

Challenges and Opportunities in Mainstreaming and Implementing the Water-Energy Nexus in Korea

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The World - Korea



Korea



Population :

51.6 Million – SOUTH
25.6 Million – NORTH

For Last 40 years in Korea

1. Population Growth (35 M to 52 M)
2. Economic Growth & Industrialization (US \$1,000 to US \$30,000)
3. Urbanization (50% to 93%)
4. Climate Change (Temperate to Subtropical)

What Korea has done and learned in

Water and Sanitation

Dams and Reservoirs for Water Resources

Total **17,491** Dams and Reservoirs

90 Dams for Drinking/Industrial/Hydro power (78%)

17,401 Reservoirs for Agriculture (22.0%)

Current Status of Korean Water Works

Drinking Water Supply

- 1st Drinking Water Treatment Plant (DWTP)(1908)
- Currently **499 DWTPs** in Korea (2016)
- National Service Rate = **98.9%**
- National DW Standards = **61 items**
- From Sand Filtration to Membrane Process
- O&M by Municipal Gov't (100%)

Current Status of Korean Sewage Works

Sewage Treatment

- **1st Sewage Treatment Plant (STP) in Korea (1976)**
- Currently **625 STPs** in Korea (2016)
- STP Effluent Standards = **6 items**
- National Service Rate = **92.9%**
- From Conventional Process to Tertiary Process
- O&M by Municipal Gov't (35%) vs Private Sector(65%)

STP Effluent Standards in Korea

1978

Env.
Protection
Law

1994

Water
Quality
Control
Law

2001

Water
Quality
Control
Law

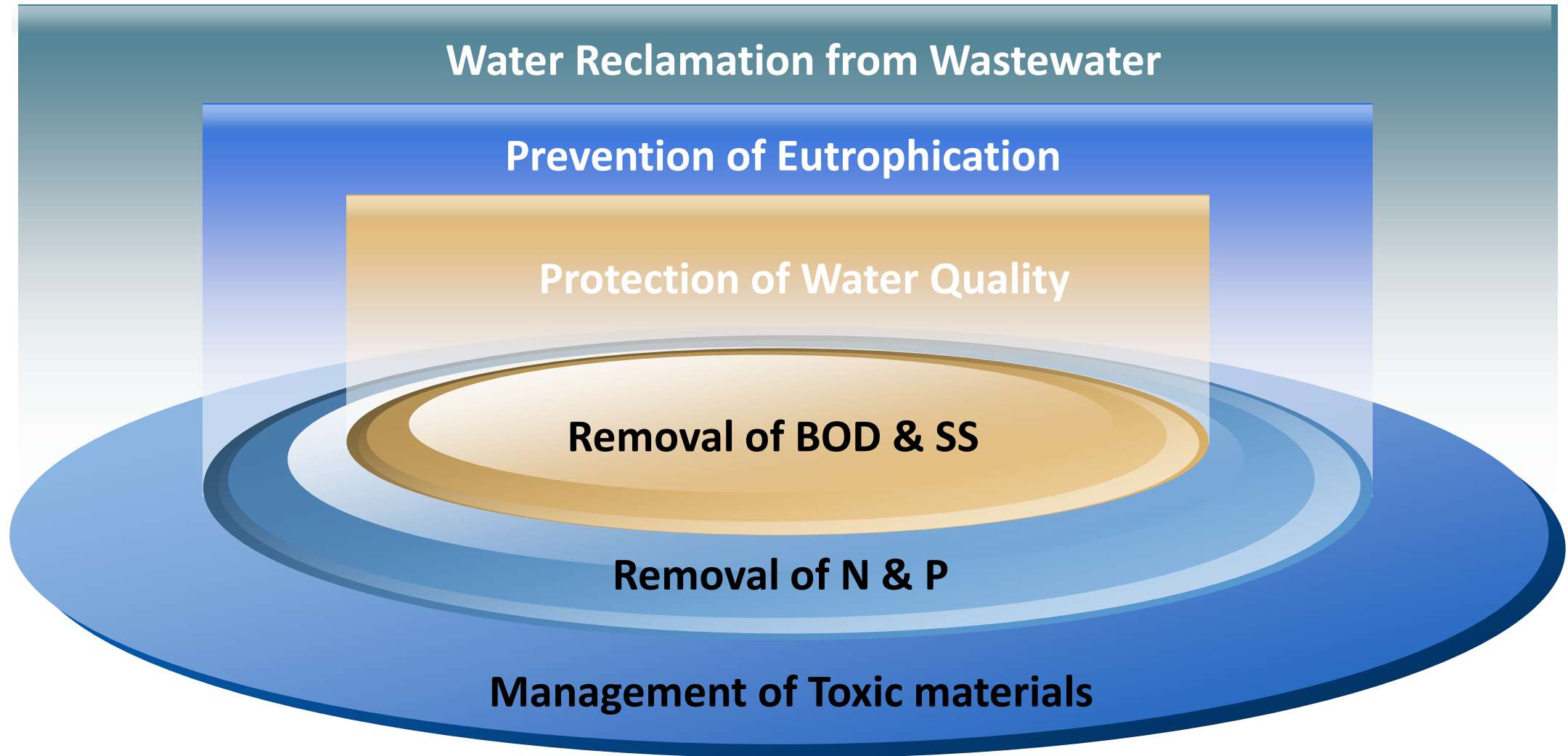
2008

Sewerage
Law

2012

Sewerage
Law

Advancement of Sewage Treatment



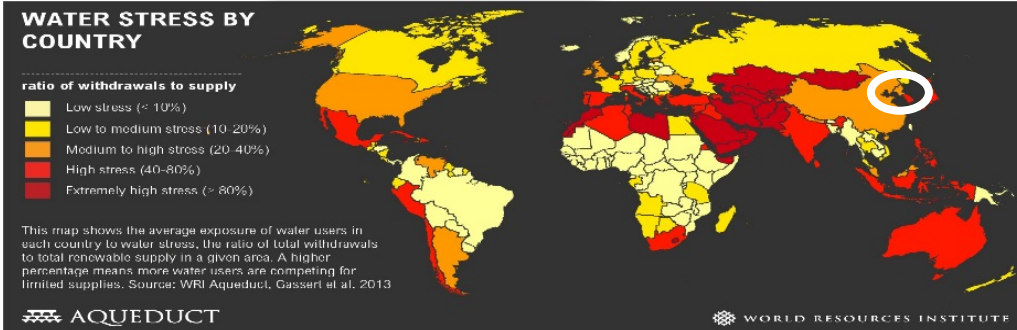
National Water R&D Program in Korea

- **G7 Project (1992-2001)**
- **Eco-STAR Project (2001 – 2011)**
- **Eco-Innovation Project (2011-2020)**

Needs of the W-E-F Nexus in Korea

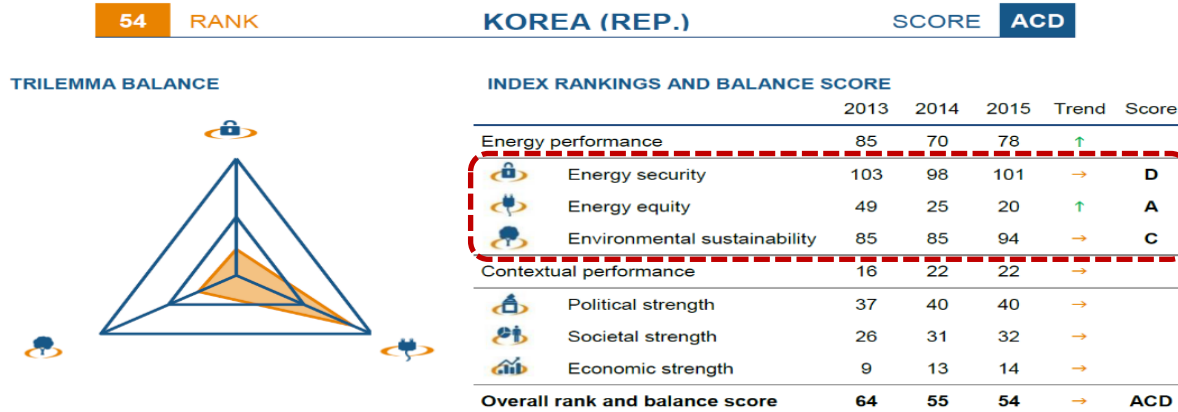
Security of the W-E-F in Korea

Water Security



- Increase in rainfall intensity, duration and frequency of floods due to climate change
 - ✓ Increase of flood/drought uncertainty
- Warming due to rising temperature and deteriorating water quality and water environment
 - ✓ Difficulty in securing clean water available

Energy Security



- Energy production structure highly dependent on foreign countries
- Need to develop and utilize new and renewable energy for reduction of CO2 to meet the national GHG goals.

Food Security

G20 Countries Food Security Index (total 100)



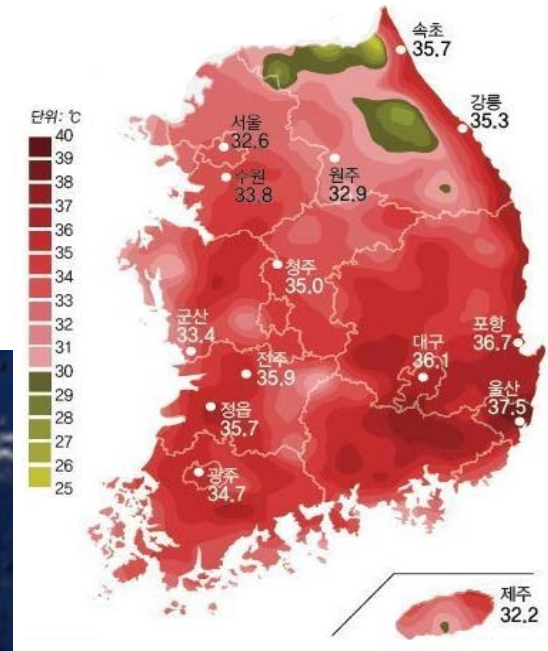
- Food self-sufficiency rate 47.2%
- Lowest rank among OECD
- Domestic food production threat due to less competitiveness in the food sector
- Estimated instability of future food security

Water-related Disasters

The Worst Drought in 124 years (2015)



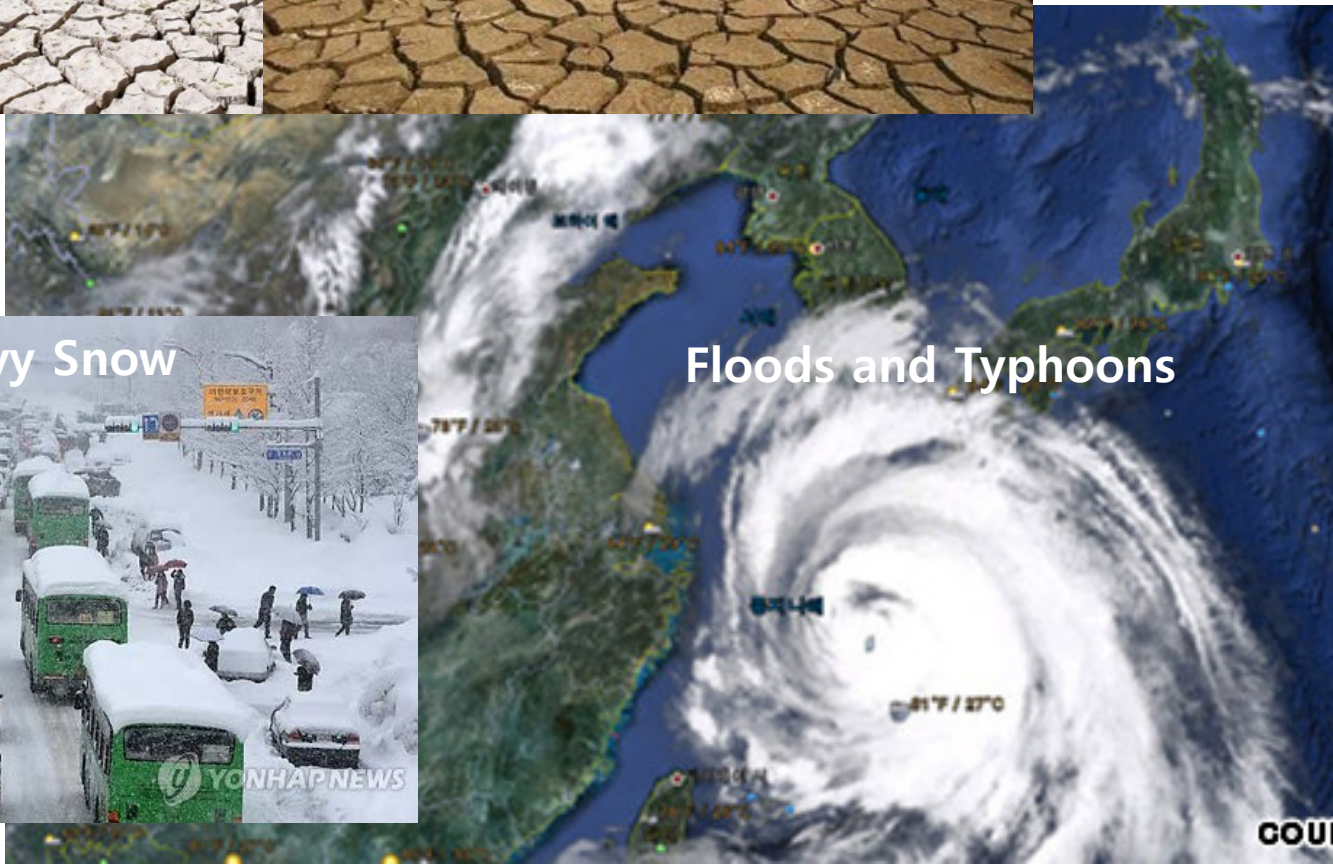
Abnormal Heat Waves



Heavy Snow



Floods and Typhoons



Algal Blooms



COURTESY GOOGLE EARTH

Example Cases of the **W-E-F Nexus** in Korea

Multipurpose Use of Hydropower Dams (Water-Energy Nexus)

Multipurpose dam (1)

water supply
flood control
electricity generation
(K-water)

Hydropower dams (5)

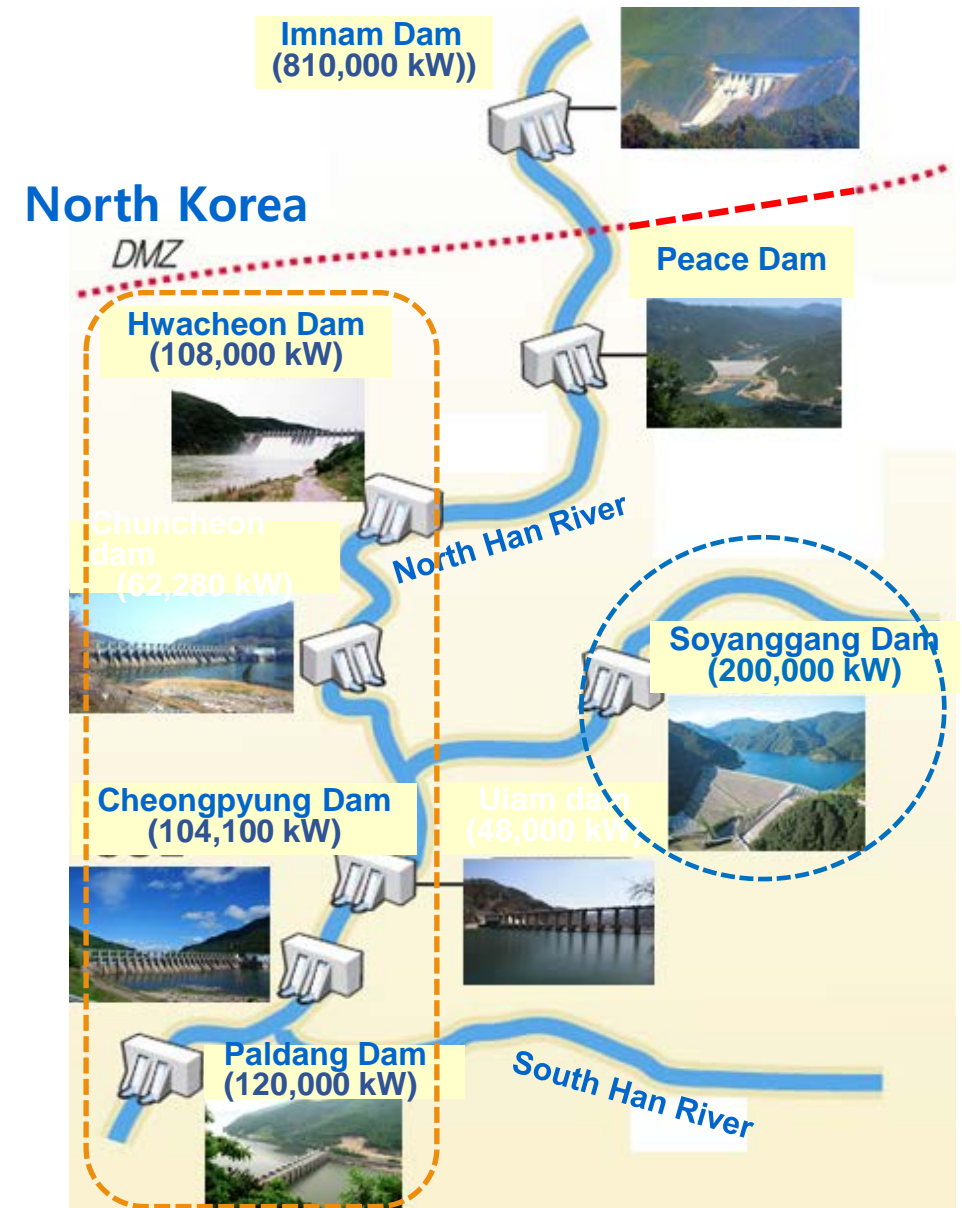
electricity generation
(Korea Hydro & Nuclear
Power Co.)

Water-Energy Nexus

- Change priority of hydropower dam operation for integrated water resources management & multipurpose
- water supply & flood control **>** electricity generation

Outcomes

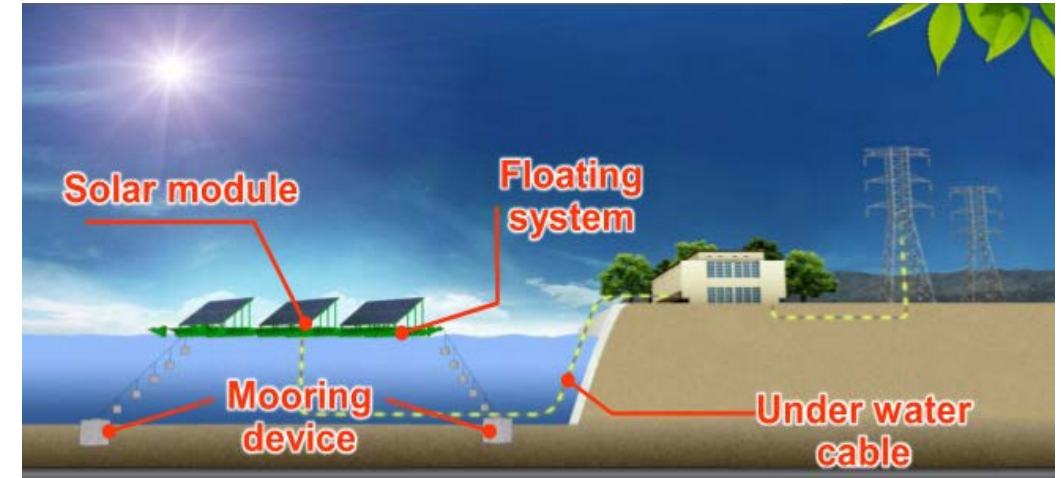
- additional water supply: 880 million m³/yr
- additional flood control: 240 million m³/yr



Floating Photovoltaic Solar Power (Water-Energy Nexus)

- Floatovoltaics

- convenient to install in areas with limited land availability.
- in general the cost of water surface is much lower than the cost of land.
- many places around the world that do not have available land for PV installations



Hapcheon Dam (500 kW/ 718 MWh/yr, 2012)

- Floatovoltaic potential capacity in Korea: 5,483 MW

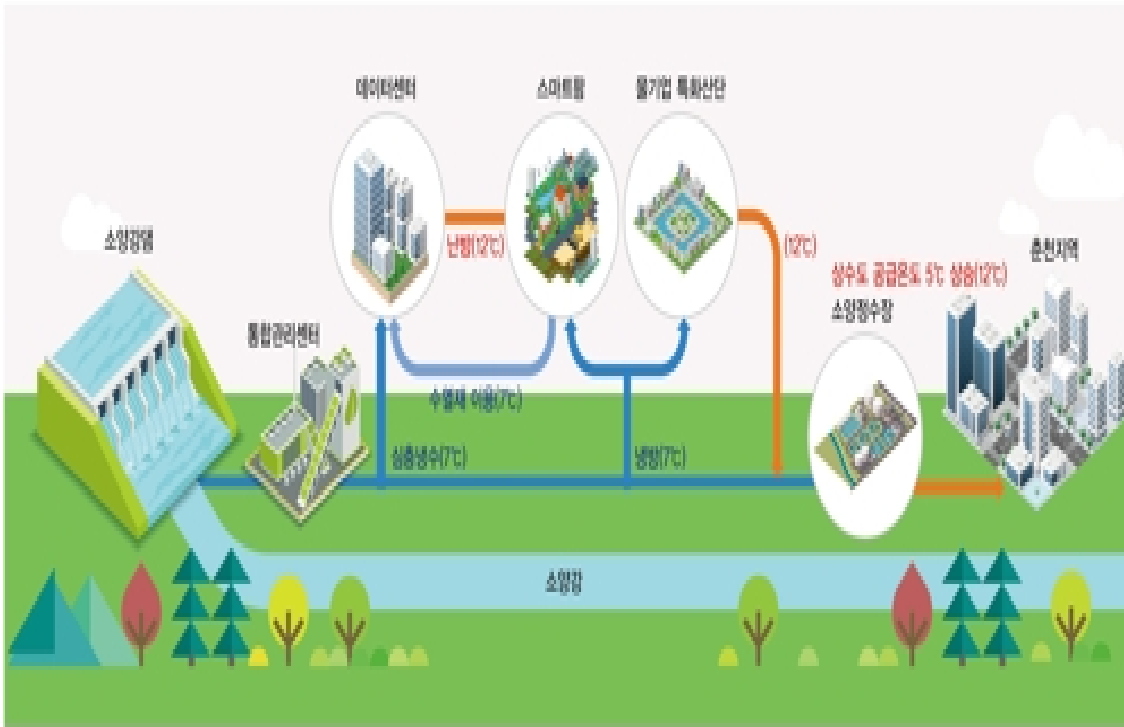
- ✓ 2018: 40 MW in Hapcheon Dam (K-water)
- ✓ 2022: 1,200 MW at 12 reservoirs (K-water)

40 MW
(world largest)



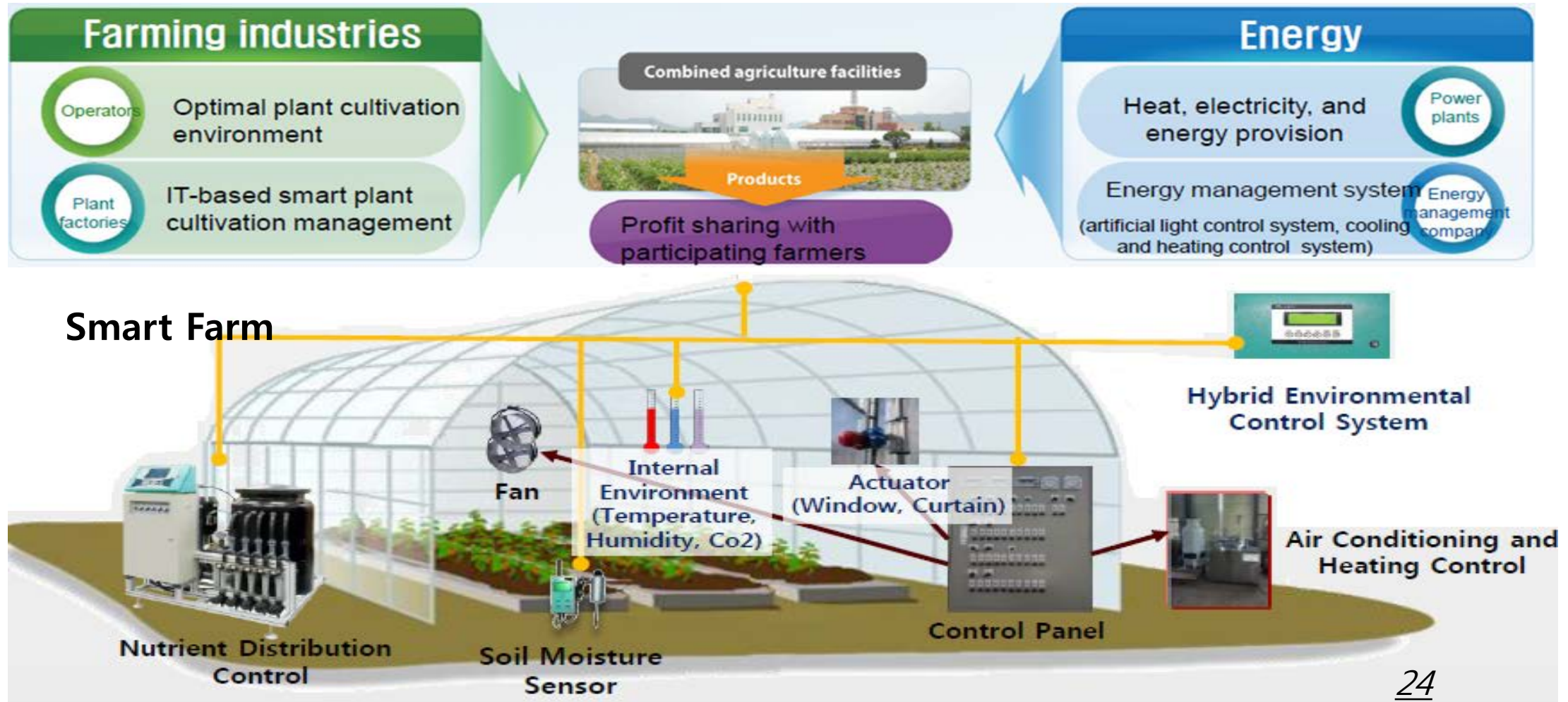
Water Cooling (Dam or Reservoir water) (Water-Energy Nexus)

- ✓ Producing renewable energy by utilizing the constant temperature dam water
- ✓ For Soyanggang Dam, water supply for cooling of the large Internet Data Center(IDC) and again reuse of cooling water for cooling and heating of smart farms in Chuncheon city



Smart Farms (Water-Energy-Food Nexus)

- ✓ Warm coolant wasted from power plants to be used by nearby farming and fishery industries to reduce fuel costs and environmental impact



Water – Heat Pump System (Piped water)

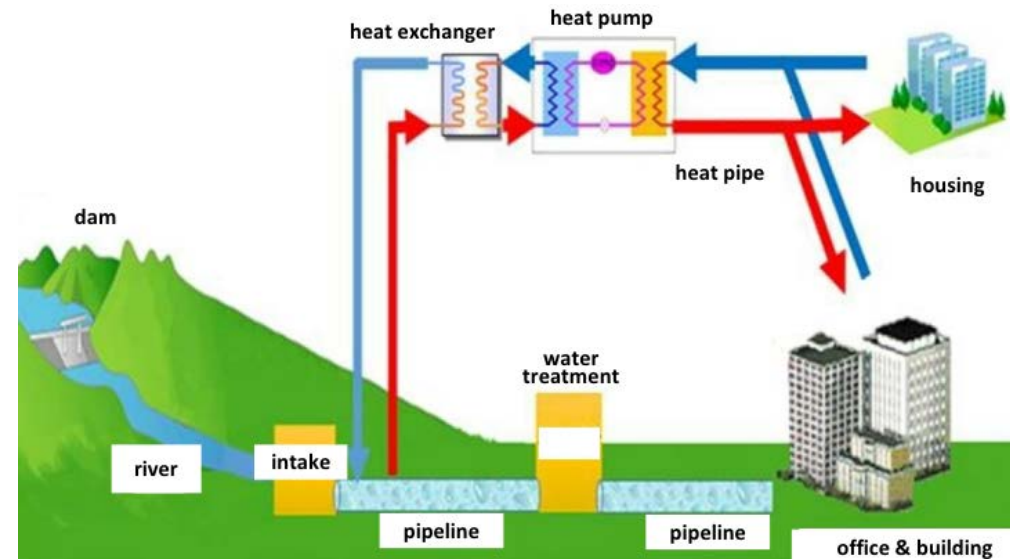
(Water-Energy Nexus)

Heat pump system using raw water from water supply system

- ✓ The raw water temperature is lower than air temperature in the summer, but higher than in the winter

Lotte World Tower

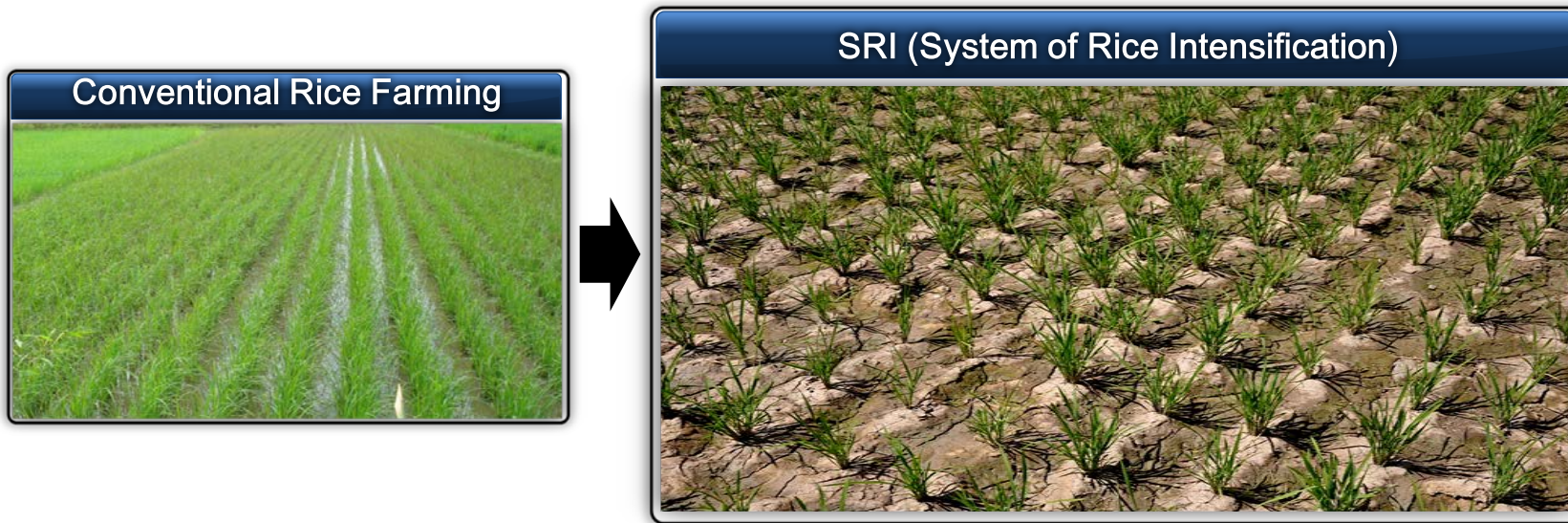
- Height: 556 meters and 123 stories
- **Heating & cooling system** using raw water (50,000 m³/d) from the Seoul Metropolitan water supply pipeline
- Reduce heating & cooling costs by 20% compared to fossil fuel



System of Rice Intensification(SRI)

(Water-Food Nexus)

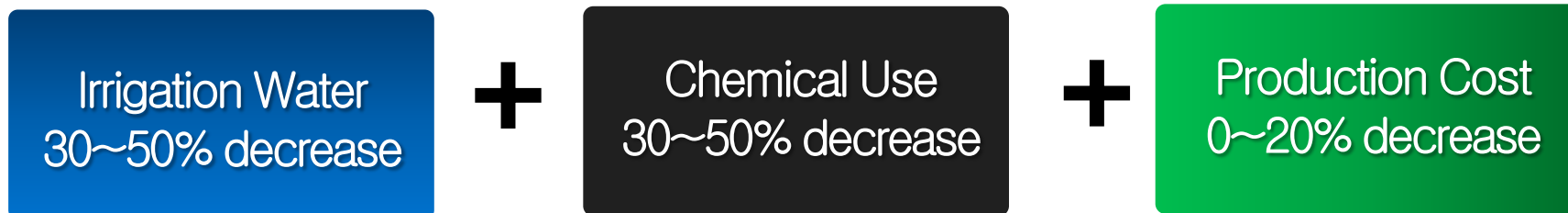
- SRI is an innovation paddy cultivation method to increase rice yields with less water and agro-chemicals
- SRI is currently practiced in over 40 countries in the world



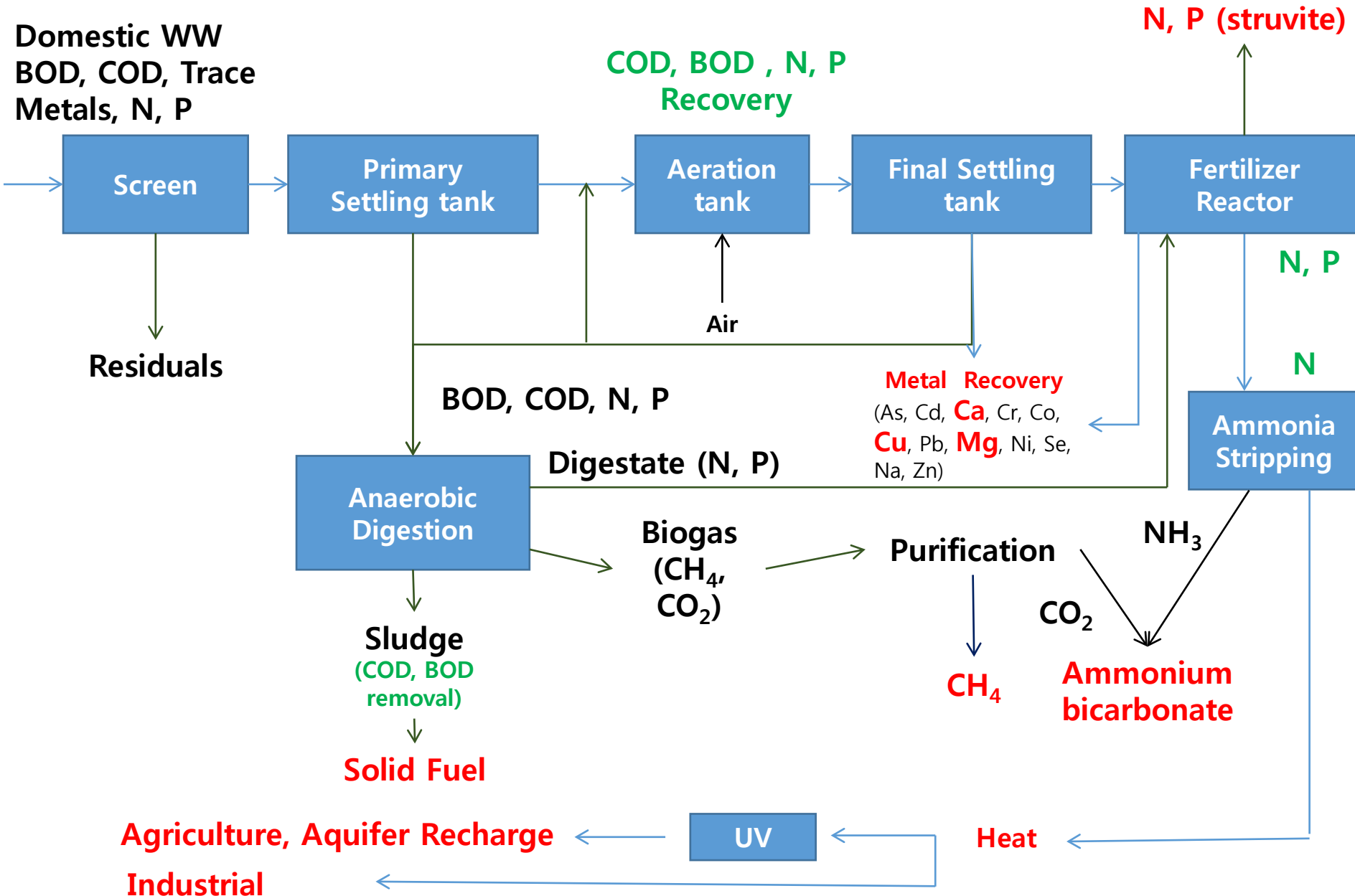
6 Main Practices of SRI

- a. Single plant/hill
- b. Transplant young seedlings (2 leaf stage)
- c. Wide spacing-planting in a grid
- d. **Minimum water application during vegetative growth**
- e. Assure soil aeration
- f. Use organic amendments as base fertilization

Benefits of SRI



New Paradigm **Resource Recovery** Wastewater Treatment



**Pollution
Eliminator**

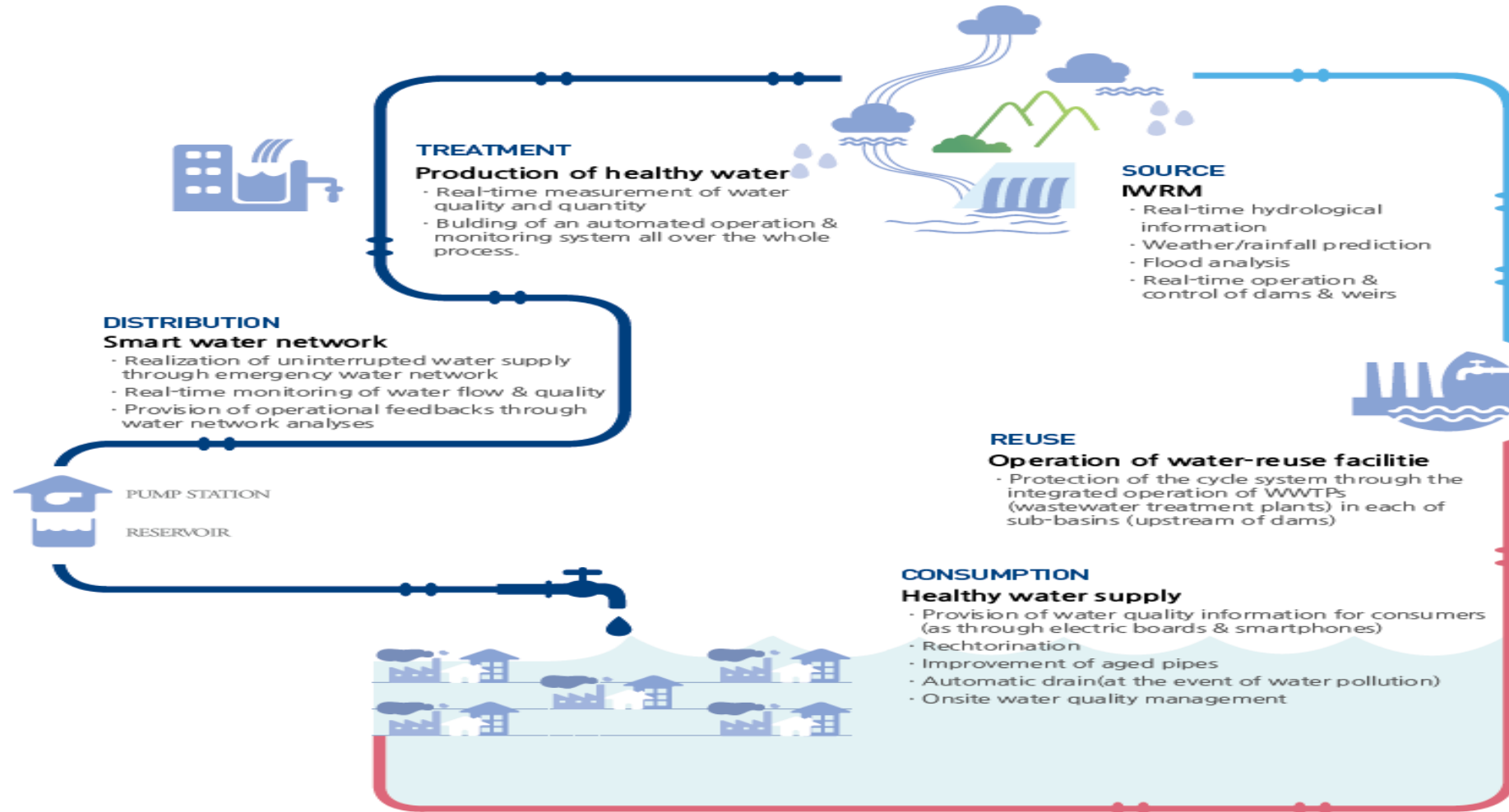


**Product
Producer**

**Organics
N
P
Micropollutants
Biosolids**

**Biogas
Heat
Fertilizers
Chemical raw materials
Electricity**

Demonstrate and Deploy “Smart Water Management Initiative” (SWMI)



Issues & Challenges in Korea

- 1. Aging system requires rehabilitation**
- 2. Standards are getting stringent**
- 3. Self-sufficient energy system is required**

Opportunities for Improvement in Water & Sanitation

1. Water Efficiency (Urban, Industrial, Agricultural)
2. Energy Efficiency in Water & Sanitation (W-E Nexus)
3. 4 Rs (Reduce, Reuse, Recycle, Recovery) in Water & Sanitation
4. Smart Water Management (IOT, Big Data, AI, Cloud)

**Last 40 years
for Water and Sanitation in Korea**

We did it

Together, we can do it

Thank you

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