Circular Economy
with Digital Technology and Data

2023 September 11ᵗʰ | **SK ecoplant**

SK ecoplant Business Area

Eco Environment

Eco Energy

Eco Solution

No.1 Water Treatment

(1,295 plants, 4.43 megaton/yr)

No.1 Waste Incineration

(10 plants, 7.55megaton/yr)

No.3 Landfill

(4 sites, 3.2 million m2)

Fuel Cell

Invest to Bloom Energy(USA)

Hydrogen

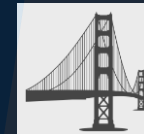Production of green-H_2 through SOEC system

Renewable Energy

Offshore wind power/ Solar power

Energy Solution

Carbon neutral industrial complex

Infrastructure
- Domestic No.1 in oversea infrastructure PPP
- Premium living space "DEFINE"

Construction

Offshore platform

Plant
- Offshore wind power EPC
- Battery & Material, Hydrogen & Eco-friend, Gas & Power plant

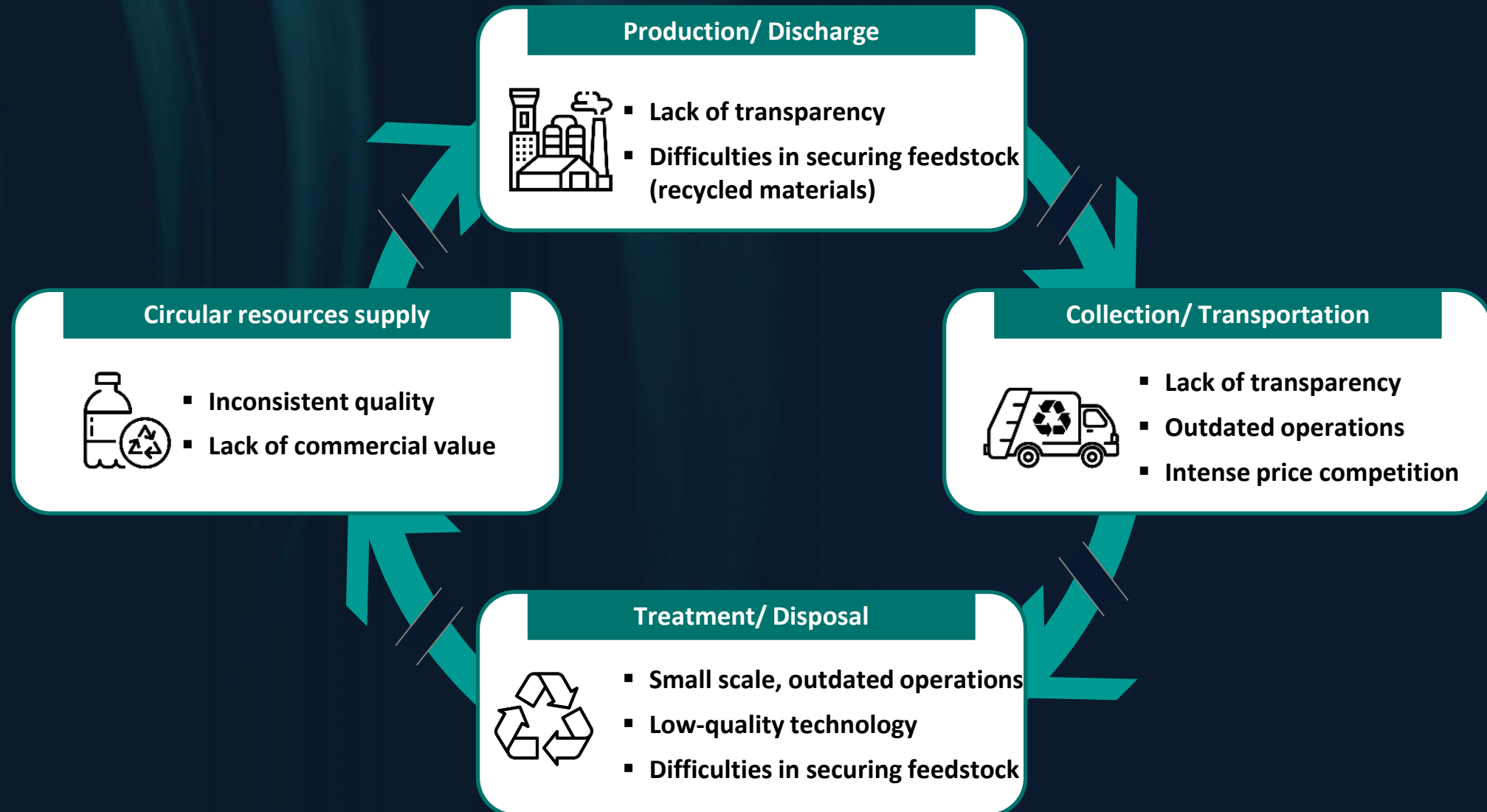Asia's No.1 Environmental Company

Global No.1 Fuel Cell Business Company

Korea's Top 10 Construction Company

Two pillars for a sustainable future

Net Zero

Circular Economy

# Fragmented value chain and inefficient operation hinder Circular Economy

Production/ Discharge
- Lack of transparency
- Difficulties in securing feedstock (recycled materials)

Collection/ Transportation
- Lack of transparency
- Outdated operations
- Intense price competition

Treatment/ Disposal
- Small scale, outdated operations
- Low-quality technology
- Difficulties in securing feedstock

Circular resources supply
- Inconsistent quality
- Lack of commercial value

Data
Connection

Digital platforms and technologies help us connect the dots in achieving Net Zero and Circular Economy
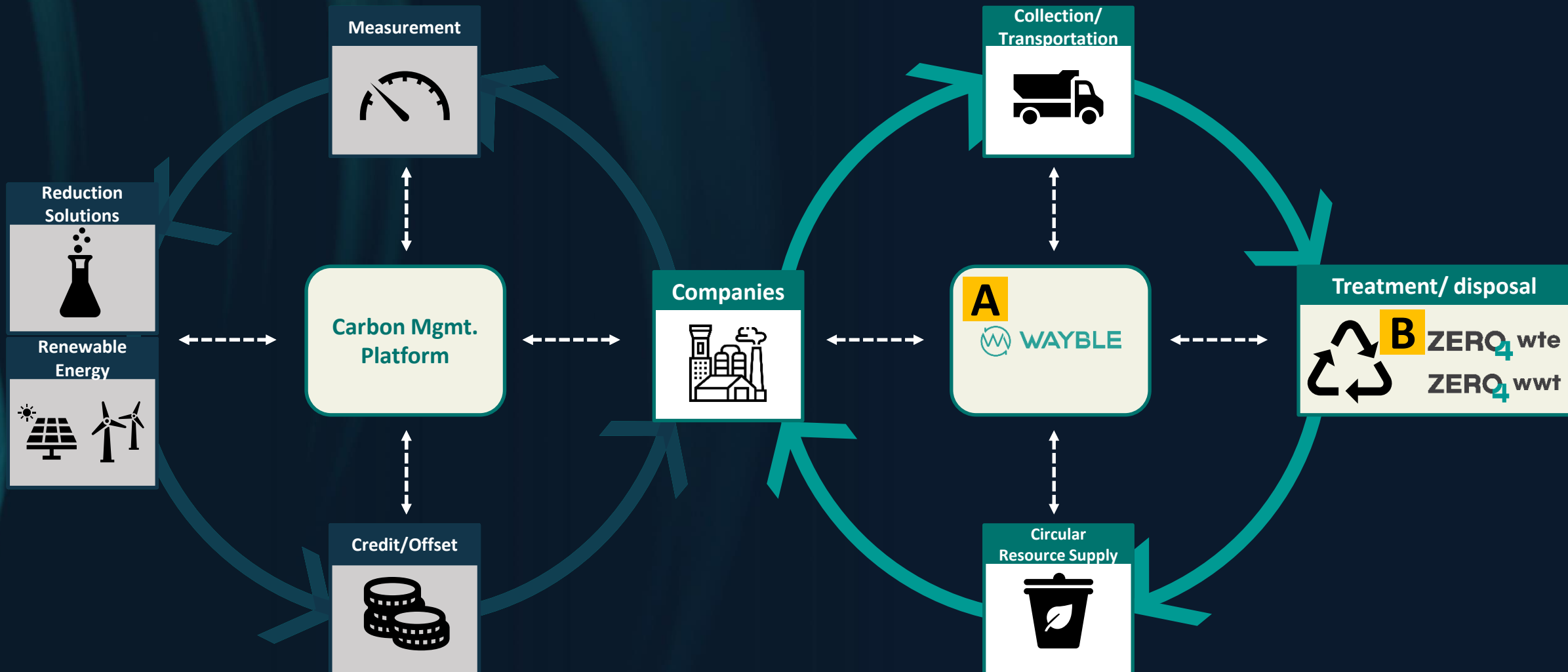
A **WAYBLE** helps us manage waste to resource lifecycle transparently and efficiently

Digital based management solution for entire waste disposal process.

**WAYBLE®
Digital Operations**

- Easy to use interface (App/Web service)
- One-stop request for waste discharge

- Provide visibility of waste disposal process (e.g., haulers route, treatment status)

- Automatic generation of required document

- Analyze and manage environmental impact
- Support data driven decision making

**WAYBLE®
Closed Loop Mgmt.[1]**

Digitally managing closed loop by providing traceability of end-to-end waste lifecycle. (e.g., real-time monitoring dashboard, report based on data)

**WAYBLE®
Marketplace[1]**

Providing data/index about circular resources. (e.g., price, quantity)

Certifying the quality of circular resources, and matching supply and demand of high-quality ones.

1.These services are currently in development and will be available in 2024/2025.

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B ZERO₄ wte solution supports optimal operation of Waste-to-Energy plants

"AI-aided Waste-to-Energy Operation Control Solution"

ZERO₄ wte

Technical Features

- AI algorithm[1] offers optimal operation guides(e.g., waste feeding) by predicting future combustion conditions.

Digital & Transparent Experience

- Real-time monitoring for incineration process and air pollutant emissions.
- AI guidance makes stable plant operation regardless of operator's own experience.

Improved Performance[2]

- Improve energy recovery ratio 3.1%
- Reduce air pollutant emission: NOx 12.4%↓, CO 49.7%↓

1.Collect and use more than 200 types of data, e.g., PLC, Crane load cell, TMS, CCTV, Various measuring instruments and others / 2.Operation result of SKEP's 5 WtE plants ('22.10)

ZERO₄ wte VISION

Acquire energy recovery rate increase and transparency by Digital Transformation of the Incineration Cycle

1 Waste Pre-Treatment	2 Incineration	3 ESG / Monitoring

"Uniform Property Waste Feed"
: Waste as High Quality Energy Source

1A WtE Waste Pre-Treatment Solution
1B Pretreated Waste Calorific Value Prediction

"Energy Generation Facility"
: Not Incinerator just for Incineration,
Incinerator as Waste-to-Energy Facility

2A Waste Property Analytics
**2B** Optimized Incineration Operation
2C Incineration Automatic Operation(ACC)

"Transparent Incineration"
: Achieve Incineration Process/Result Transparency

3A Incineration Operation Monitoring
3B WtE Plant Management System
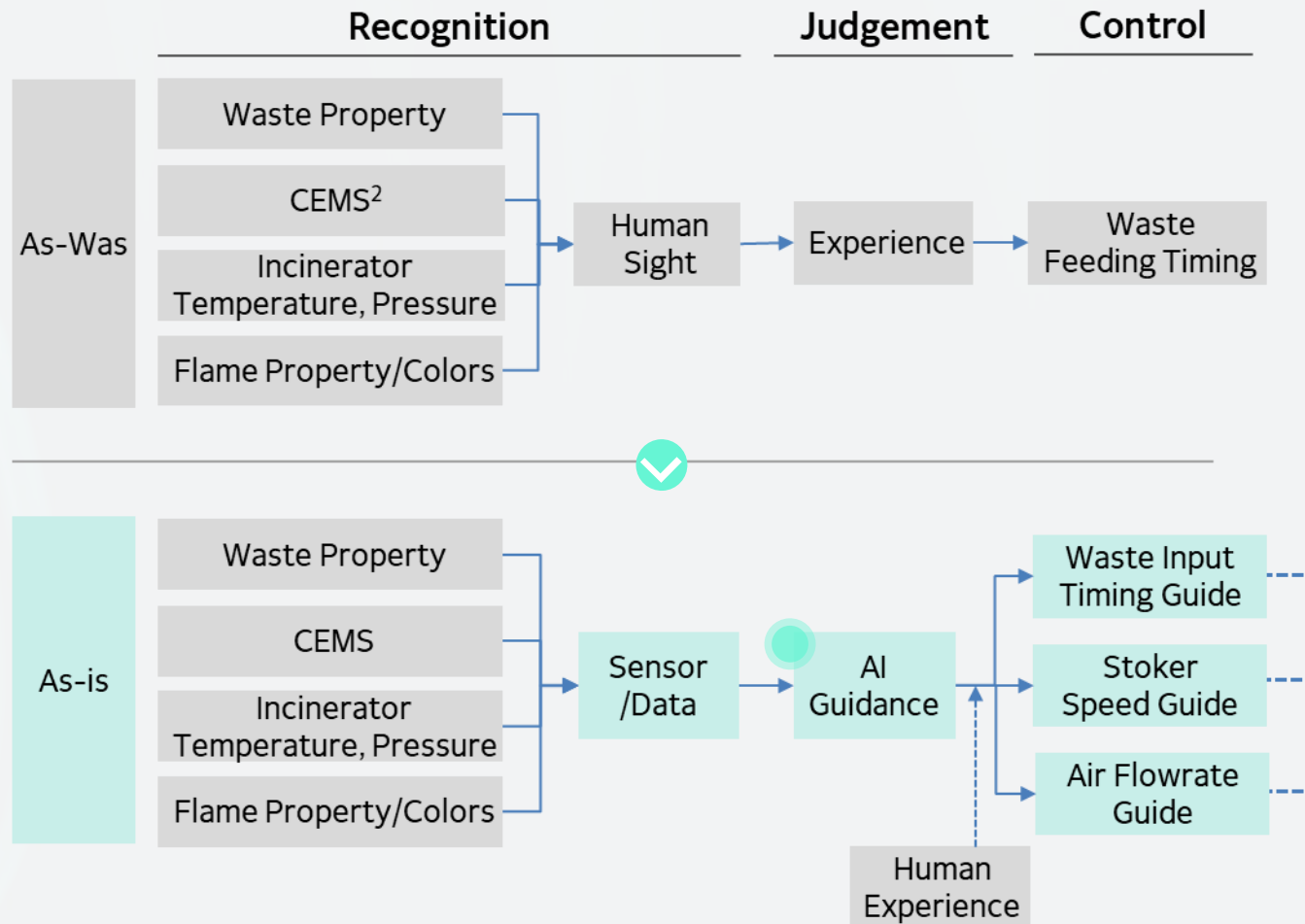**3C** Energy Recovery Rate Measurement/Management

Pre-Treatment
Combustibles Selection
Recycles Selection

Waste Hopper
Incinerator
Pollution Control
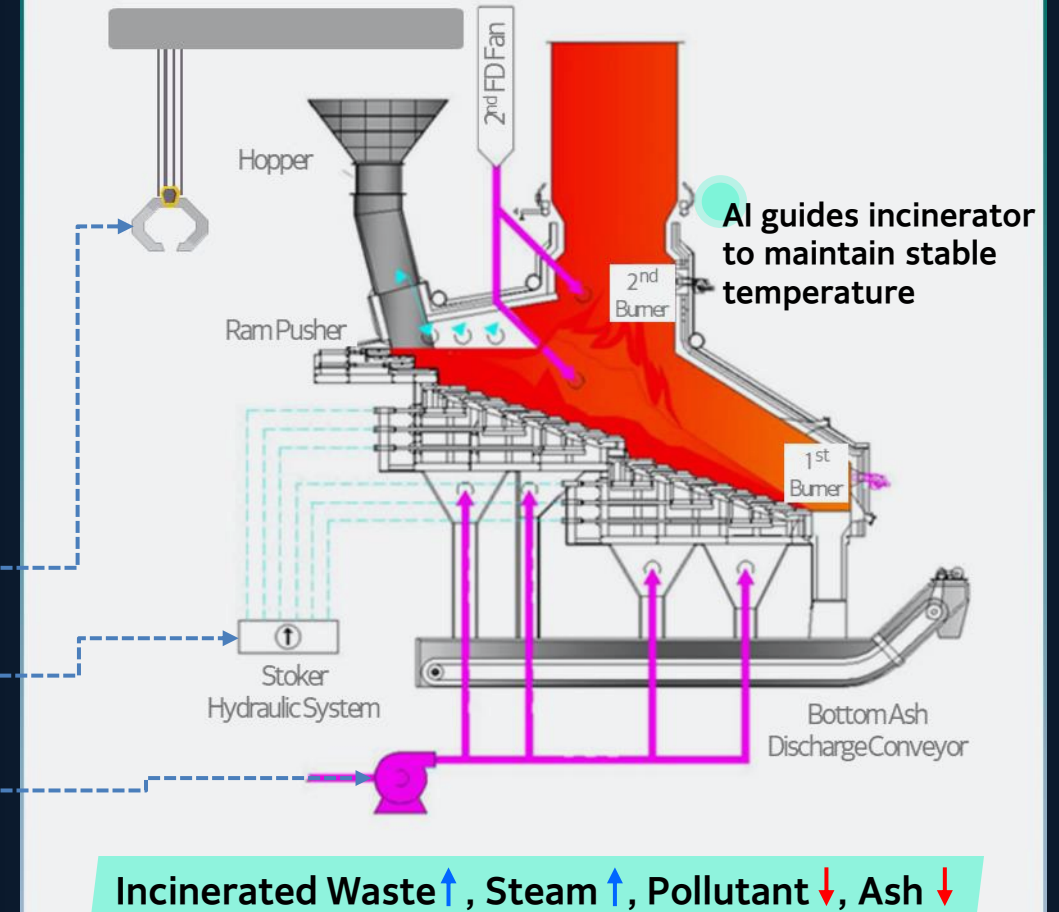
■ '21~'22 Completed
■ '23 Planned
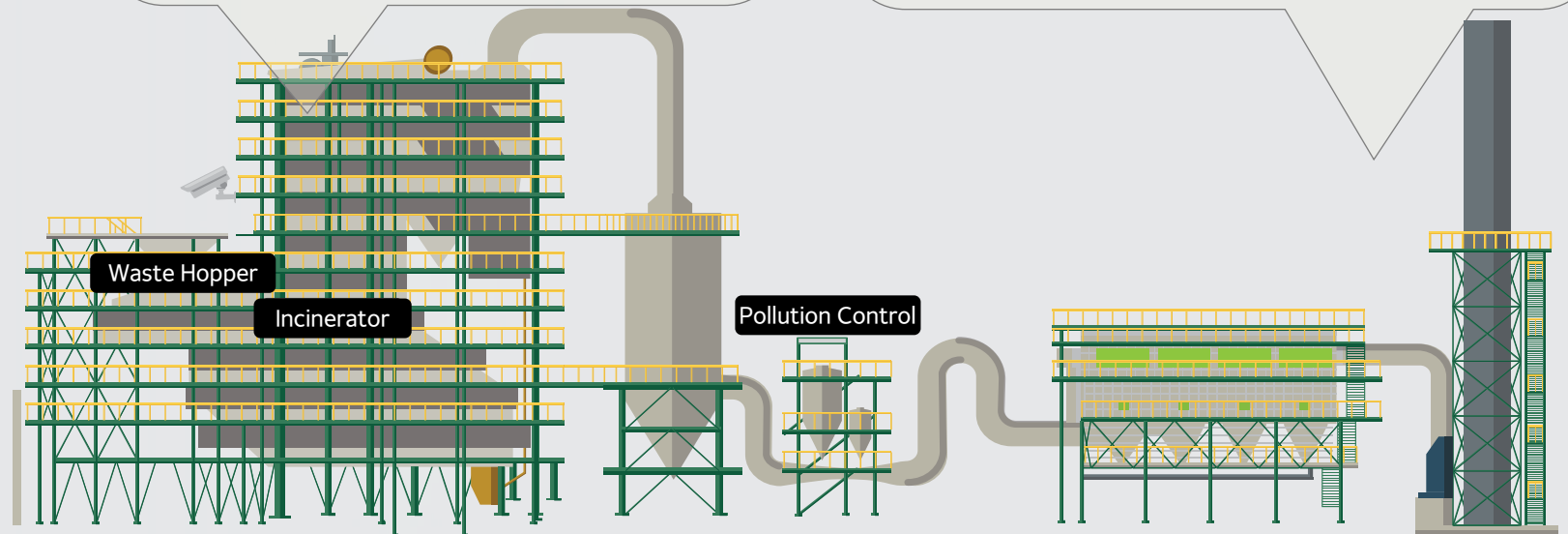
ZERO4 wte CONCEPT

Data & AI-based application providing optimized 3T[1] control guidance, reducing pollutant and improving efficiency
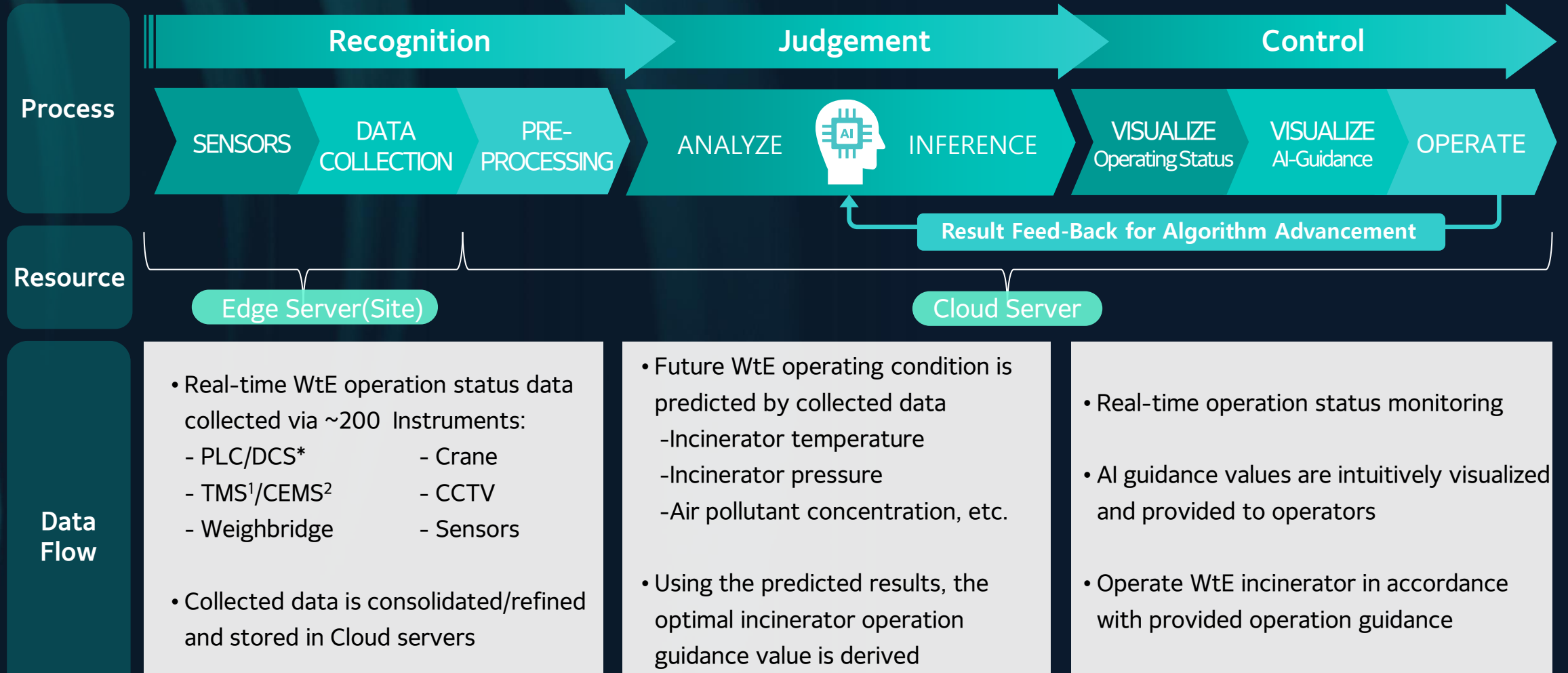
Conceptual Framework

	Recognition	Judgement	Control
As-Was	Waste Property / CEMS[2] / Incinerator Temperature, Pressure / Flame Property/Colors → Human Sight	Experience	Waste Feeding Timing
As-is	Waste Property / CEMS / Incinerator Temperature, Pressure / Flame Property/Colors → Sensor /Data → AI Guidance	Human Experience	Waste Input Timing Guide / Stoker Speed Guide / Air Flowrate Guide

Operating Parameters

2nd FD Fan
Hopper
Ram Pusher
2nd Burner
1st Burner
Stoker Hydraulic System
Bottom Ash Discharge Conveyor

AI guides incinerator to maintain stable temperature

Incinerated Waste↑, Steam↑, Pollutant↓, Ash↓

1.Temperature, Time, Turbulence / 2.Continuous Emission Monitoring Systems.

ZERO4 wte PROCESS

Visualized AI guidance and operation status is provided by analyzing and inferring real-time collected data

Process

Recognition | Judgement | Control

SENSORS | DATA COLLECTION | PRE-PROCESSING | ANALYZE | AI | INFERENCE | VISUALIZE Operating Status | VISUALIZE AI-Guidance | OPERATE

Result Feed-Back for Algorithm Advancement

Resource

Edge Server(Site) | Cloud Server

Data Flow

- Real-time WtE operation status data collected via ~200 Instruments:
  - PLC/DCS*
  - TMS[1]/CEMS[2]
  - Weighbridge
  - Crane
  - CCTV
  - Sensors

- Collected data is consolidated/refined and stored in Cloud servers

- Future WtE operating condition is predicted by collected data
  - Incinerator temperature
  - Incinerator pressure
  - Air pollutant concentration, etc.

- Using the predicted results, the optimal incinerator operation guidance value is derived

- Real-time operation status monitoring

- AI guidance values are intuitively visualized and provided to operators

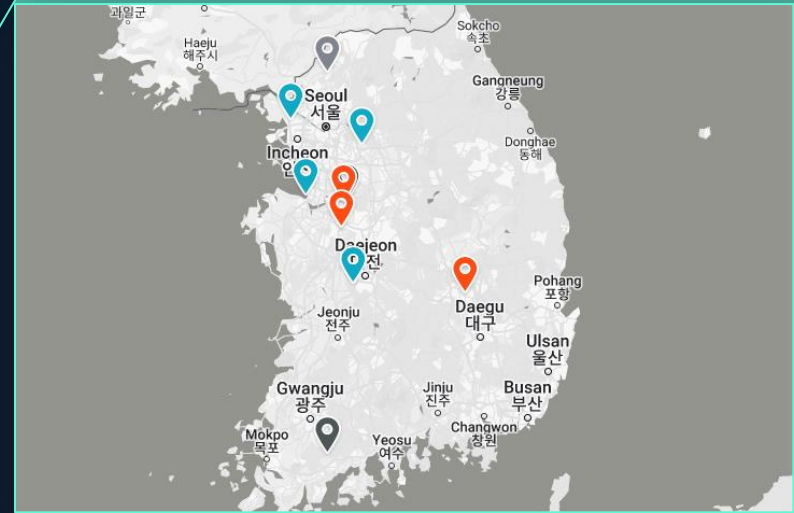- Operate WtE incinerator in accordance with provided operation guidance

* ZERO4wte can be used with existing control system (Designed for PLC / DCS)

ZERO4 wte APPLICATION
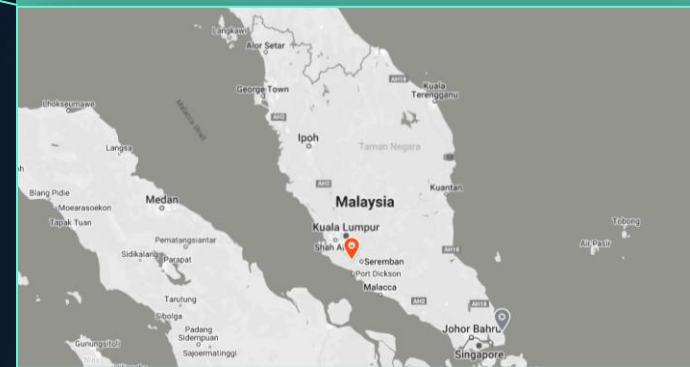## Applied and validated in 10 WtE domestic sites and is being expanded to international WtE sites

South Korea (10 WtE Plants)

Malaysia (1 WtE Plant)

DIGITAL TECH.

SK ecoplant's Digital Tech. creates new values by connecting stakeholders and utilizing data through services that enhance efficiency and visibility in circular economy & net zero area

WAYBLE
- Waste Management Digital Operation Services
- Closed Loop Management
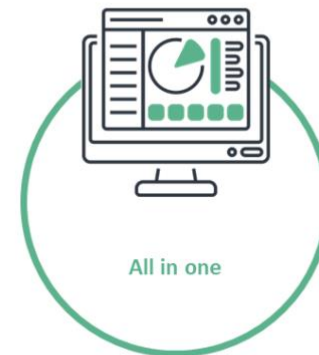- Circular Resource Marketplace

ZERO4 wte / wwt
- AI-based Automatic Control Solution
- Real-time Monitoring Solution
- Greenhouse Gas Monitoring /Management Solution
- Operation Management Solution

Carbon Management
- Carbon Accounting & Management
- Connecting Carbon Reduction Solutions/Carbon Credits

Sustainable carbon management

All in one

Convenient, systematic, and sustainable carbon neutrality management

ROMA
- Robotics Solution for Medical Waste
- Automated Waste Classification with RFID-based Calorific Value(CV) Estimation
- Waste Combination/Loading Robots for Optimal CV
- AI Guidance based on Predicted CV
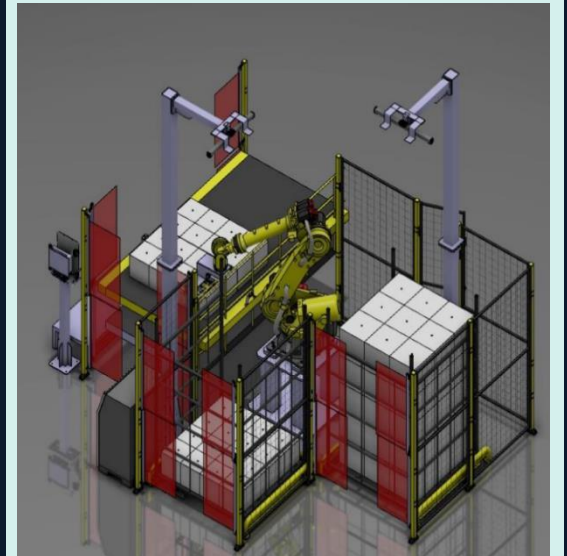
We Solve
Environmental Problems
with Digital Technology and Data