Leading Korea's water supply digital transformation

K-water AI·DT Water Treatment Plant

October 21, 2025 (Tuesday)

Presenter : Dong gi, Shin
E-mail : tonyshin93@kwater.or.kr
(tonyshin93@gmail.com)

K water

Contents

A New Era of Water, A Paradigm Shift in Water Management

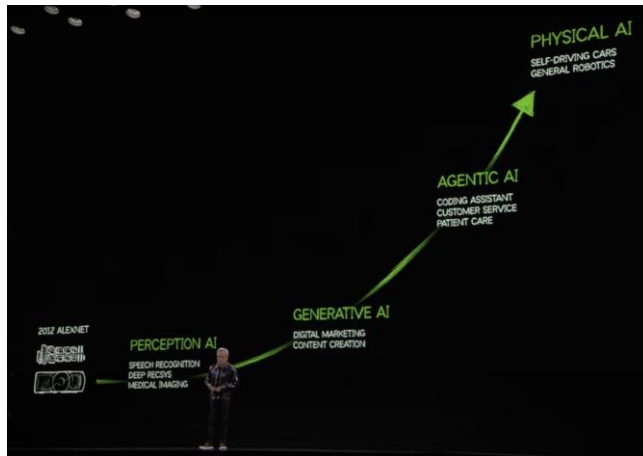# Background and Necessity

K water

> **AI now transcends operation tech, driving the water management paradigm shift**
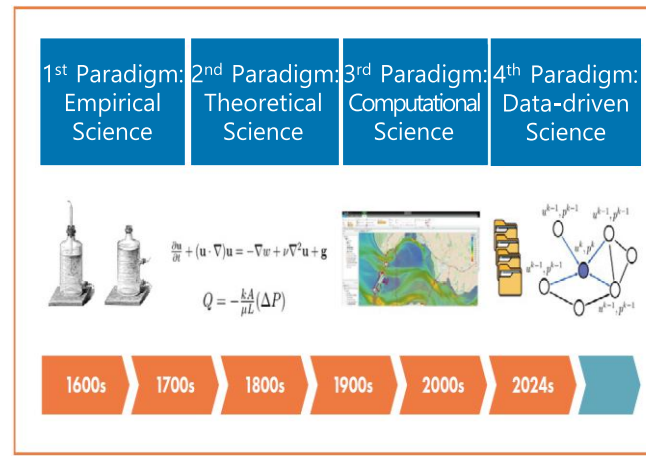
Rapid Advancements of AI Technology

- Rapid emergence & active convergence of tech

- Generative AI fuels faster innovation

   * Singularity arrival forecast : 2045 → 2029

Source : Jensen Huang (CES 2025 Keynote Speech)
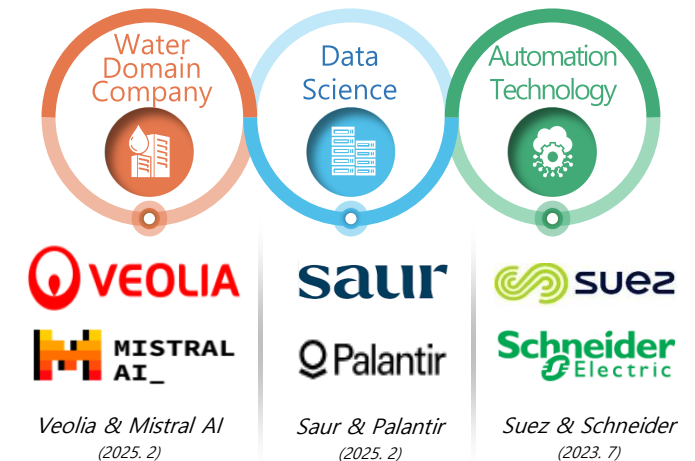
Water Management Paradigm Evolution

- Transition to Data-driven Science Paradigm

- Securing applicability of AI tech to water sector

* Expecting increased efficiency & productivity in solving issues

1st Paradigm: Empirical Science	2nd Paradigm: Theoretical Science	3rd Paradigm: Computational Science	4th Paradigm: Data-driven Science

1600s 1700s 1800s 1900s 2000s 2024s

Source : Applications of AI for Water Management, UNESCO (2025)

Collaboration between Global Companies

- Digital Transformation at Water Leader Veolia

* AI utilization in '18, adoption of secure GPT in '23(first in France)

- Strategic Alliances : Water & AI Companies

Water Domain Company — Data Science — Automation Technology

VEOLIA — saur — suez

MISTRAL AI_ — Palantir — Schneider Electric

Veolia & Mistral AI (2025. 2) — Saur & Palantir (2025. 2) — Suez & Schneider (2023. 7)

Source : GWI Technology (2025)

" **AI WTP is a key solution to address policy, climate and demographic shifts.** "
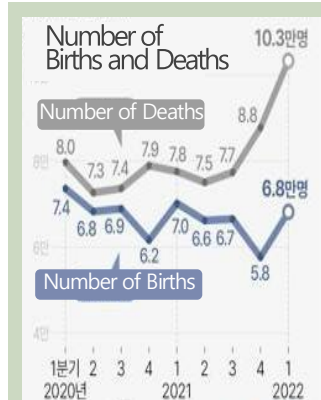
Addressing Operational Challenges

Flood

Turbid water inflow

Drought

Inflow of pollutants

Regional Depopulation

Number of Births and Deaths
Number of Deaths
Number of Births
10.3만명
8.8
8.0 7.3 7.4 7.9 7.8 7.5 7.7
6.8만명
7.4 6.8 6.9 6.2 7.0 6.6 6.7 5.8
1분기 2 3 4 2020년 2 3 4 2021 1 2022

Population & social structural changes

Necessity of a reliable water supply in emergencies

Response to Digital Transformation Policies

21st Presidential Oath of Office

'25.6.

AI and High-Tech Investment & Support

Global Water Company leading the response to the climate crisis

'23.11.

Leading climate response, Water DX

Promoting digital innovation in water management in line with policy

K-water's Efforts to Transition to Future-oriented Digital Water Management

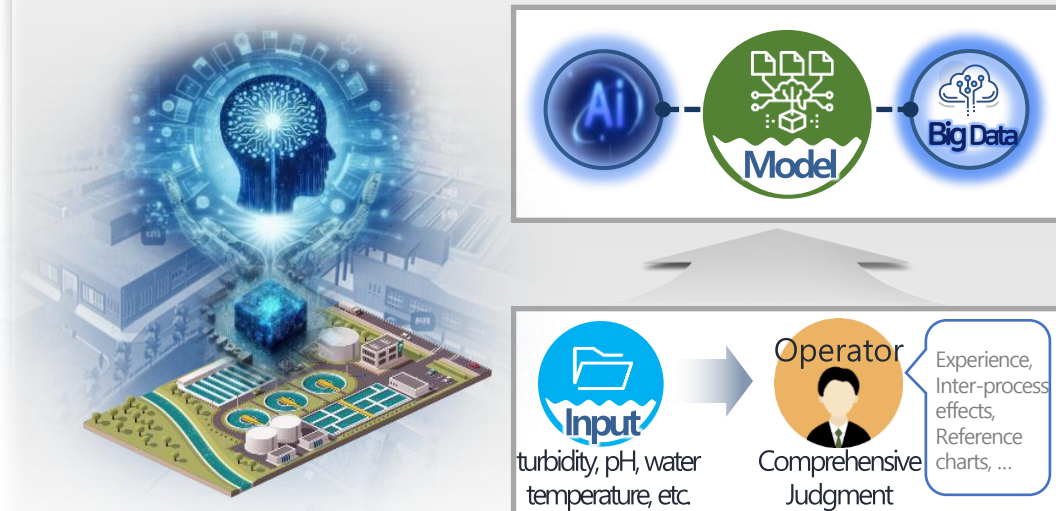# Progress of AI & DT in WTPs

K water

> **Under the Ministry of Environment's「Metropolitan SWM project」,**
> **A next-gen WTP, built on a Foundation of big data·AI·3D·GIS, enable optimal operation and predictive simulation, leading the digital transformation of the domestic water supply**

Smart(AI) WTP

Project Name	Pilot and Expansion of Smart (AI) WTP
Project Budget	$34.6 million (30% government funding)
Project Period	2020 ~ 2024

Input — turbidity, pH, water temperature, etc.

Operator — Comprehensive Judgment

Experience, Inter-process effects, Reference charts, …

Digital Twin for WTP Facilities (DT)

Project Name	Pilot of the Hwaseong WTP DT
Project Budget	$2.16 million (30% government funding)
Project Period	2021 ~ 2024

* 1 USD = 1,390 KRW (As of August 28, '25)

> **A smart WTP that integrates big data and AI with existing human-operated systems**
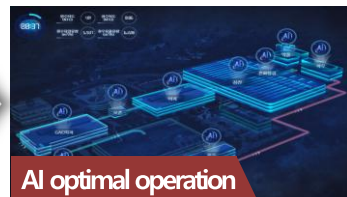
(Four Key Technologies : AI-based Autonomous Operation, EMS, PMS, Intelligent Monitoring)

① Full Autonomous WTP Operation

Reduced chemical & disinfection costs ($1.94M/year)

Human analysis & judgment → AI optimal operation

> **Efficient Process Operation, Zero Human Error**

② Smart Energy Management(EMS)

Reduced electricity costs ($1.44M/year)
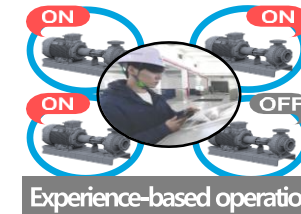
Experience-based operation → Energy consumption optimization
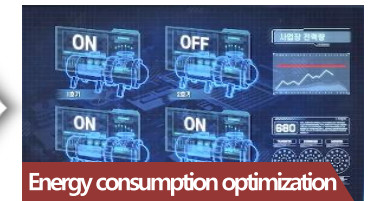
③ Equipment predictive maintenance (PMS)

Reduced inspection costs ($3.15M/year)

Personnel-centered inspection → Real-time monitoring & diagnosis

④ Intelligent Video Surveillance

Prevention of safety accidents ($0.25M/year)

Time required for recognition → Immediate incident awareness

> **Smart Site Prioritizing Safety · Environment**

Outcome "Stabilized process and quality, Zero Human Error" **+** "Reduced production cost ($6.79M/year)" **+** "Accident prevention"

* 1 USD = 1,390 KRW (As of August 28, '25)

① AI Autonomous Operation | AI-based autonomous control of all 8 WTP processes via big data-driven decision-making

Optimal AI operation for the entire process

Autonomous Operation Process

Data Acquisition/Analysis (Real-Time DB)

Big Data → **Operational/Experimental Data** (1~3 years of data)

Real Time → **On-site Measurement Data** (real-time)

AI algorithm analysis/prediction (Every 1~5 Minutes)
Development of Process-Specific AI Models (RF, LGBM, EGB, KNN etc.)

Optimization of Decision-Making →

Autonomous process operation (standalone or integrated)
Control of Valve Opening, Dosing Rates, Equipment Scheduling, etc.

Feedback (real-time data)

Intake | Pre-chlorination | Chemicals | Mixing/Flocculation | Sedimentation | Intermediate chlorination | Filtration | Ozone | GAC Filtration | Post-chlorination | Treated Water

Process	1. Intake	2. Chemicals	3. Mixing/Flocculation	4. Disinfection	5. Sedimentation	6. Filtration, 7. GAC	8. Ozone
DATA	· WTP inflow & outflow volumes · Sedimentation basin operational index · Clearwell Water Level	· Raw water flow rate, turbidity, electrical conductivity, temperature · Settled water turbidity, etc.	· Raw water temperature · Mixing intensity by basin · Coagulation basin value	· Residual chlorine (mixing, basin sedimentation basin) · chlorine injection rate, temperature	· Raw water flow rate, turbidity · Raw water chemical dosage · Sedimentation basin collector status	· Filter basin inflow/outflow rates · Water levels, time, etc. per filter basin · Time-of-use electricity tariff	· Ozone concentration (inlet, intermediate, outlet) · Retention time, etc.
MODEL	· Inflow valve opening prediction · Clearwell water level prediction	· Raw water quality classification · Coagulant injection rate prediction	· Flocculator rotation speed (RPM) determination	· Sedimentation basin retention time prediction · Chlorine evaporation prediction	· Sedimentation sludge generation prediction	· Prediction of required filter basin · Predicted water level per basin	· Residual ozone prediction
AI	Inlet valve openings	Coagulant dosage rate	Flocculator rotation speed	Chlorine injection rate	Sludge collector schedule	Filter basin operation schedule	Ozone injection rate

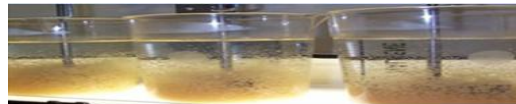**K-water AI WTP Autonomous System**

⦿ AI Autonomous Operation Process for Chemical Dosing

As-Is (Operator)

✓ **Operator injects chemicals based on experience and judgment, informed by in-house lab test**
- **Slow response to sudden water quality changes (takes over 30 mins)**
- **Risk of human error remains present**

Water Quality Analysis	· **In-house Test**(lab test) · Comparison with historical data (reference table)
Dose Determination / Injection	· Reference in-house test results by **operator** · **Manual determination/injection** of chemical dose
Water Quality Check	· **Operator checks water quality status** · Manual adjustment of chemical dose

To-Be (AI Autonomous Operation)

✓ **AI autonomously injects chemicals in real-time based on past big data analysis & prediction**
- **Easily responds to sudden water quality changes (real-time analysis)**
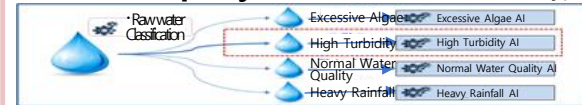- **Zero human error, improved process efficiency**

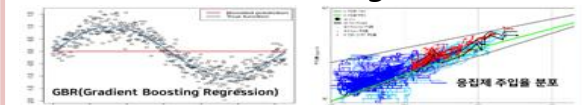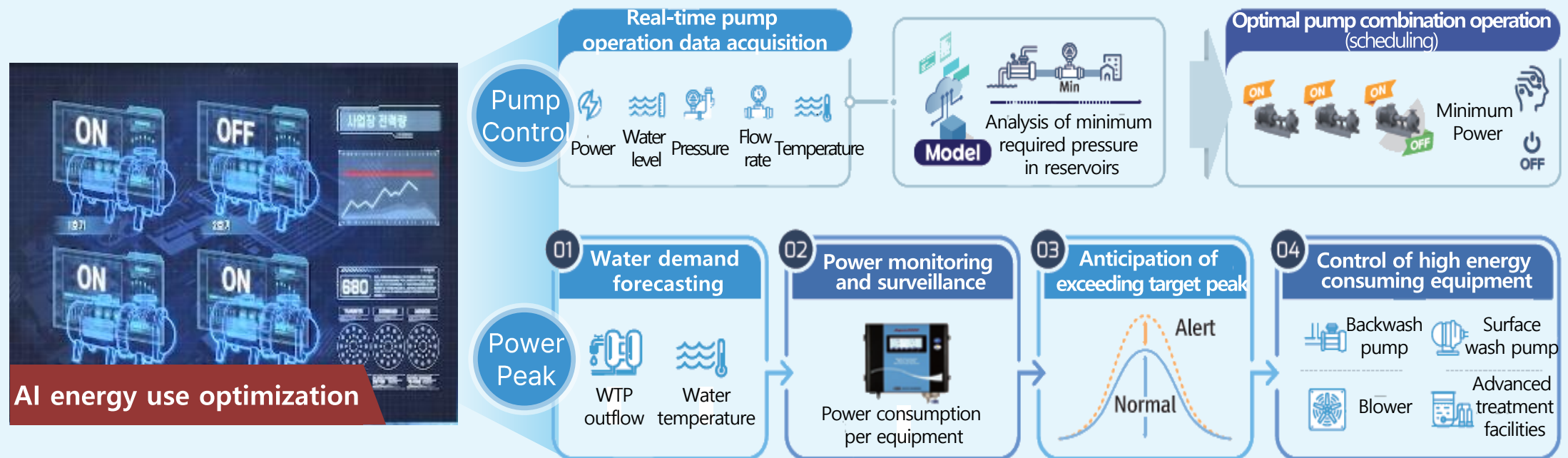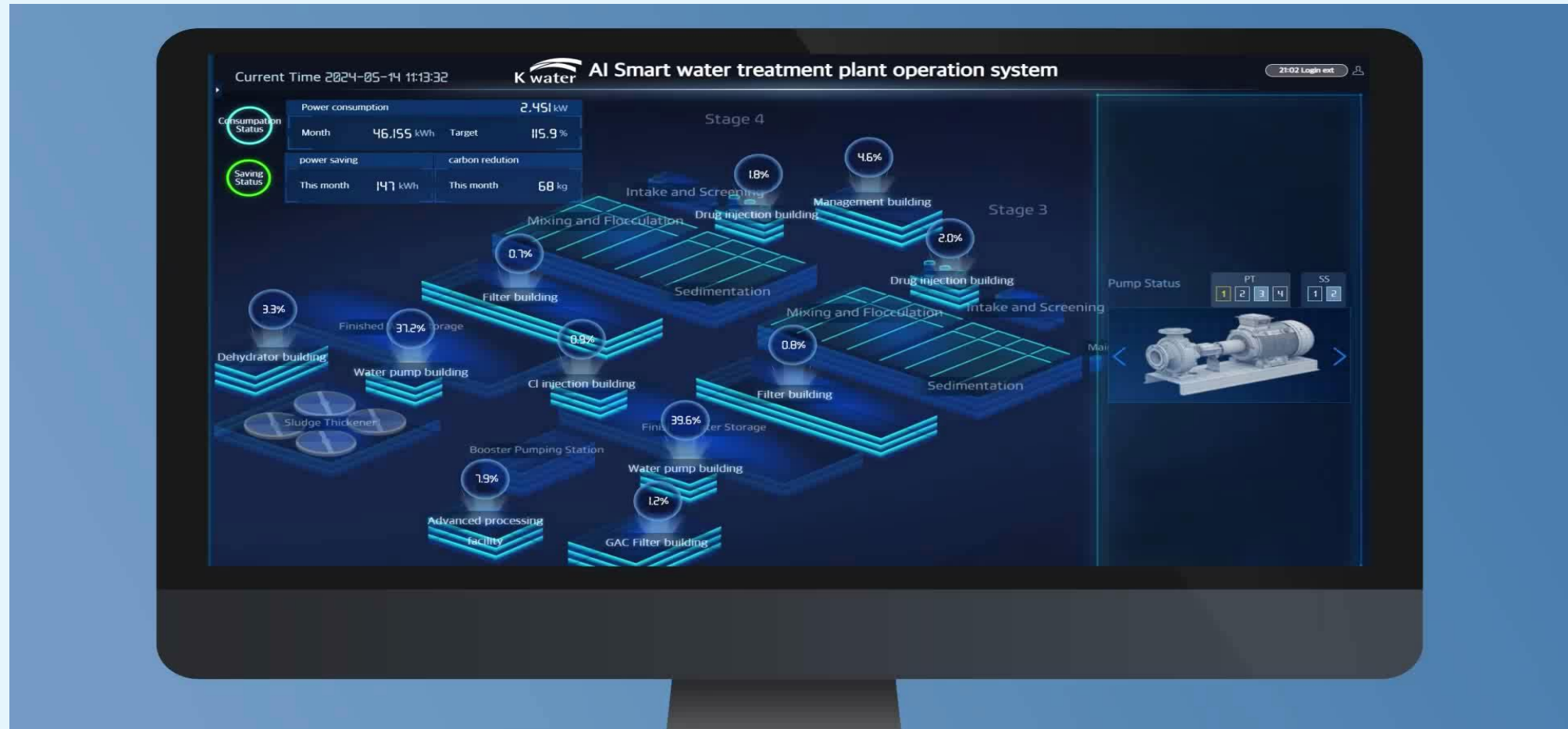| **Raw Water Condition Analysis**		· **Real-time water quality data analysis** (water temperature, pH, turbidity, electrical conductivity)
Autonomous Chemical Injection	**Clustering**	· **Raw water quality cluster classification**(10 types) ·Raw water Classification — Excessive Algae → Excessive Algae AI / High Turbidity → High Turbidity AI / Normal Water Quality → Normal Water Quality AI / Heavy Rainfall → Heavy Rainfall AI
	Prediction	· **Linear and non-linear regression models** GBR(Gradient Boosting Regression) / 응집제 주입율 분포
	Injection	· **Injection rate prediction & auto dosing** AI ➕
Water Quality Check		· **AI monitors water quality condition** · **Auto feedback dosing control**

☑ AI Autonomous Operation
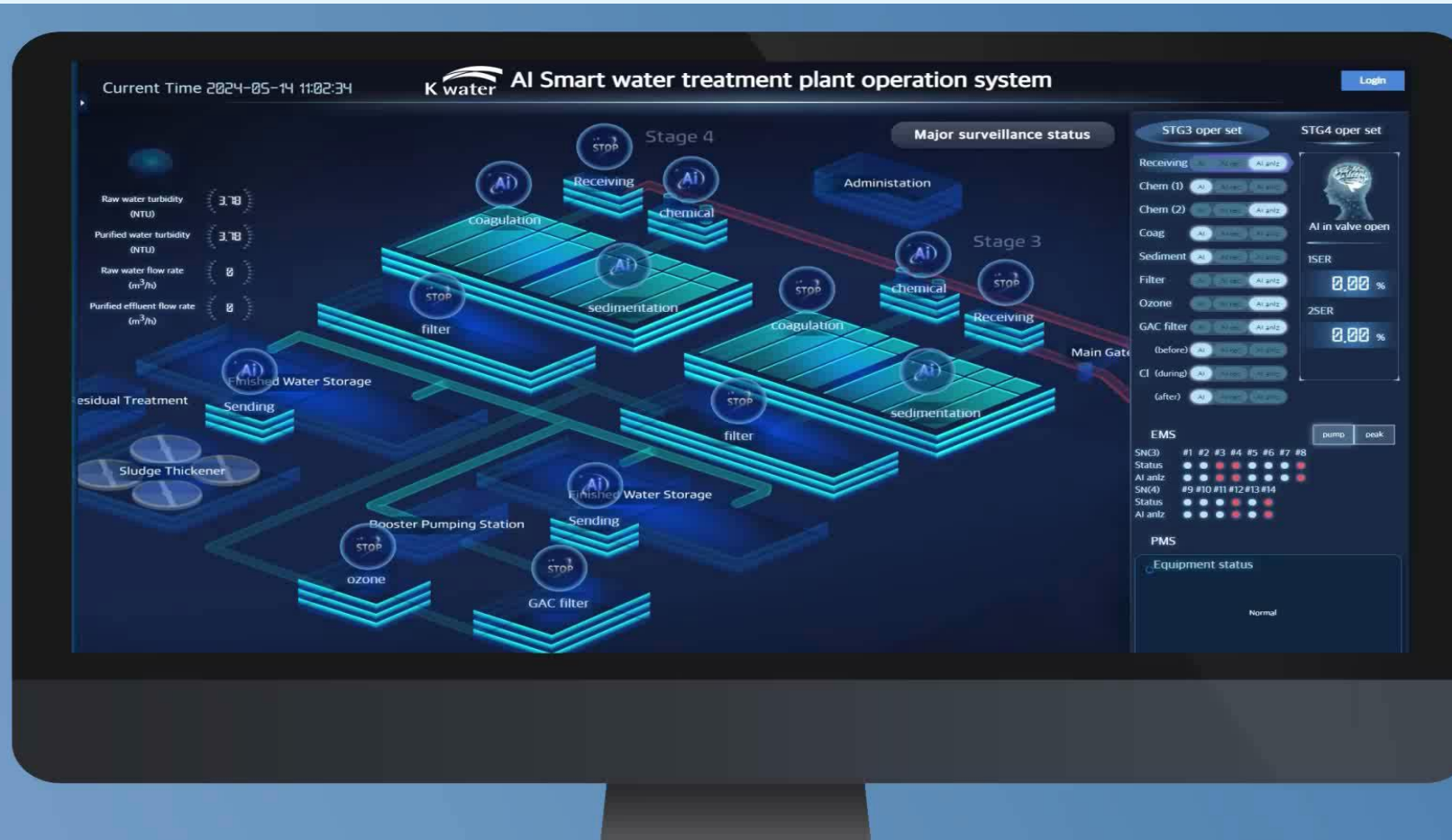
② Energy Management (EMS) | AI based real-time demand & energy analysis for optimal operation planning

- (Pump Control) Optimal pump control using minimum required reservoir pipe pressure

- (Power Peak) Alert triggered when forecast exceeds target peak

AI energy use optimization

Pump Control

Real-time pump operation data acquisition

Power — Water level — Pressure — Flow rate — Temperature

Model — Analysis of minimum required pressure in reservoirs

Optimal pump combination operation (scheduling)

ON ON ON OFF — Minimum Power OFF

Power Peak

01 Water demand forecasting
WTP outflow — Water temperature

02 Power monitoring and surveillance
Power consumption per equipment

03 Anticipation of exceeding target peak
Alert — Normal

04 Control of high energy consuming equipment
Backwash pump — Surface wash pump
Blower — Advanced treatment facilities
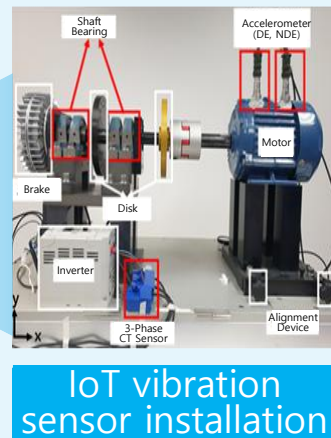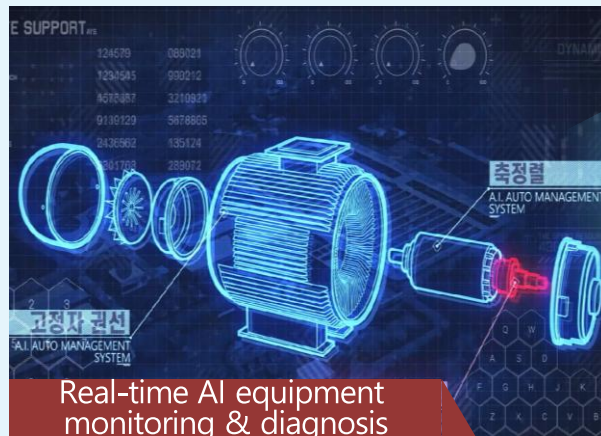
☑ EMS(Energy Management System)

③ **Equipment predictive maintenance** | Real-time IoT sensor analysis for proactive anomaly detection & diagnosis

- (Self Diagnosis) Real-time vibration data analysis to detect faults and identify cases

  * Faults : Shaft misalignment, mass imbalance, impeller defects, motor defects, bearing defects, cavitation

- (Abnormality Detection) Early anomaly detection and alerts from operational data analysis
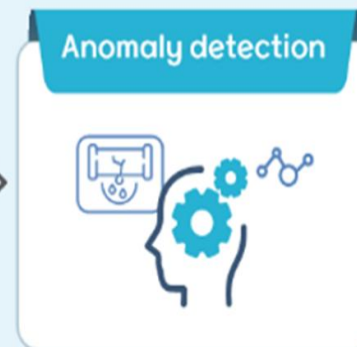

Real-time AI equipment monitoring & diagnosis

IoT vibration sensor installation

Vibration data acquisition

IoT data analysis

Proactive abnormality alerts

☑ PMS(Equipment predictive maintenance)

④ **Intelligent Video Surveillance** — Intelligent CCTV with an AI video analysis algorithm to detect and respond to signs of an accident

- (Equipment Accidents) Fire/smoke, pipe leaks

- (Facility Security) Unidentified person intrusion, loitering

- (Industrial Safety) Falling, distress signals, no insulating gloves, no safety helmet

KISA , KTL Performance certification

Immediate Accident Recognition

Video analytics surveillance sensors > Anomaly detection > CCTV Tracking > Video Display, Alarm
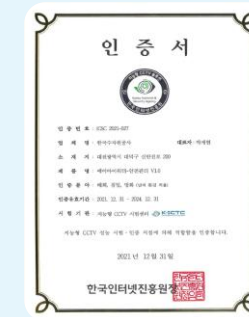
☑ Intelligent Video Surveillance

"Driving step-by-step innovation, from R&D to standardization"

☑ **First Chemical Process Application**
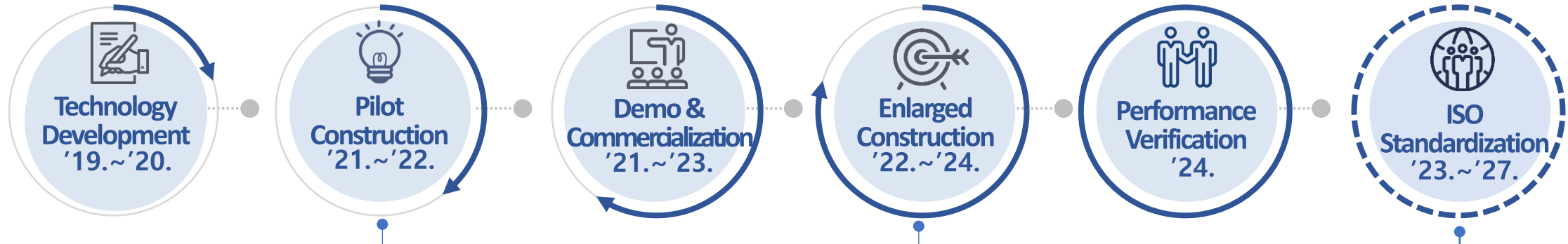
- (Target) Hwaseong WTP,
  (Project Cost) $0.42 Million
- (Effect) Chemical reduction 4%

☑ **Core Tech Patent Filing (4 cases)**

- AI algorithms, operating software, platforms, etc.

☑ **Performance Evaluation Model Development**

- Drive External AI Expert Collaboration
- 5 processes, 5 items

Technology Development '19.~'20.

Pilot Construction '21.~'22.

Demo & Commercialization '21.~'23.

Enlarged Construction '22.~'24.

Performance Verification '24.

ISO Standardization '23.~'27.

☑ **43 Metropolitan WTPs Established Nationwide**

- (Cost) Pilot Project: $2.73 Million, Expansion Project: $31.9 Million
- (Effect) Production Cost Savings : $6.65 Million/year

World's First Construction

Global Recognition

WEF Global Lighthouse Selection

Standard Modeling

☑ **Providing AI WTP Construction Guidelines**

- K-water-led International Standard Development Underway
- National Standard Tech Enhancement Project (MOTIE), $0.68 Million

* MOTIE : Ministry of Trade, Industry and Energy

* 1 USD = 1,390 KRW (As of August 28, '25)

"Implementing real-world facilities in a virtual space to enable monitoring, management, analysis, and simulation functions"

Building a Water Supply Digital Twin

Construct a 3D model for WTP
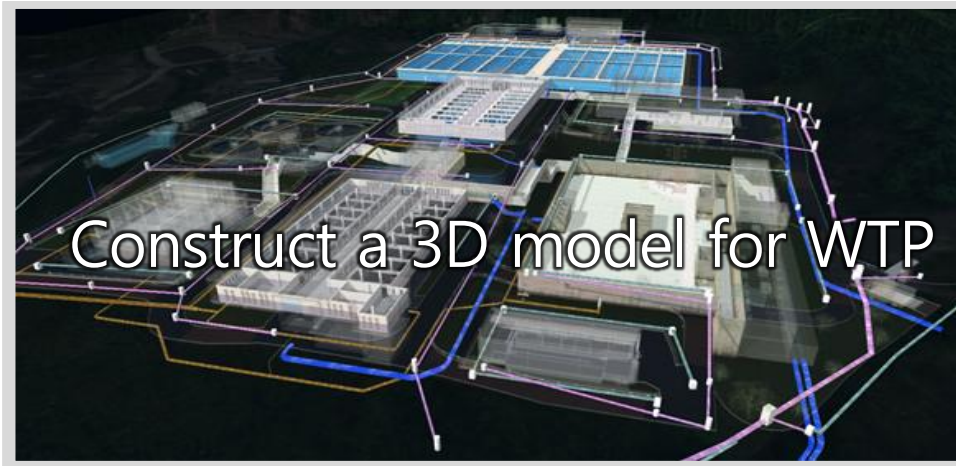
· Construct 3D models of WTP and facilities/equipment

· Intuitive understanding of facility status through 3D

Operation & Maintenance linked to the DT
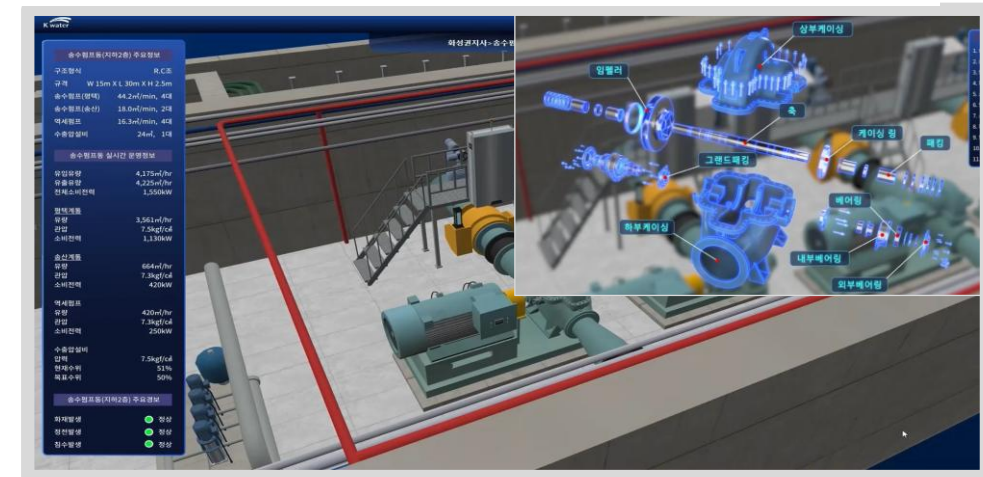
· Facility history inquiry, input and management of inspections and maintenance

· Monitoring operational/status data, timely fault response

Plan "Establishing a decision support system using the Digital Twin(DT)"
* Integrating all SW (monitoring, analysis, simulation, crisis response) into a single platform

Chapter 3

Improvement of Water Infrastructure Based on AI and Smart Technologies

Key Achievements

K water

Significance of technological innovation

- World's first AI tech in water treatment process operation
- Proprietary tech based on K-water's operational big data

Establishment of a digital ecosystem

- 25 patents transferred to 7 private companies
- Global & Domestic market development support
  (e.g., CES, ACE, Water Korea)

External Achievements

Grand Prize at Seoul International Invention Fair	**Selected as a WEF Global Lighthouse**	**the UN SDGs Digital Game Changer Award**	**Top 10 Mechanical Tech of the Year in Korea**	**IR52 Jang Young-Shil Award(108th)**
2023.11.	2024.1.	2024.8.	2024.11.	2025.08.
Recognition of world-class tech in global inventions	World's first in the water field, 4th Industrial Tech Leading Company (4th domestically, 154th globally)	Awarded for innovative, socially impactful 'digital solutions'	Recognized for outstanding technology and innovation (Award level: Korea's first lunar rover, etc.)	New tech & innovative products (Evaluation criteria: Economic feasibility, technological superiority, etc)

" Securing tech diffusion momentum through ISO & digital ecosystem development "

▍ISO International Standards Established

▪ **AI WTP design and technical evaluation methods**
(Target: by 2027 through government-funded project)

Positioning as a super gap tech

Expanding the water industry Ecosystem + Securing Leadership in smart water tech

Leading the global supply of AI WTPs

[Reference: ISO standard development process]

❶ PWI Prepar-ation → ❷ NP New Proposal → ❸ WD Drafting → ❹ CD/DS Committee Approval → ❺ FDIS Final Approval

Current

▍Pursuing OECD BDN (expected acquisition in Nov. 2025)

▪ **"Anticipated as World's First in Water Sector, Korea's First**

* BDN(Blue Dot Network) : OECD certification improving infra efficiency, promoting investment, and tackling global crises

▍Pursuing international standard patents(KIPO)

▪ **Establishing strategies to obtain ISO standard patents**

- (Significance) Securing Korea's tech rights & dominance
- (Duration) Mar. 2025 ~ Dec. 2025 / (Project Cost) $36 K

➡ **Targeting 2 standard patents in 2025, and 10 by 2028**

▍Filing 4 core tech patents & promoting tech transfer

▪ **Fostering a domestic digital ecosystem through tech transfer and collaborative growth**

K-water AI WTP Platform Synergy Creation Participation of SMEs, tech transfer, and co-growth

Participation of 39 ICT SMEs

7 SMEs transferred 25 technologies

Supporting market entry at CES, ACE
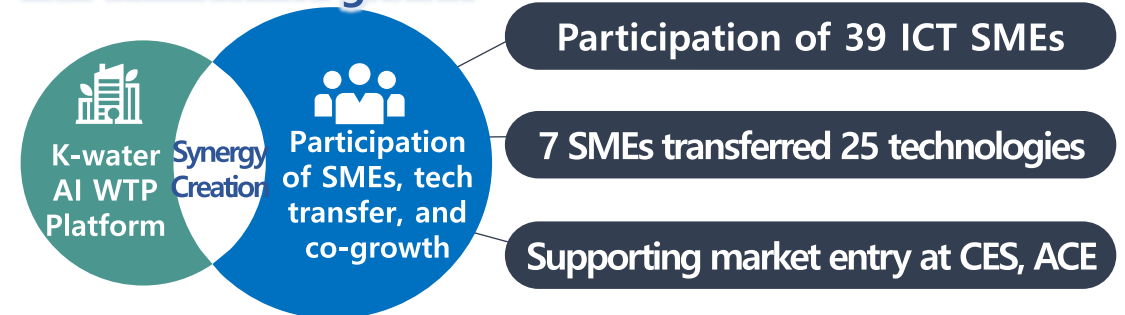
* KIPO : Korean Intellectual Property Office

* 1 USD = 1,390 KRW (As of August 28, '25)

Leading global water market via tech expansion

New Tech Application

Continuously advanced via autonomous robots, carbon neutrality, etc.

K-water AI WTP Tech. Development

Derivative Tech

Applicable to other business sectors.

Tech Export

Tech export potential to ISO member states(173) via ISO standardization.
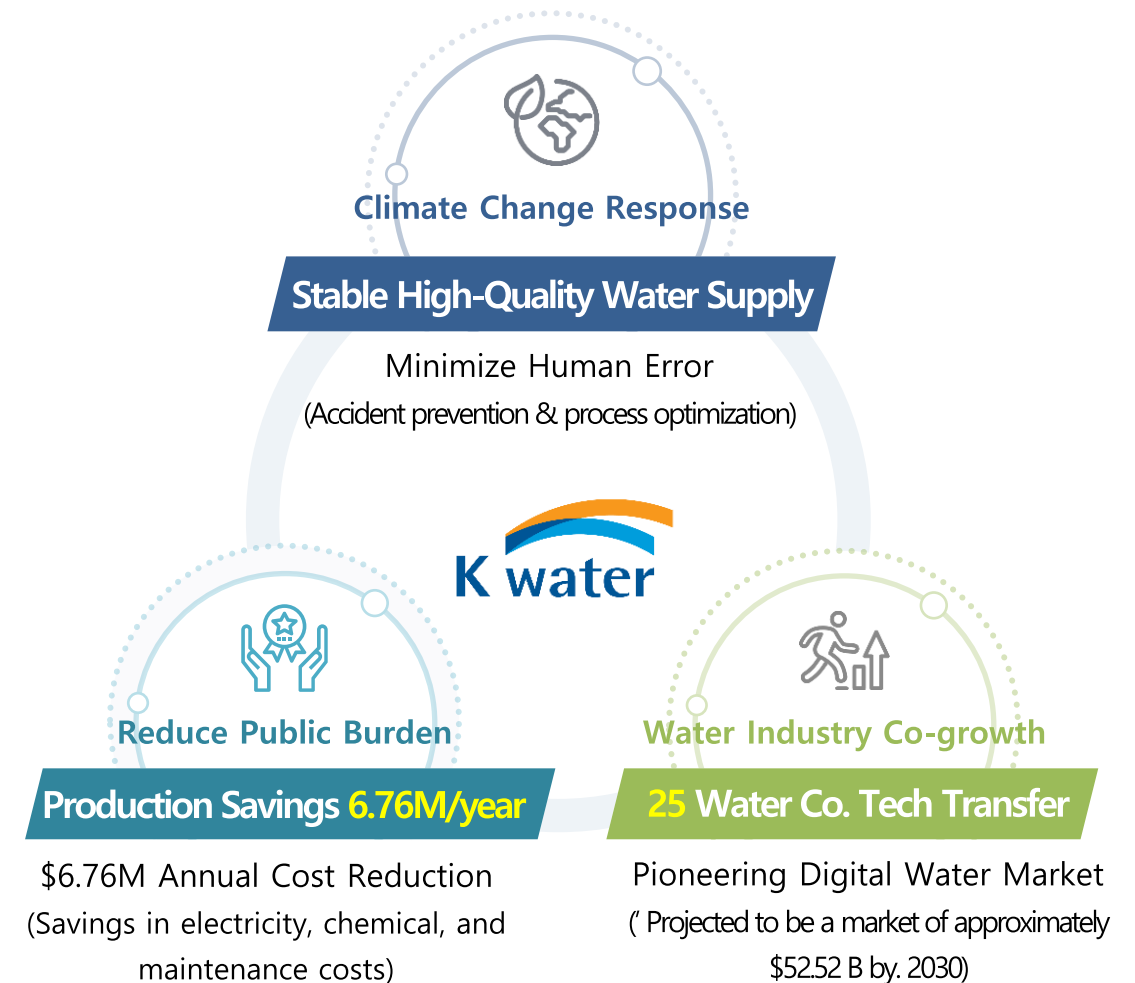
Support AI Adoption in Local Water Supply

Tech Spread

2 Overseas Projects

Expandable as universal tech to local water, sewage, and industrial water.

Master plan for AI integration in local water supply
- (Sep. 2024 – May 2025, $0.11M)
- Definition of AI level and development of evaluation tools

Indonesia New Capital City Project
- ODA Project, $20.5 Million
- Chemical Process, Intelligent Video ($0.29 Million)

Vietnam Long An Water Supply Project
- PMV Water Co. Equity Acquired, $21.29M
- Gov't Shared Growth Project, $0.51 Million

• **Consulting support planned for local governments and Tokyo Metropolitan Government, based on AI WTP requests**

Reducing production costs & enhancing public value

Climate Change Response

Stable High-Quality Water Supply

Minimize Human Error
(Accident prevention & process optimization)

K water

Reduce Public Burden

Production Savings 6.76M/year

$6.76M Annual Cost Reduction
(Savings in electricity, chemical, and maintenance costs)

Water Industry Co-growth

25 Water Co. Tech Transfer

Pioneering Digital Water Market
(' Projected to be a market of approximately $52.52 B by. 2030)

* 1 USD = 1,390 KRW (As of August 28, '25)

Realizing Digital · AI Transformation based DT Platform

Government, Local Government

Linking to G-cloud, and domestic private clouds

AI Decision Making

Monitoring · Operation

Assets Management

Digital Twin

VR·AR

Domestic Expansion

Drone · Robot · Mobile

K-water Digital Platform
(General-purpose Platform)

Overseas Expansion

Monitoring ·Simulation

Cloud(infra-Virtualization)

Data Center

Government, Corporations

Linking to domestic & international private clouds

Thank you.

K water