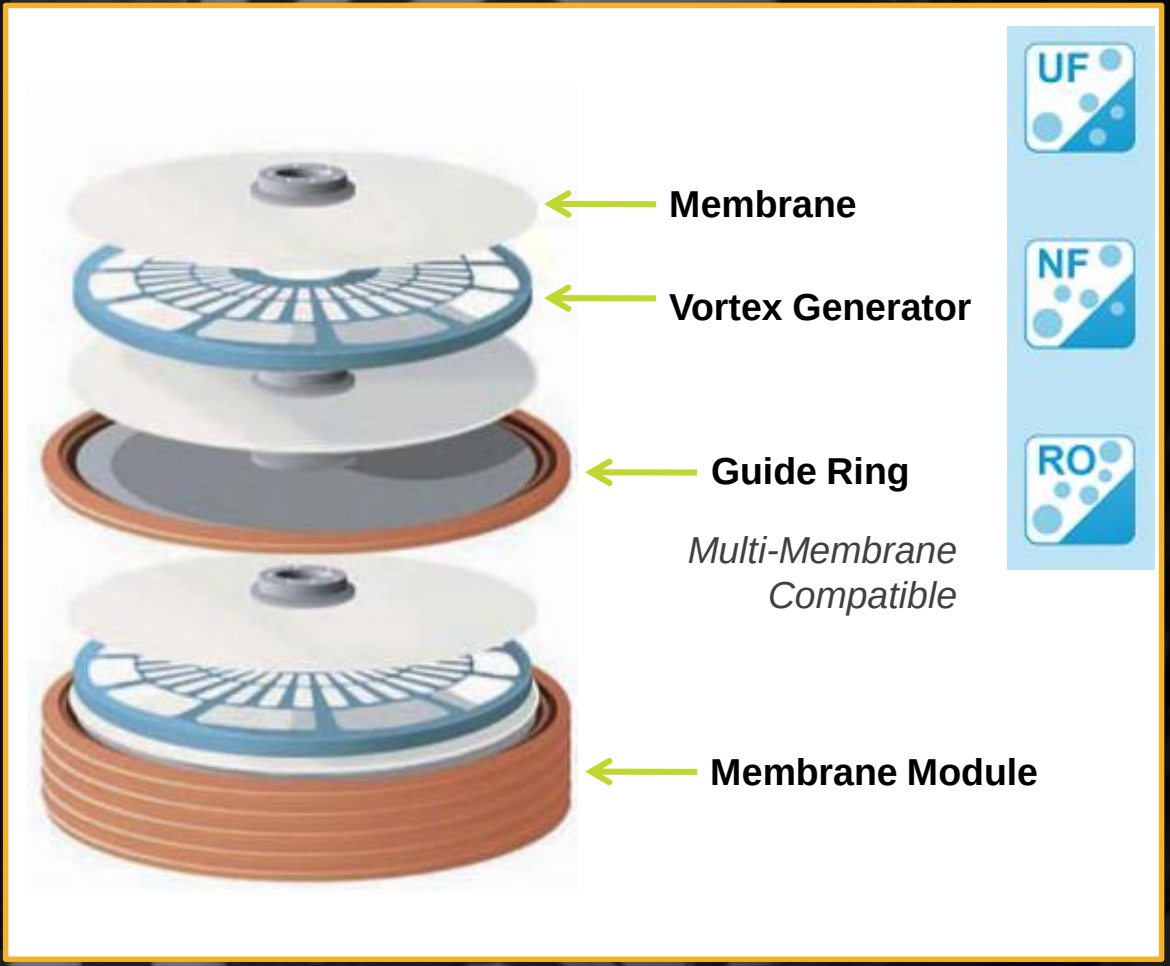
→ **HIGHER** scale tolerance

→ **GREATER** recoveries

→ **HIGHER** salt rejection

→ **HIGHER** permeate flux

→ **ANY** flat-sheet membrane



FMX in Wastewater Treatment

III. Today Business

Digestate Treatment

Nutrient Recovery & Treatment

The FMX system recovers valuable nutrients, transforming waste streams into profit streams.

Flue Gas Desulfurization WWT

Emission Regulation Compliance

Using nanofiltration membranes, the FMX system can pretreat FGD wastewater to remove all contaminant ions (TDS) simultaneously.

*** Funded by U.S. Dept. of Energy. Both projects have been successfully completed.**

FMX in Manufacturing

FMX
Anti-Fouling Membrane

FMX Technology improves recovery for the chemical, biochemical, and hi-tech industries.

FMX maximizes concentration, while mini mizing clogging, scaling, and fouling.
It can filter the thickest of fluids.

FMX simplifies production processes and optimizes treatment trains, making them less energy and water intensive.

FMX is used in:

→ Colloidal particle concentration
→ Fermentation broth filtration
→ Probiotics concentration & separation
→ Amino acid concentration
→ Diafiltration

CHEBIGEN Inc. CHEMISTRY_BIOLOGY_GENOMICS
CJ
Dongkook PHARMACEUTICAL
SK bioland
SAMSUNG
LOTTE FINE CHEMICAL
DUPONT
BIFIDO Probiotics World Best
NALCO An Ecolab Company

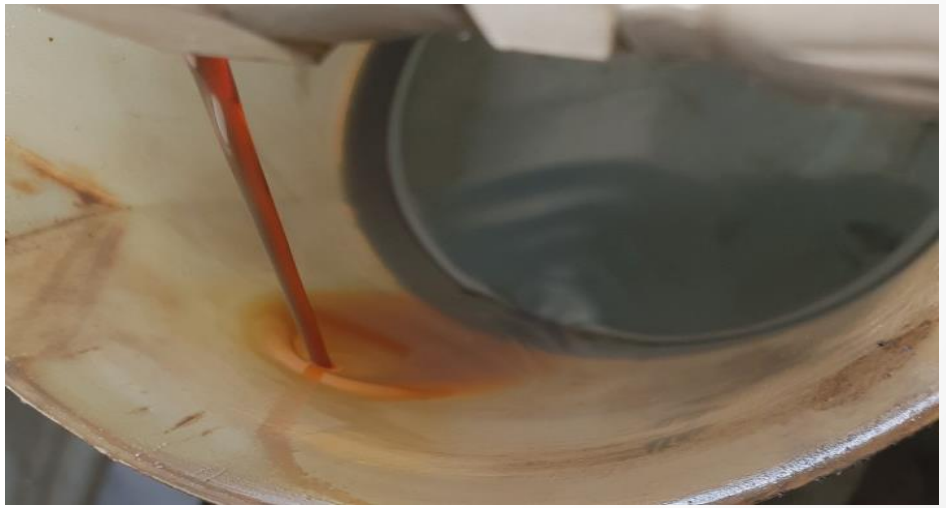
FMX Anti-Fouling Membrane

Waste Oil Filtration

Simplified Production Processes

(Chemical sedimentation + Centrifugal Separation → FMX)

Higher Quality + Greater Recovery



FMX Reference Sites Worldwide

Sector		Product	Process	Model (Qty)
Chemical	MP	Methyl Cellulose	Methyl Cellulose Concentration	S-100(7)
Chemical	MP	Silica	Colloidal Silica Concentration	S-100(1)
Chemical	MP	Chemical Process	Chemical Process R&D	B(1)
Chemical	MP	Water Reuse	Optical Film Production	P(2)
Chemical	MP	Nano-material	Nano-material	B5(1)
Chemical	MP	Refined fuel	Waste Oil Refining	E(1)
Biotech	MP	2,3-BDO	2,3-BDO Separation/Concentration	E(1)(MF), E(2)(UF)
Biotech	MP	Micro Algae	Micro Algae Separation/Concentration	B(1), B5(1)
Biotech	MP	Chinese Medicine	Chinese Medicine R&D	B(1)
Biotech	MP	Antibiotics	Antibiotics R&D	B5(1)
Biotech	MP	Natural Extracts	Natural extract purification process	E20(1)
Biotech	MP	Muconic acid	Biorefinery R&D	B5(1)
Biotech	MP	PDO	PDO Separation/Concentration	P(1)
Biotech	MP	Amino Acid	L-Methionine Concentration(DF)	S-100(2)
Biotech	MP	Probiotics	Probiotics Separation/Concentration	E(1), P40(1)
Biotech	MP	Enzyme	Enzyme Separation/Concentration	E(1)
Biotech	MP	ß-Glucan	ß-Glucan Separation/Concentration	E(1)

FMX Reference Sites Worldwide

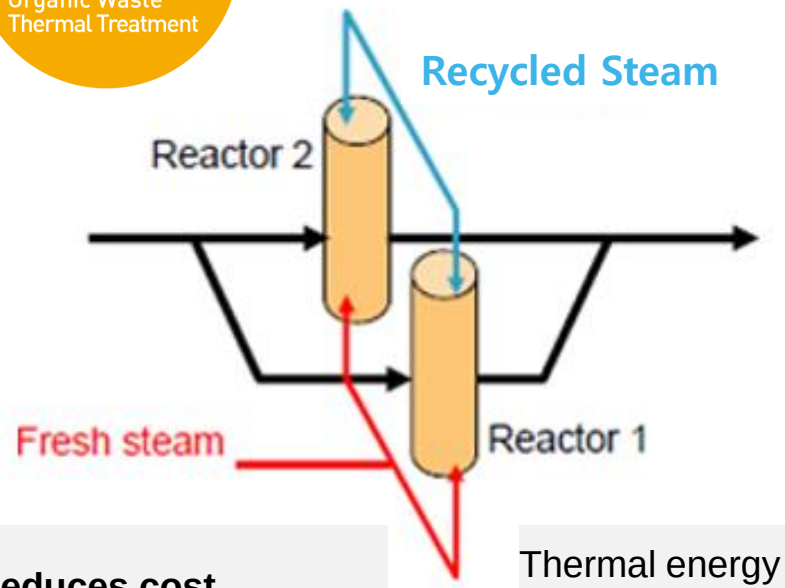
Sector		Product	Process	Model (Qty)
Biotech	MP	Cell separation	Bio R&D-Cell separation	B5(1)
Biotech	MP/UF	Functional sugars	Protein separation/concentration	B5(1)
Biotech	MP	Bio-Cosmetic	Bio-Cosmetic	B5(1)
Biotech	MP	Bio-Cosmetic	Bio-Cosmetic	B5(1)
Biotech	MP	Antibiotics	Antibiotics	PP(1)
Biotech	MP	Protein	Protein separation/concentration	E(1)
Biotech	MP	R&D	Bio R&D-Cell separation	B(1)
Biotech	MP	Tryptophan	Tryptophan	S(3)
Livestock	WW	Liquid Fertilizer	Liquid Fertilizer Production	S-20(1)
Livestock	WW	Liquid Fertilizer	Liquid Fertilizer Production	S-30(1)
Livestock	WW	Liquid Fertilizer	Liquid Fertilizer Production	S-70(1)
Livestock	WW	Liquid Fertilizer	Liquid Fertilizer Production	S-60(1)
Livestock	WW	Liquid Fertilizer	Liquid Fertilizer Production	S-40(1)
Digestate		BGP	BGP	S-80(3)
Digestate		BGP	Digestate Liquid/Solid Separation	E5(1)
Energy & Mining	WW	Produced Water	Produced Water Reuse	S-20(1)
FGD	WW	FGD	FGD Wastewater Treatment	P-10(1)
R & D	WW	WWT	R & D	B(1)
R & D	WW	WWT	R & D	B(1)
R & D	WW	WWT	WWT	P(1)

COWTT
Organic Waste
Thermal Treatment

Cyclic Organic Waste Thermal Treatment

Energy Production

BKT's Thermal Hydrolysis (THP) Solution: Cyclic Organic Waste Thermal Treatment Process



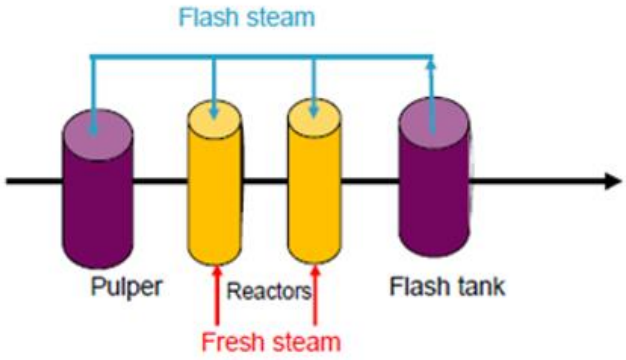
Steam recycled between pair reactors to **maximize energy recovery**

Pair reactors in parallel to **minimize footprint and cost**

Reduces cost of equipment from additional tanks

Thermal energy transferred directly between reactors to **minimize heat loss**

Conventional THP

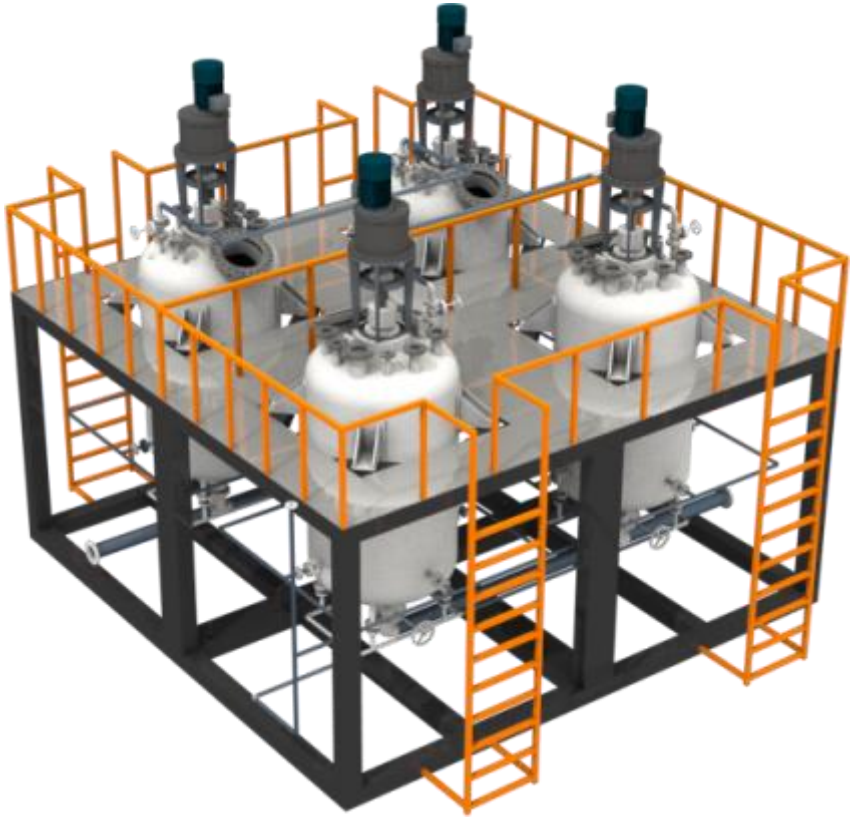


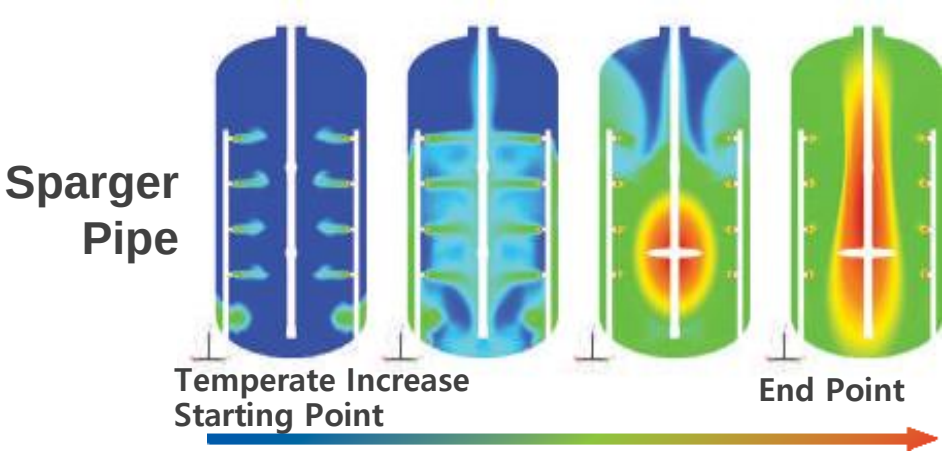
Energy Production

COWTT
Organic Waste Thermal Treatment

Direct heat transfer using patented *multipoint spargers* and patented mixing systems

Unique equipment design allows processing of high-solids feed stocks (TS=25%), allowing for more cost-effective and efficient installations.





Incheon Organic Waste Treatment

Dangjin Sludge Treatment

Thermal Hydrolysis System used for organic waste treatment, including sludge and animal remains.

COWTT Reference Sites Worldwide

Site Location	Feed Material	Capacity (dry ton/y)	Process Objectives	Installation Year
Guri, S. Korea	Municipal sludge	9,125	Biogas Class A cake	*In Design* (2018)
Icheon, S. Korea	Animal remains	1,460	Volume reduction Disposal	2016
Dangjin, S. Korea	Municipal sludge	1,460	Demonstration	2015

AAD
Activated Anaerobic Digestion

Activated Anaerobic Digestion

Activated Anaerobic Digestion

Highly efficient mixer and sediment discharge system

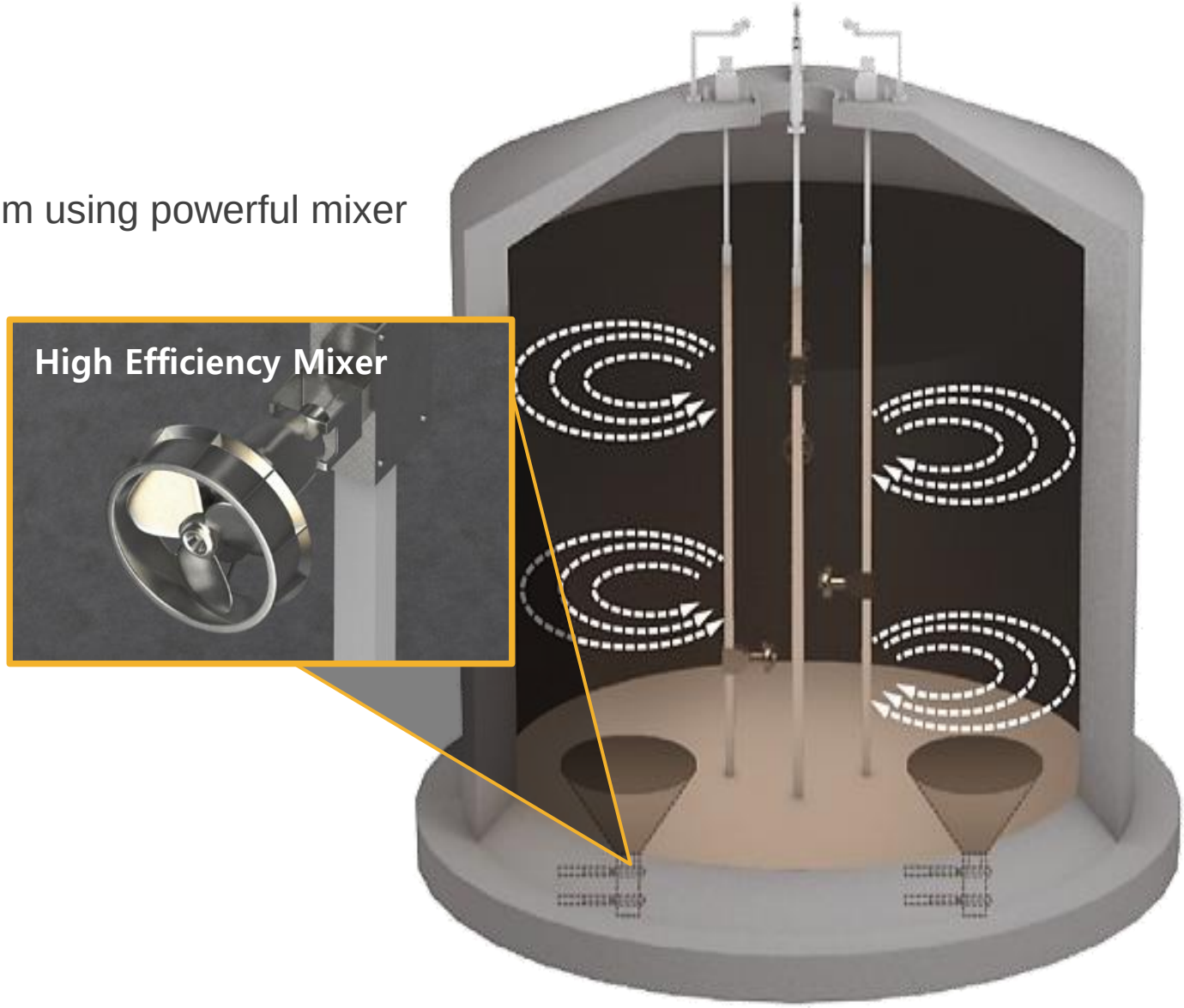
Advantage

→ Eliminate dead space and scum using powerful mixer

→ Minimize maintenance costs

References in South Korea

- Hongcheon
- Miryang
- Gimhae
- Uljin
- Anseong
- Guri
- Jinju



AAD Reference Sites

Hongcheon
Eco-friendly Town

Gimhae
Livestock Wastewater Treatment Plant

Kyeongsan
Organic Waste Recycle facility

COWTT
Organic Waste
Thermal Treatment

Well-balanced & Well-organized Energy Production Process

AAD
Activated Anaerobic
Digestion

Safeguard Your System
The Most Resilient Anammox Process In The World

AMX
Anammox

Two-Stage AMX®

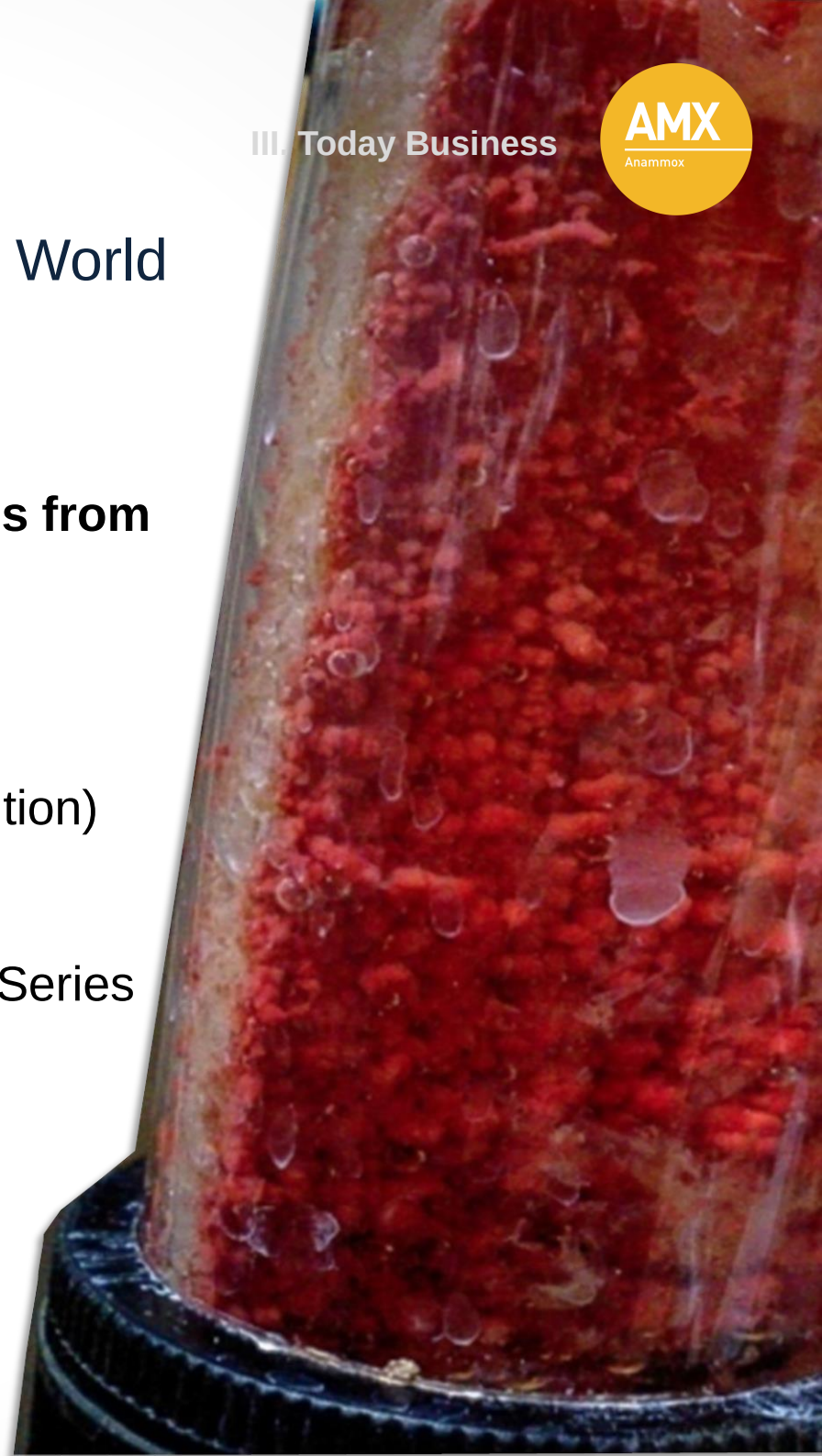
Two-Stage **AMX®**

The Most Resilient Anammox Process in the World

III. Today Business

AMX Anammox

- ✓ **Avoid the risk of catastrophes caused by spikes from High TSS and High COD**
- ✓ **Highest Removal Rates:** Up to 2.5 kg N/m^3d (>50% higher than the competition)
- ✓ **Unique, Super-Efficient Anammox Strain:** OBA Series
- ✓ Use both **suspended and attached growth**



AMX Reference Sites Worldwide

Project Classification		Site	Capacity	Comments
Korea	Side-stream (Digester Centrate)	Noksan STP (Busan)	780 m^3/d	Under construction. Seeding planned for Oct 2019
		Daejon STP	220 m^3/d	Operational full-scale
		Gangbyeon STP (Busan)	70 m^3/d	Anammox farm. In operation till at least Noksan is operational.
	Livestock/food waste digestate	Hongcheon	2 m^3/d	Operational pilot plant. Will run for at least 7-8 months
	Landfill Leachate	Sudokwon Landfill (Incheon)	2 m^3/d	Operational pilot plant. Possible extension for 6-12 months
USA	Main-stream	JWPCP (California)	40 m^3/d	Completed demo plant
		Hyperion Water Reclamation Plant (California)	40 m^3/d	Demo plant. Starting Q4 2019
	Side-stream (Digester Centrate)	Hyperion Water Reclamation Plant (California)	1 m^3/d	Operational pilot plant
	Livestock digestate	Bos Dairy Farm (Indiana)	1 m^3/d	Completed pilot plant

Two-Stage **AMX®** Reference Sites

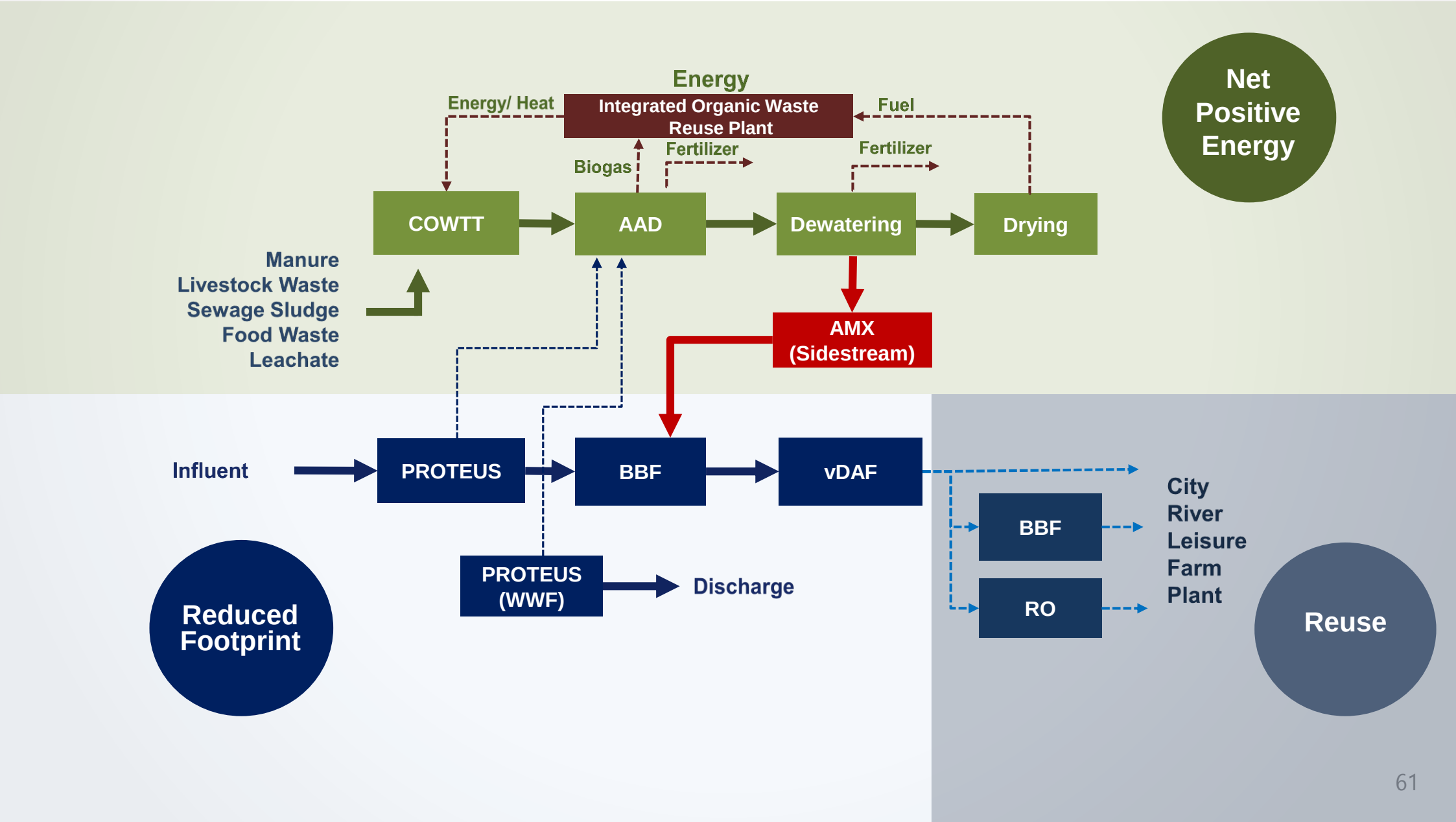
Noksan WWTP in Korea - Side-Stream AMX (780 ton/day)

Hyperion Main/Side Stream AMX

Daejeon WWTP - AMX Incubating facility (220 ton/day)

Indiana Project (livestock manure treatment in dairy farm) - AMX pilot

Total Solutions



Thank You!

A Clean and Beautiful World
Beyond Waste

BKT Innovation Beyond Waste

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