## ITU Regional Workshop on “Prospects of Smart Water Management (SWM) in Arab Region”
## Khartoum-Sudan, 12 December 2017

# Water Resources Challenges & Opportunities

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ITU expert

# Outline:

## Facts & Challenges

- Water Resources & Climate Change
- Water Industry

## ICTs in Smart Water Management

- Smart Water Supply System
- Smart Stormwater System

## Smart Water Supply System

- Smart Real Time Monitoring & Automatic Controls for Water Resources
- Smart Water Loss Detection & Control (Physical & Commercial)
- Smart Water Recycling
- Smart/Efficient Water Irrigation, Smart Water Agriculture, and Smart Water Industrial
- Smart River Bank Filtering System
- Smart Water Infrastructure Asset Management
- Energy Efficiency In Water And Wastewater Systems
- Integrated Water Resources Management (IWRM) & Urban Water Efficiency (UWE)
- Water Regulatory Efficiency

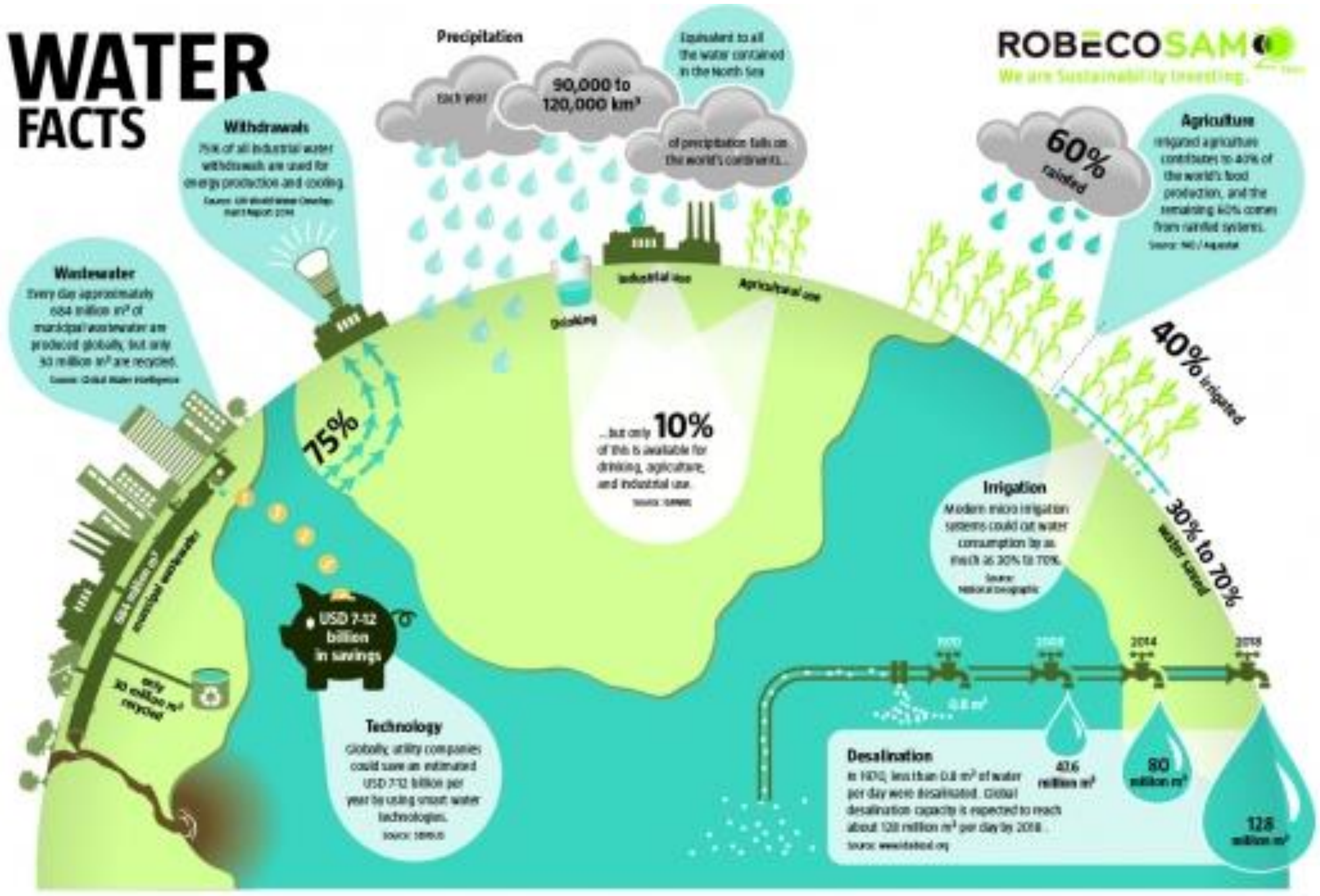
## Smart Stormwater System

## Integrated Enterprise Web and Mobile Based ICT Smart Water Management

- Smart Water Grid (SWG)
- Enable Robust Management of Big Data

## Benefits of ICT in the Water Industry

# Facts & Challenges



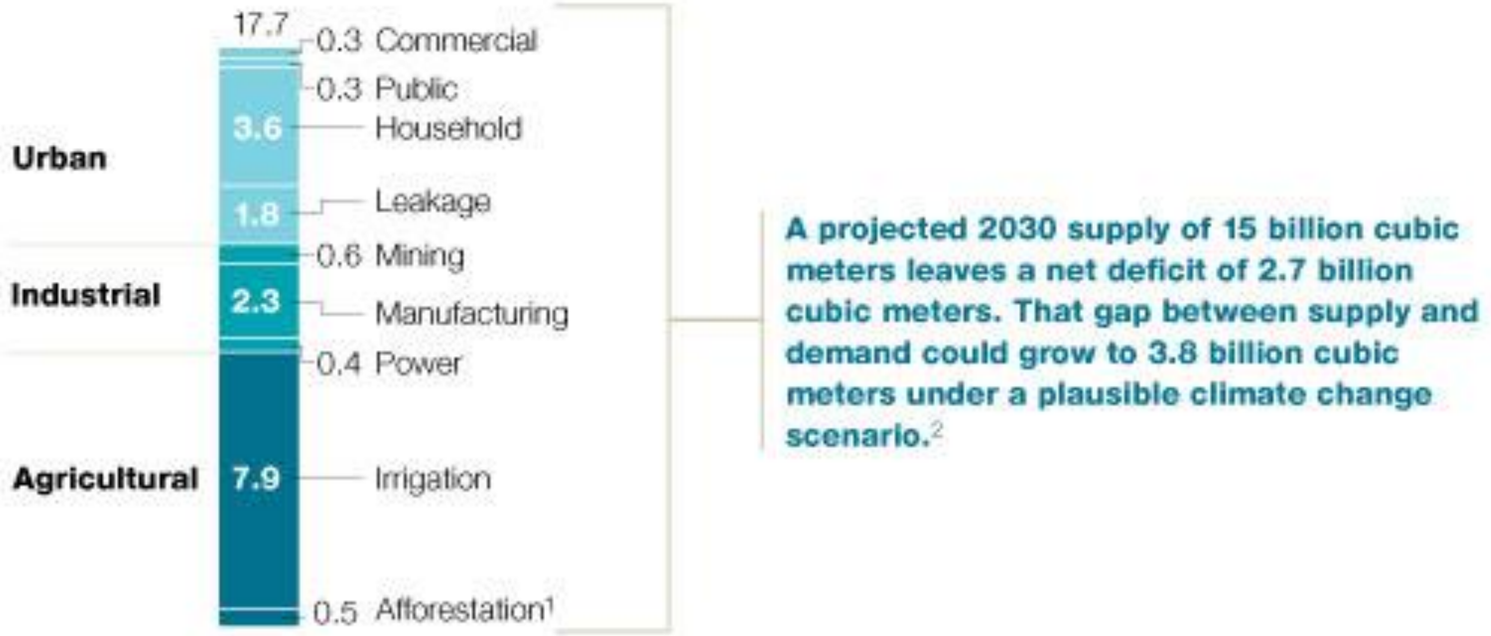
## Facts & Challenges

Driven by;

- Increasing populations (200,000 a week),
- Growing urbanization,
- Changing lifestyles, and
- Economic development,

The total demand for water in urban areas is rising dramatically.

Estimated 2030 water demand, billion cubic meters

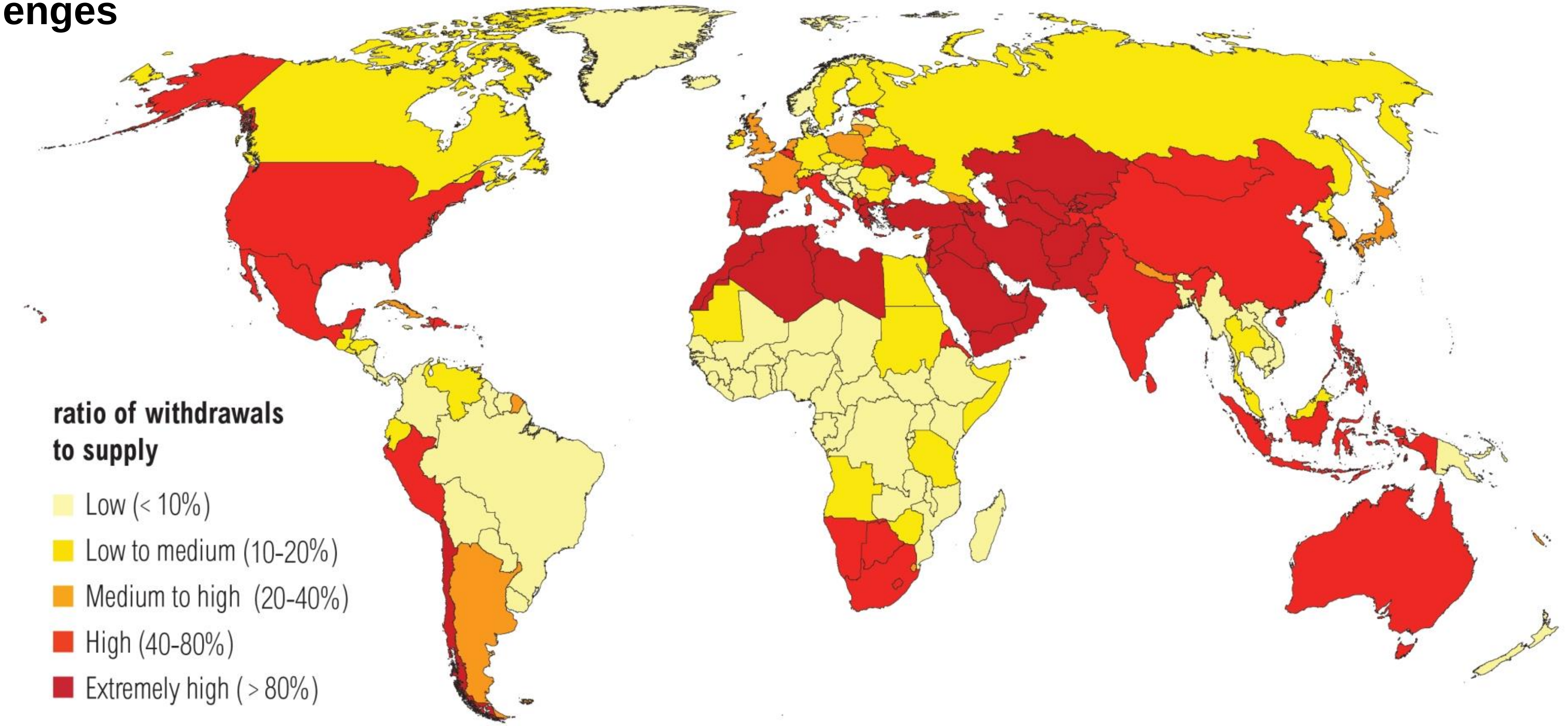



[1] Afforestation is considered a demand, as it reduces the supply available for delivery to reservoirs and then to demand centers.
[2] Assumes yield of existing supply sources drops by 10%, effective rainfall drops by –3%, and irrigation requirements increase by 10%, compared with today.

Source: *National Water Resource Strategy*, September 2004; McKinsey analysis

Facts & Challenges

# Water Stress by Country: 2040



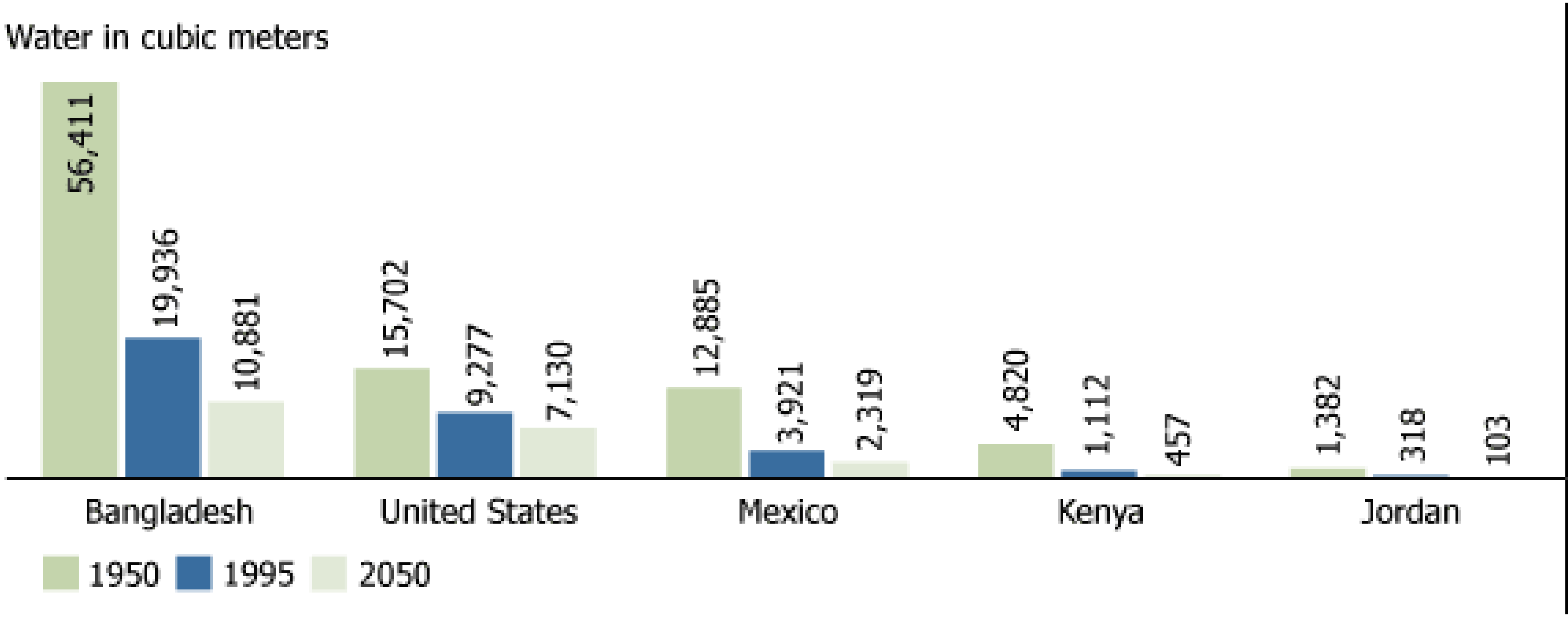

**NOTE:** Projections are based on a business-as-usual scenario using SSP2 and RCP8.5.

For more: ow.ly/RiWop

WORLD RESOURCES INSTITUTE

Facts & Challenges

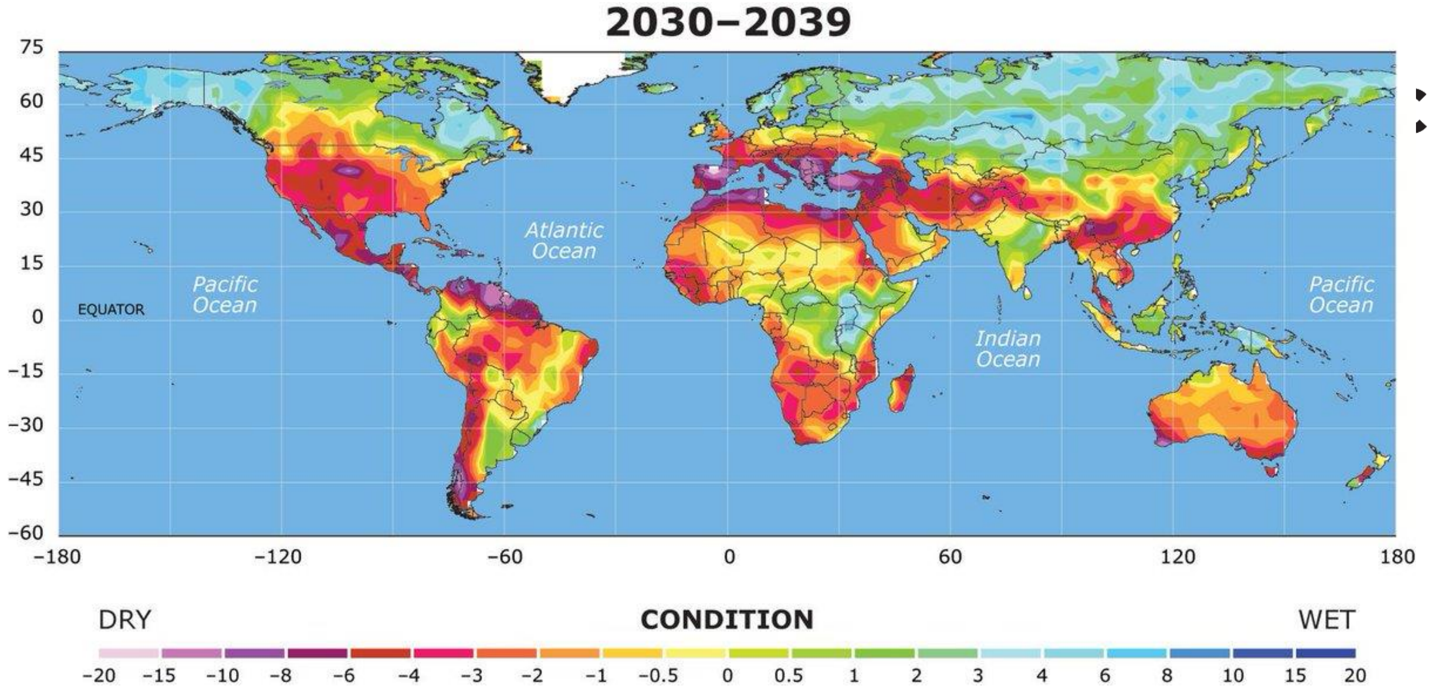
According to a World Bank study (2007), the renewable fresh water availability per capita is expected to halve by 2050 (relative to 2007).




**Annual Renewable Freshwater Availability per Capita, 1950, 1995, 2050**

**Source:** Population Action International, Sustaining Water, Erasing Scarcity.

**Facts & Challenges**




Climate change and global warming will make many regions hotter and drier.

Ecological risks & greenhouse gas emissions.

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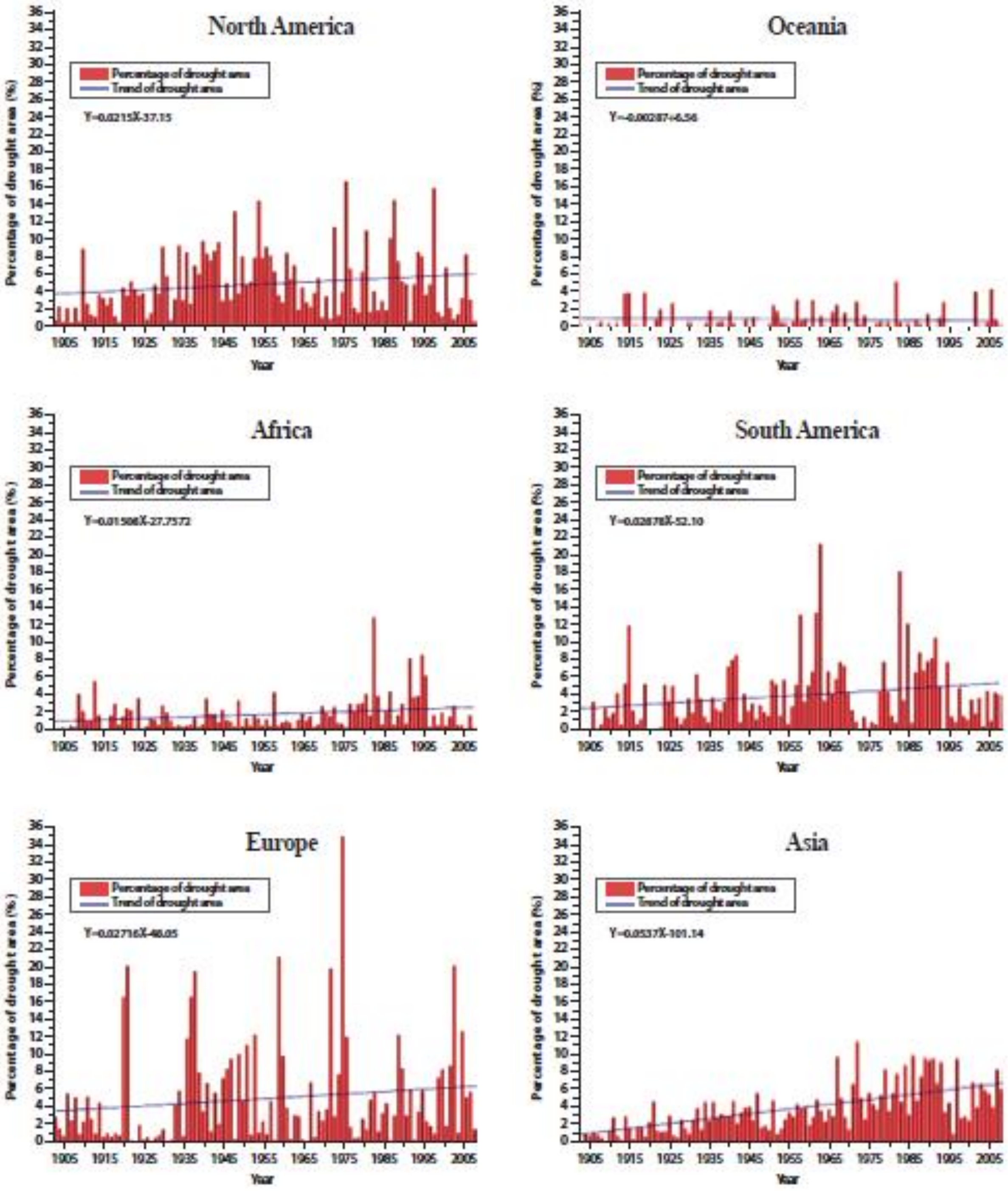


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Climate change effects; Droughts, Desertification, and Urban Flooding,….,etc.

The red histogram represents the inter-annual variability of the severe drought area for each continent during the period from 1902 to 2008; the blue line represents a changing trend of severe drought area) (Wang et al. 2014)

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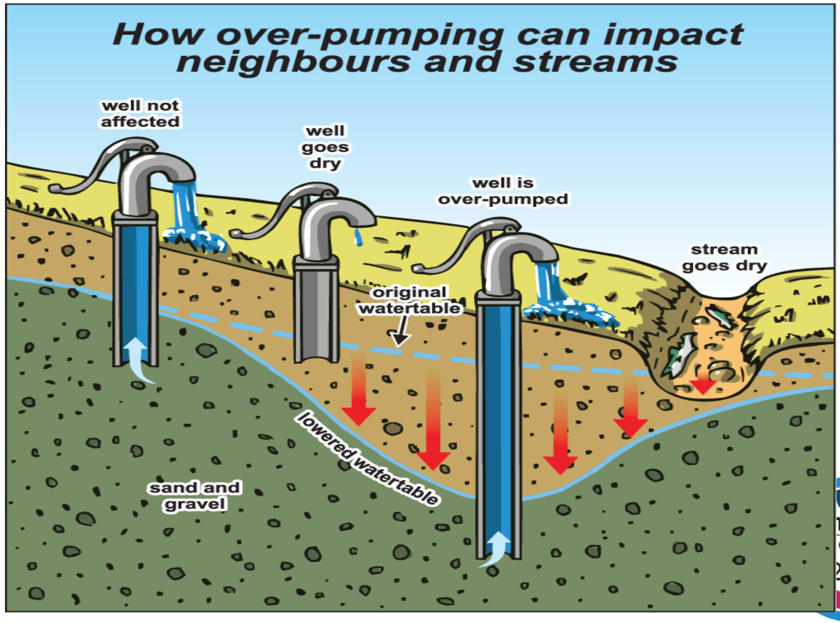
**Facts & Challenges**

**No**….regular and/or real time monitoring, diagnosis, modeling, automatic controls for water resources (surface and groundwater)




Excessive extraction of groundwater

Facts & Challenges

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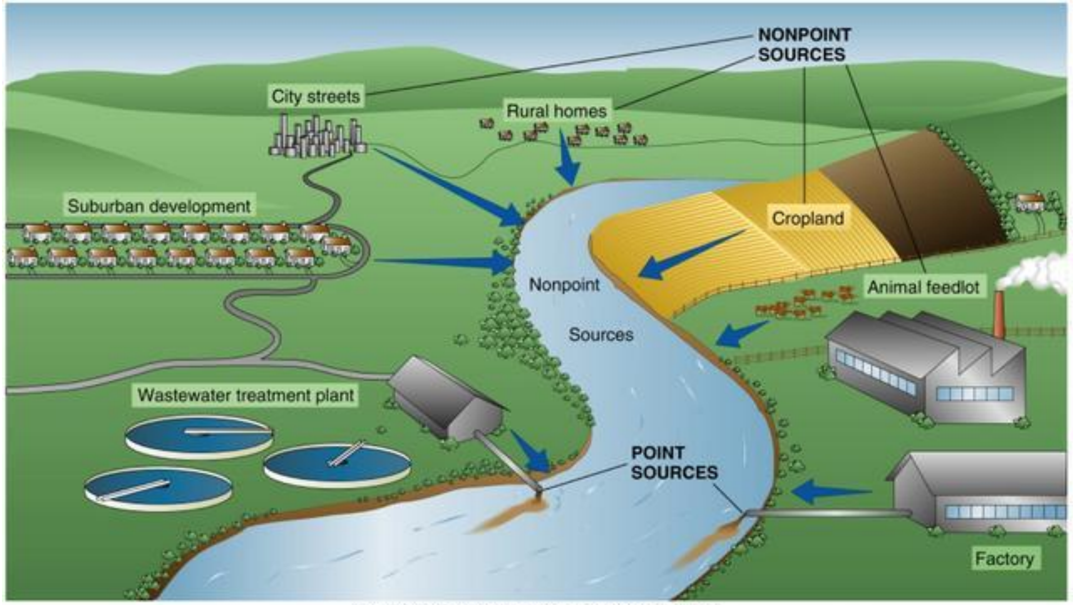
Water quality (point and non-point sources for pollution) and ecological problems, contaminated drinking water, water related disease






Energy consumption: Water industry represents one the biggest energy consumption.

Inefficient Water Recycling

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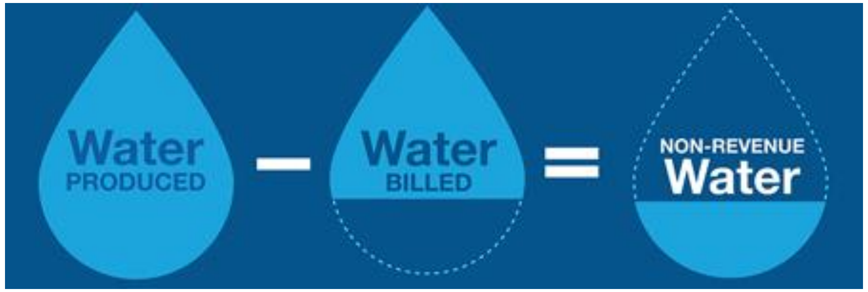
# "Unaccounted-for Water" & "Non-Revenue Water"

It's the gap between treated water and invoiced water.
This gap is known as urban water loss, or nonrevenue water (NRW). NRW could be due to physical or commercial loss. It ranges from 25 – 50 % in most of the developing and low-income countries (International Water Association, 2016).




- **Water Physical Loss**

Leakage caused by deteriorating infrastructure, unfavorable water pressure management, and reservoir overflows

- **Water Commercial Loss**

Inaccurate billing systems, deficient customer registration, inaccurate metering, insufficient and illegal connections to the water distribution network

| Real losses | Apparent losses | Unbilled Authorized consumption |
| --- | --- | --- |
|  Physical water losses |  Inaccuracies associated with production metering and customer metering |  Fire fighting and training |
|  |  Unauthorised consumption (theft or illegal use) |  Watering of municipal gardens<br>Street cleaning... |


The High Cost of
NON-REVENUE WATER
Leaks
Leaks are the largest component of real losses, with 75% of drinking water investment needs being repair and replacement of leaky pipes.
REAL LOSSES
Real losses are the physical losses of water from the distribution system.
Main Breaks
There are 650-700 main breaks per day in the U.S., or roughly 240,000 per year
A small component of NRW includes necessary but unbilled activities such as firefighting, hydrant flushing, municipal construction, and street sweeping.
Water Loss in the U.S.
We lose about seven billion gallons of water per day
The amount of water lost in one year is enough to supply the ten largest cities in the U.S.
Lost water accounts for billions of dollars in lost revenue
The amount of NRW for utilities is 10-30%
Tank Overflows
What is NRW?
Non-revenue water (NRW) is clean, treated drinking water that is "lost" before it reaches the customer.
Meter Errors
Theft
Billing Errors
APPARENT LOSSES
Apparent losses are non-physical losses that consist of water successfully delivered but not measured or recorded accurately.
Slow the Flow
AWWA's Water Audits and Loss Control Programs M36 methodology helps utilities find and control water loss:
Lowers operation and maintenance costs
Increases water availability
Reduces the need for new sources and treatment plants
Diminishes impacts from drought and climate change
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## Facts & Challenges

Aged/Deteriorated Infrastructures of the water industry. The high costs of operating, maintaining, rehabilitating, and replacing old systems

Limited capital expenditures in most of the Arab governments to carryout the necessary changes

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# Facts & Challenges

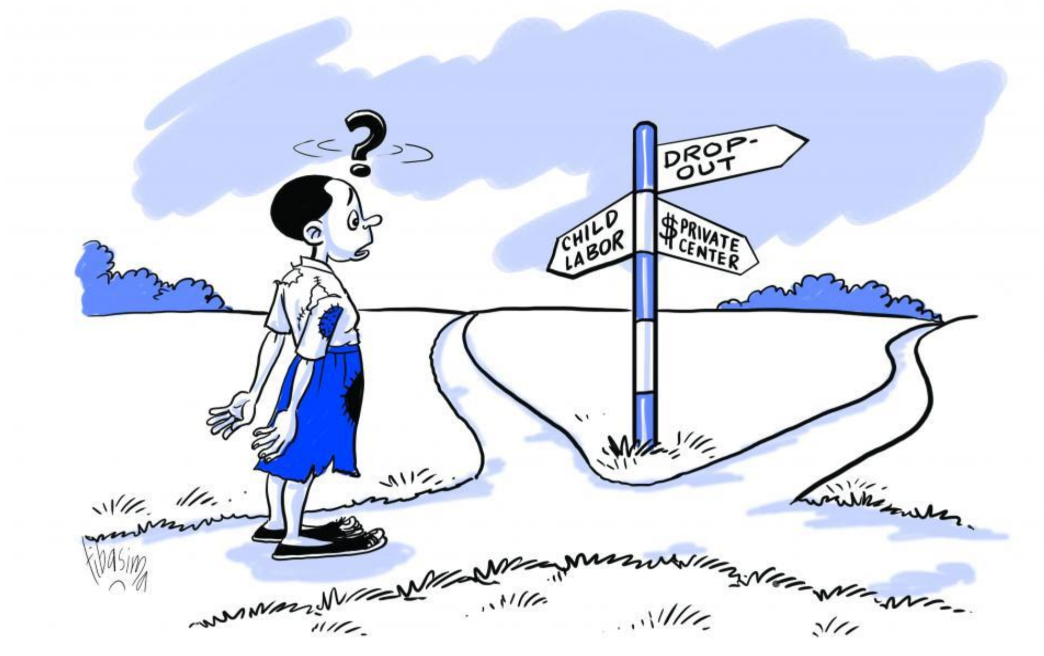
- Unskilled human resources in the water industry

- Inefficient Water Regulatory & Policies

- Underestimated Water Price/Political Constraints.

Facts & Challenges

- Non-Smart Water Residential, Agriculture, Irrigation, and Industrial.
- Insufficient Data/Information = Improper decision.




- Incompetence in management of Big Data
- Improper Decision Support System (DSS) & Disaster Risk Management (DRM)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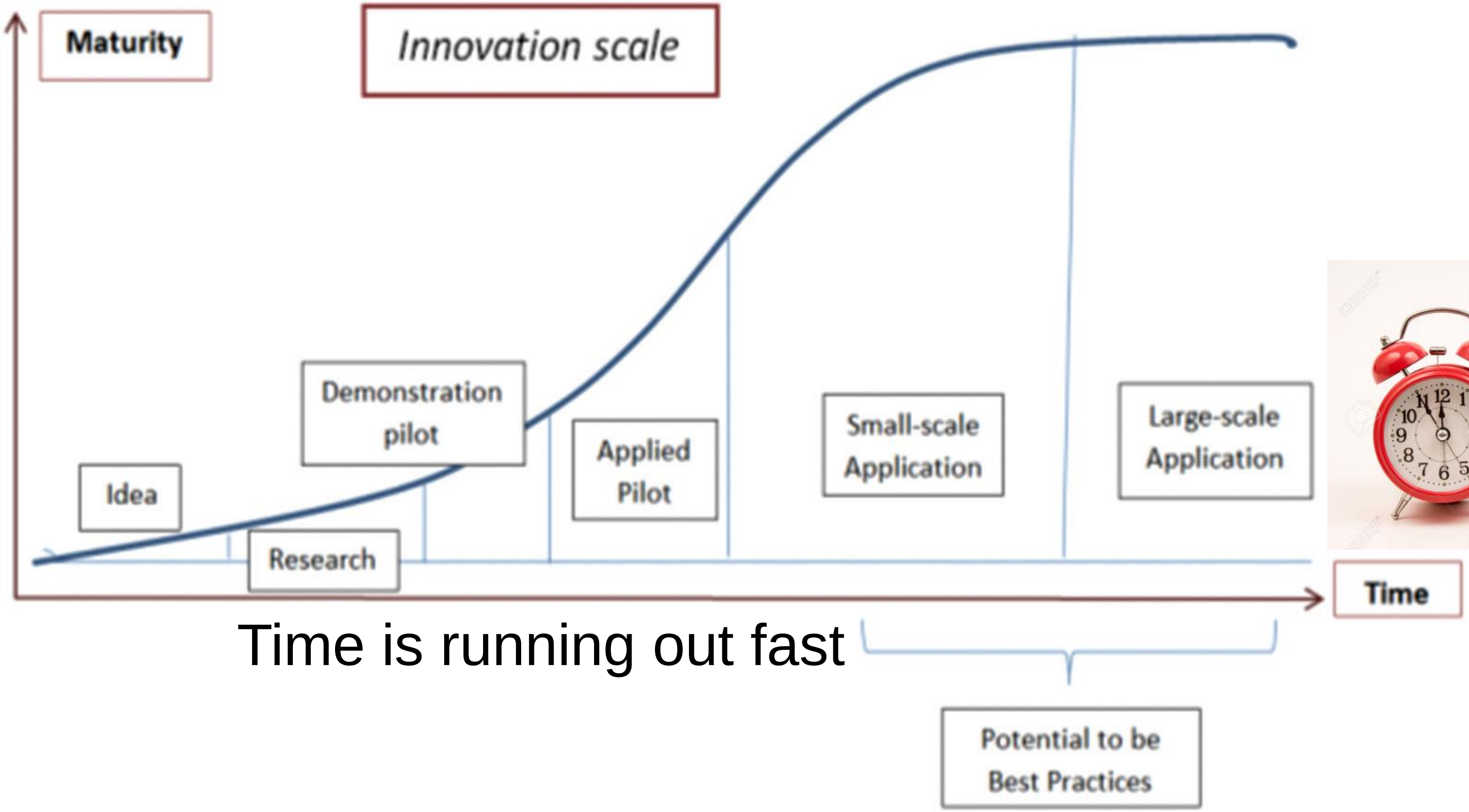
# Facts & Challenges





Time is running out fast

Innovation curve (IWA, 2014)

# ICTs in Smart Water Management

**Urban water systems are categorized into;**

- Smart water supply system and,
- Smart stormwater system.


- **Smart Water Supply System**

Deal with having enough capacity based on water demands and reducing water losses.

- **Smart Stormwater System**

Mainly include prevention and mitigation of urban flooding as well as reduction of non-point source pollutants.

# Smart Water Supply System

**Smart real time monitoring & automatic controls for water resources**

**Smart Water Loss Detection & Control**

**Water Physical Loss**

- Smart leakage detection & control,
- Smart pipe,
- Smart rehabilitation & repair of the deteriorating infrastructure,
- Smart water pressure management and reservoir overflows

**Water Commercial Loss**

- Smart meter
- Advanced Metering Infrastructure (AMI)

**Smart Water Recycling**

- Grey and black water recycling

**Smart/efficient water irrigation, water agriculture, water industrial**

**Smart river bank filtering system**

**Smart water infrastructure asset management**

**Energy efficiency in water and wastewater systems**

**The Integrated Water Resources Management (IWRM) & Urban Water Efficiency (UWE)**

**Water Regulatory Efficiency**

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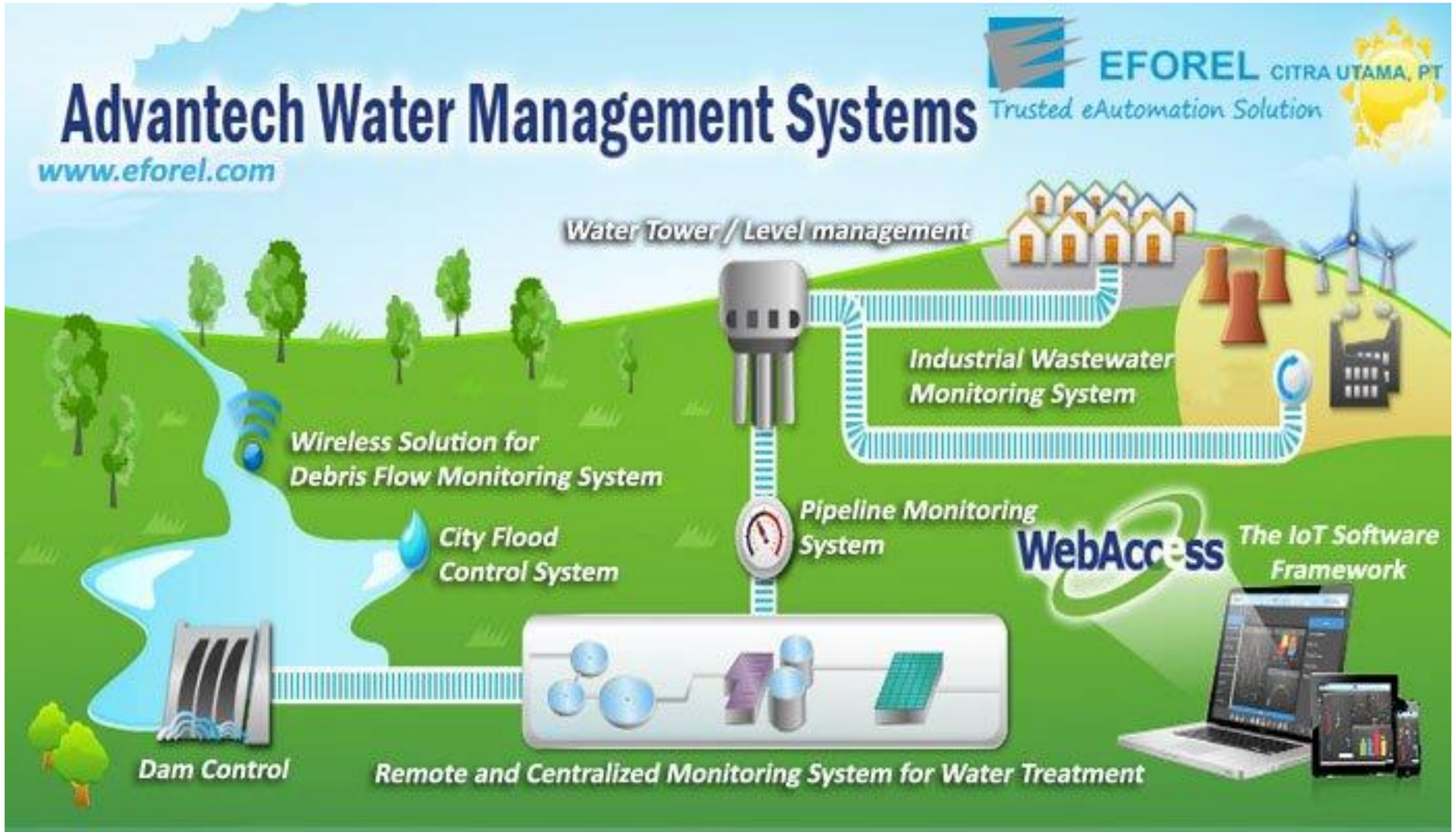
# Smart real time monitoring & automatic controls for water resources comprises surface water and groundwater

Recording levels, water quantity and quality, and detected early potential risk.

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# Water Loss

## Water Physical Loss

- Smart leakage detection & control,
- Smart pipe,
- Smart rehabilitation & repair of the deteriorating infrastructure,
- Smart water pressure management and reservoir overflows

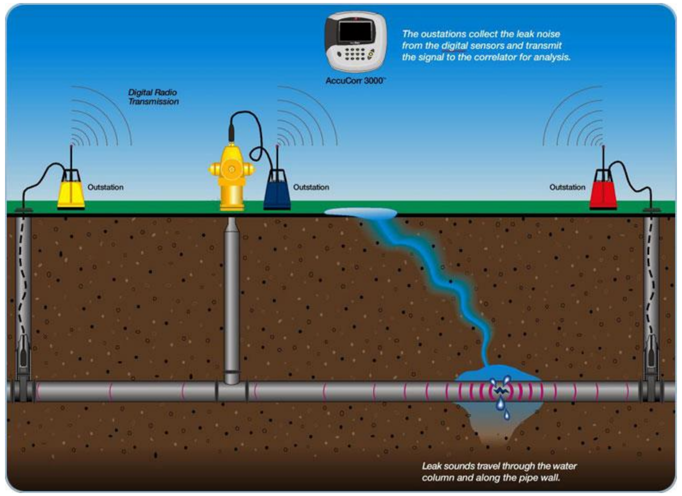
## Water Commercial Loss

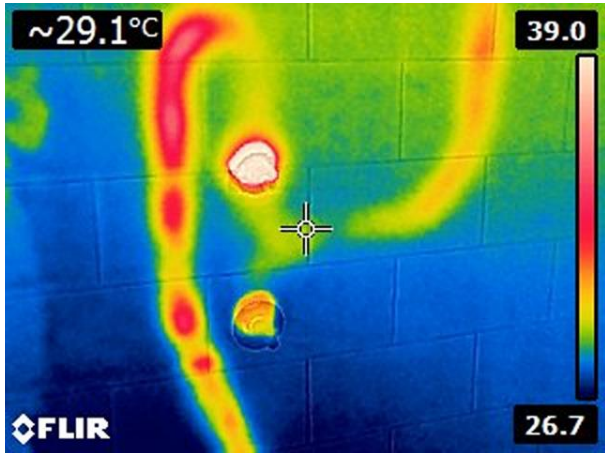
- Smart meter
- Advanced Metering Infrastructure (AMI)

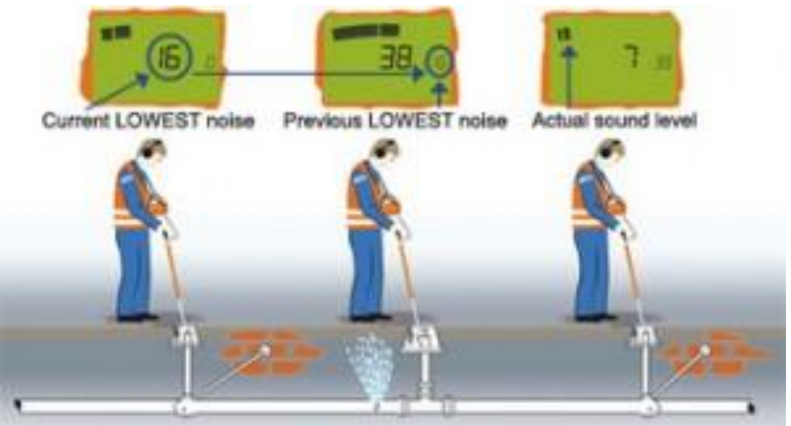
# Water Physical Loss

- Smart leakage detection & control

Detect leaks by fixed or portable hydrophones, magnetic flux or linear polarization resistance.



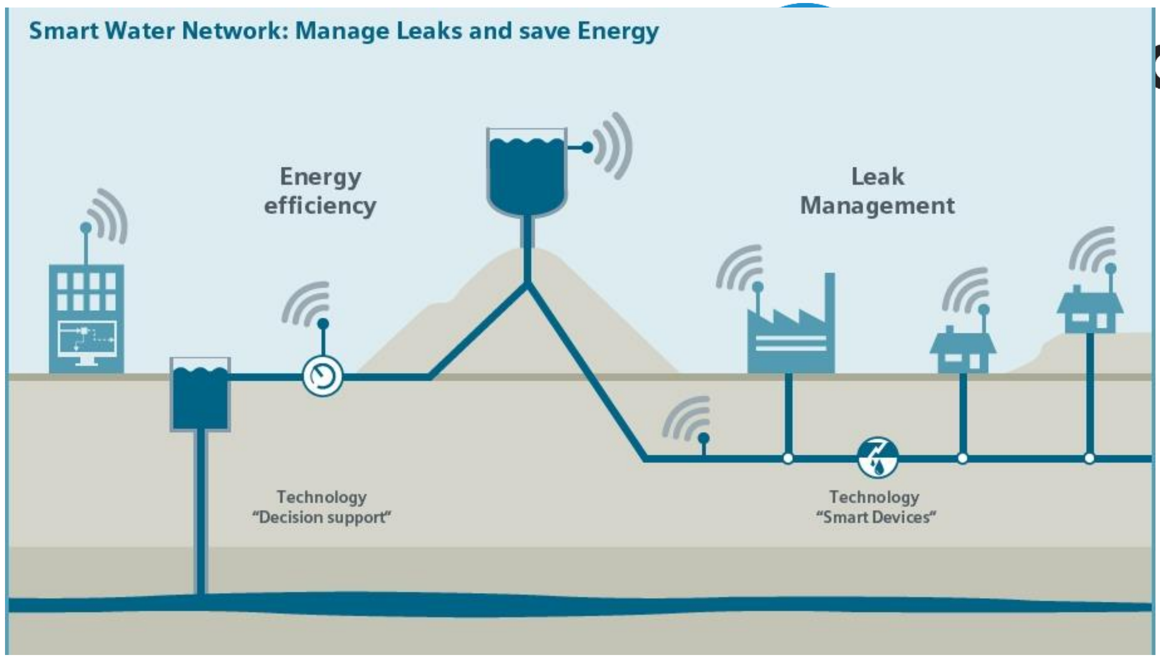



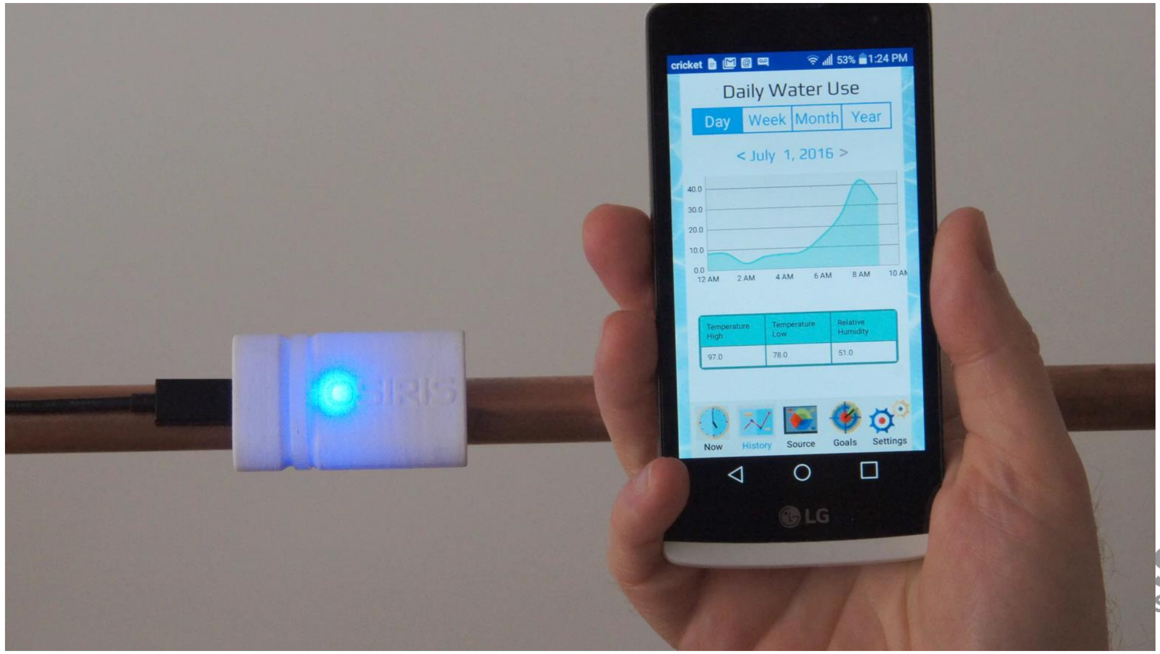

# Water Physical Loss

- **Smart pipes**

Smart pipes combine multi-functional sensors sense strain, temperature, pressure, water flow, and quality during service.

Smart pipes connected (wireless) to a command center, therefore, detection and location of potential leak can be checked in real time.



# Water Physical Loss

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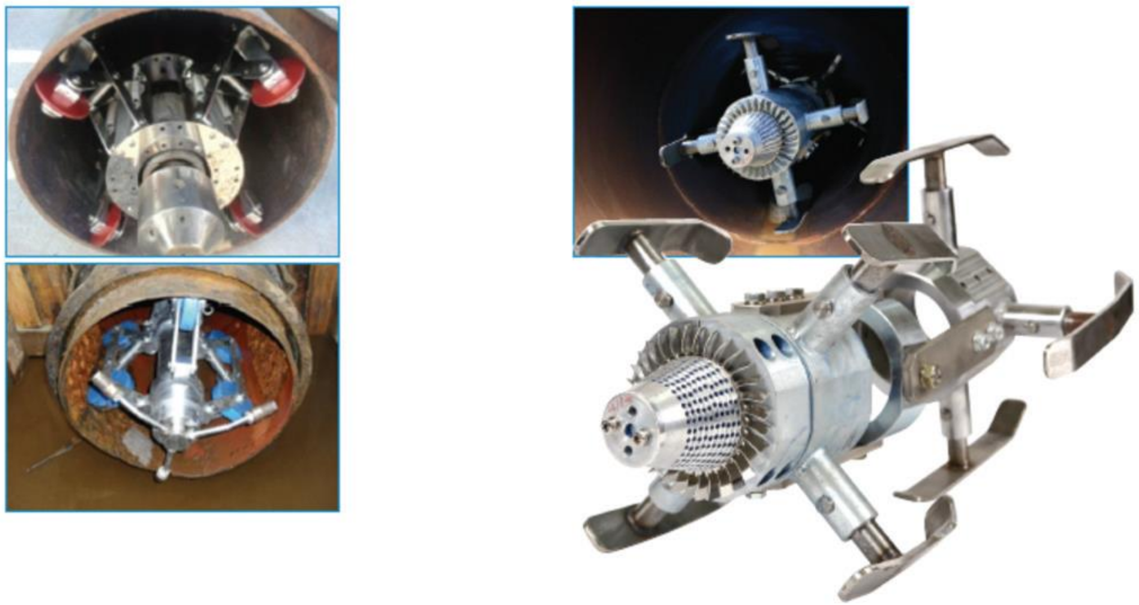
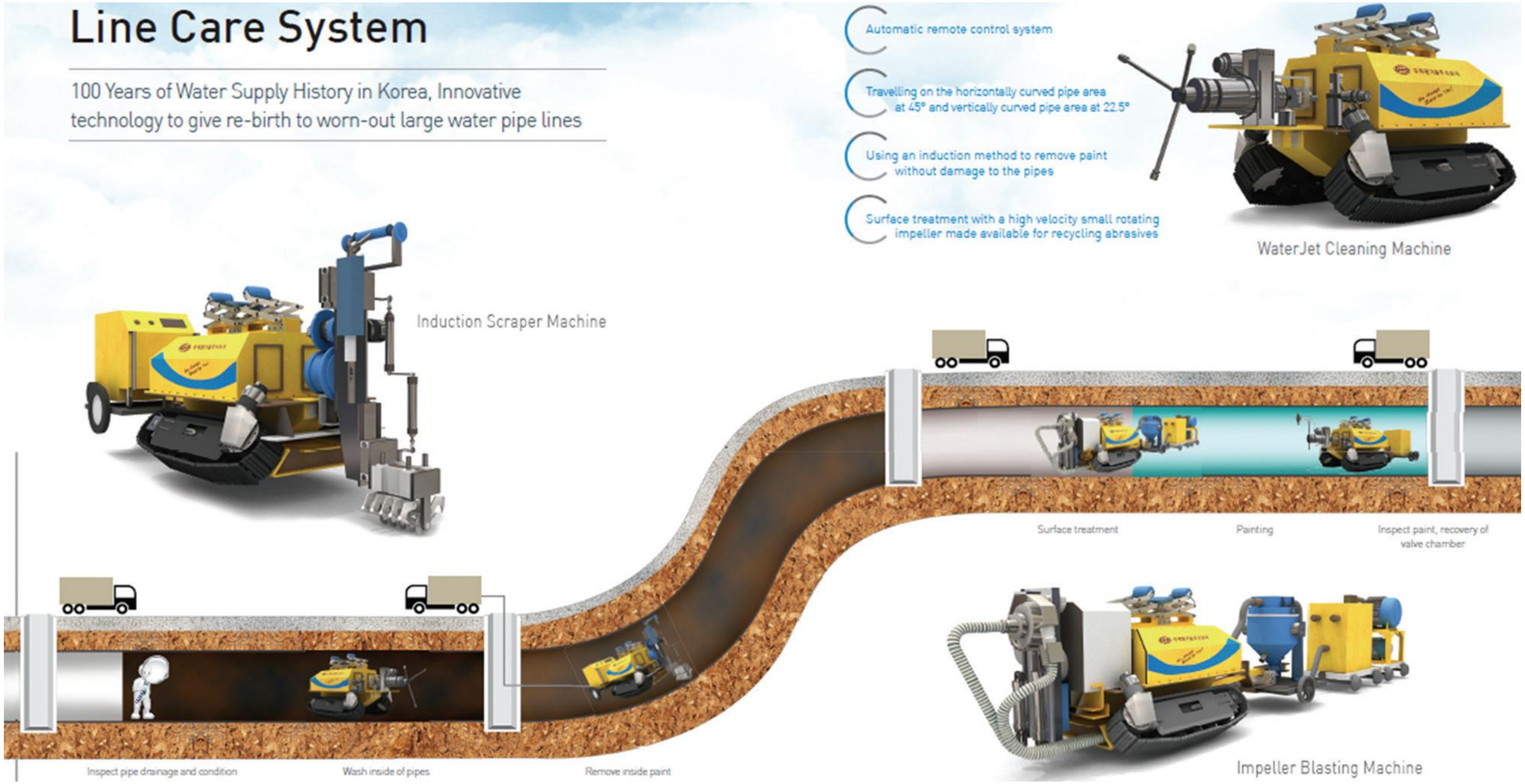
- Smart rehabilitation & repair of the deteriorating infrastructure


Image diagnosing robot



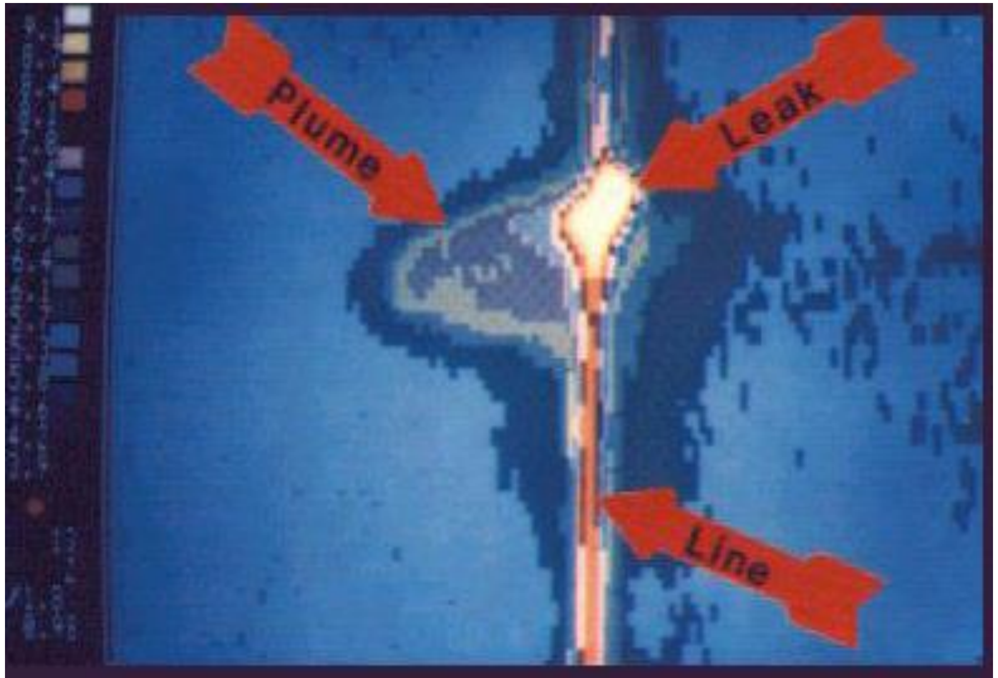
Small diameter rehabilitation system




Line care system for large pipe rehabilitation

# Water Physical Loss

- Ground-penetrating radar (GPR) and thermal infrared radiation for networks delineation


# Water Physical Loss

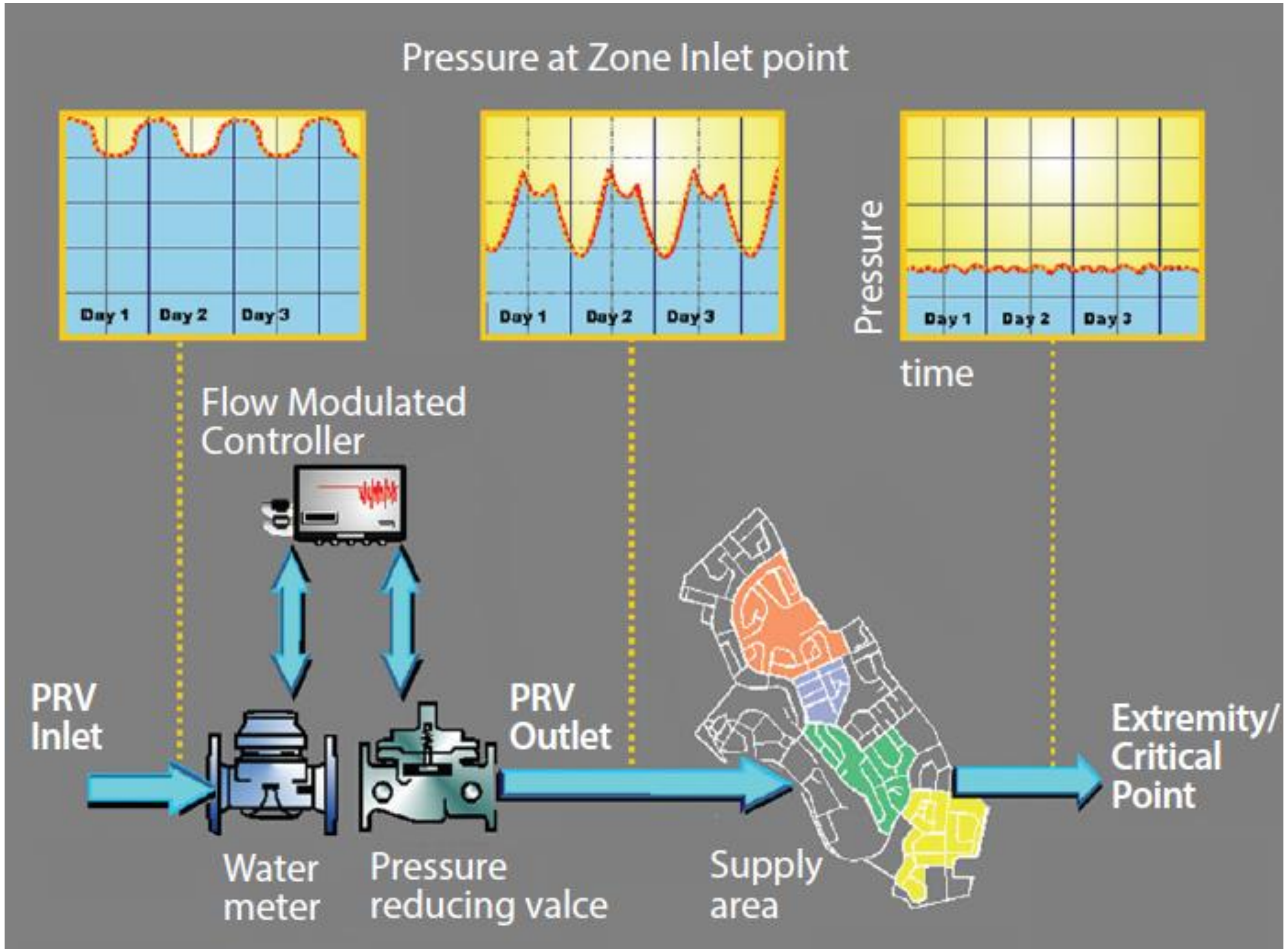
- Smart water pressure management, and reservoir overflows

Underground leak running at low pressure (Brothers K , 2002)

Underground leak running at high pressure (Brothers K , 2002)

Reducing Pipe Losses from Networks by Pressure Management

## Flow-modulated pressure

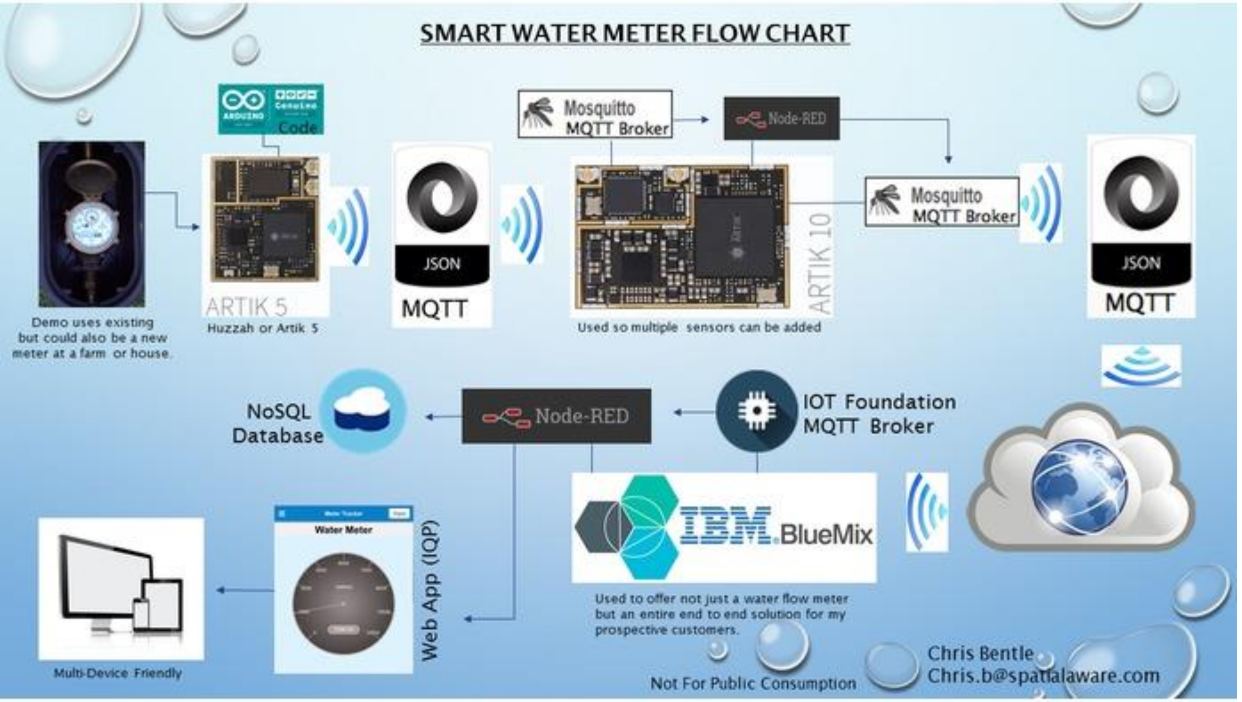



Flow modulated pressure control (McKenzie R, 2001)

In Tokyo, a control room monitors pressure in each section of the city 24/7, and their role is to reduce pressure where possible.

# Water Commercial Loss

- Smart Meter
- Advanced Metering Infrastructure (AMI)

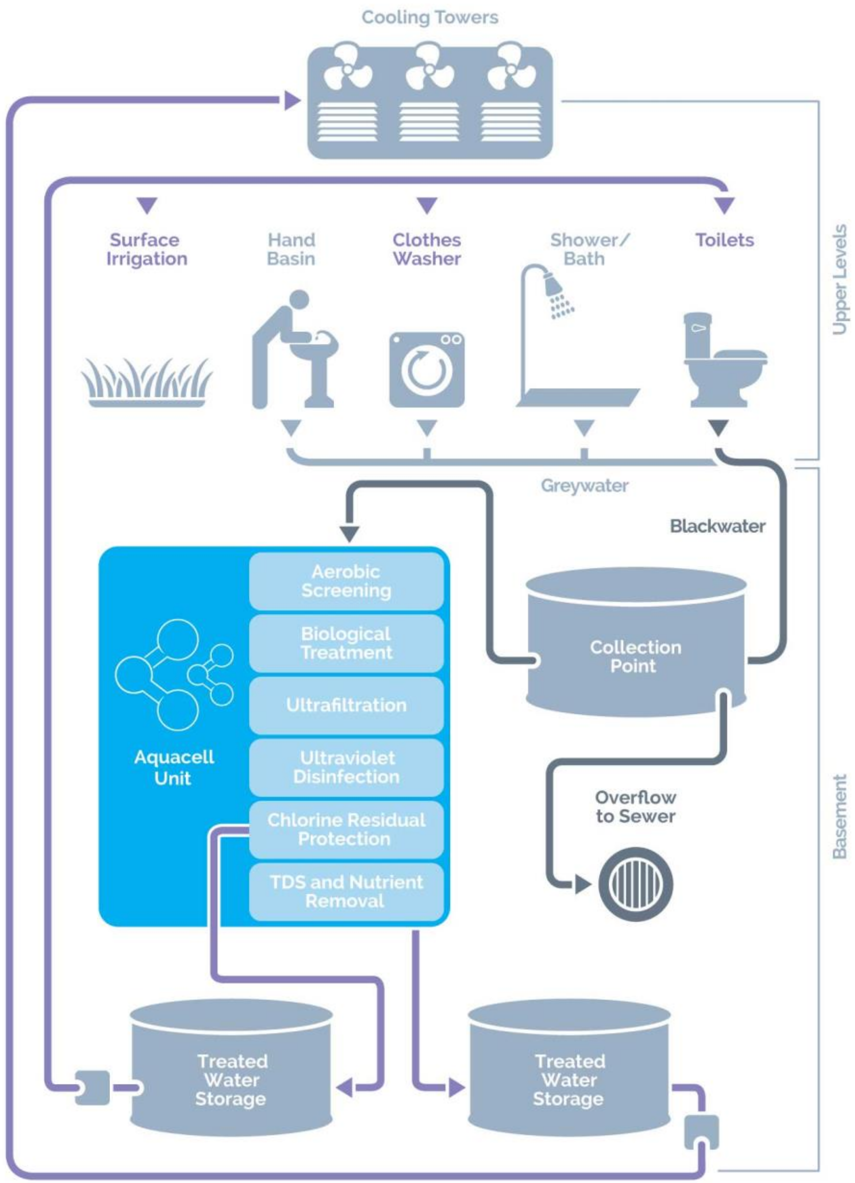




Smart meters allow; efficient billing, reduce peak demand, leak detection, increase distribution efficiency, reduce nonrevenue water, and reduce of capital spending.

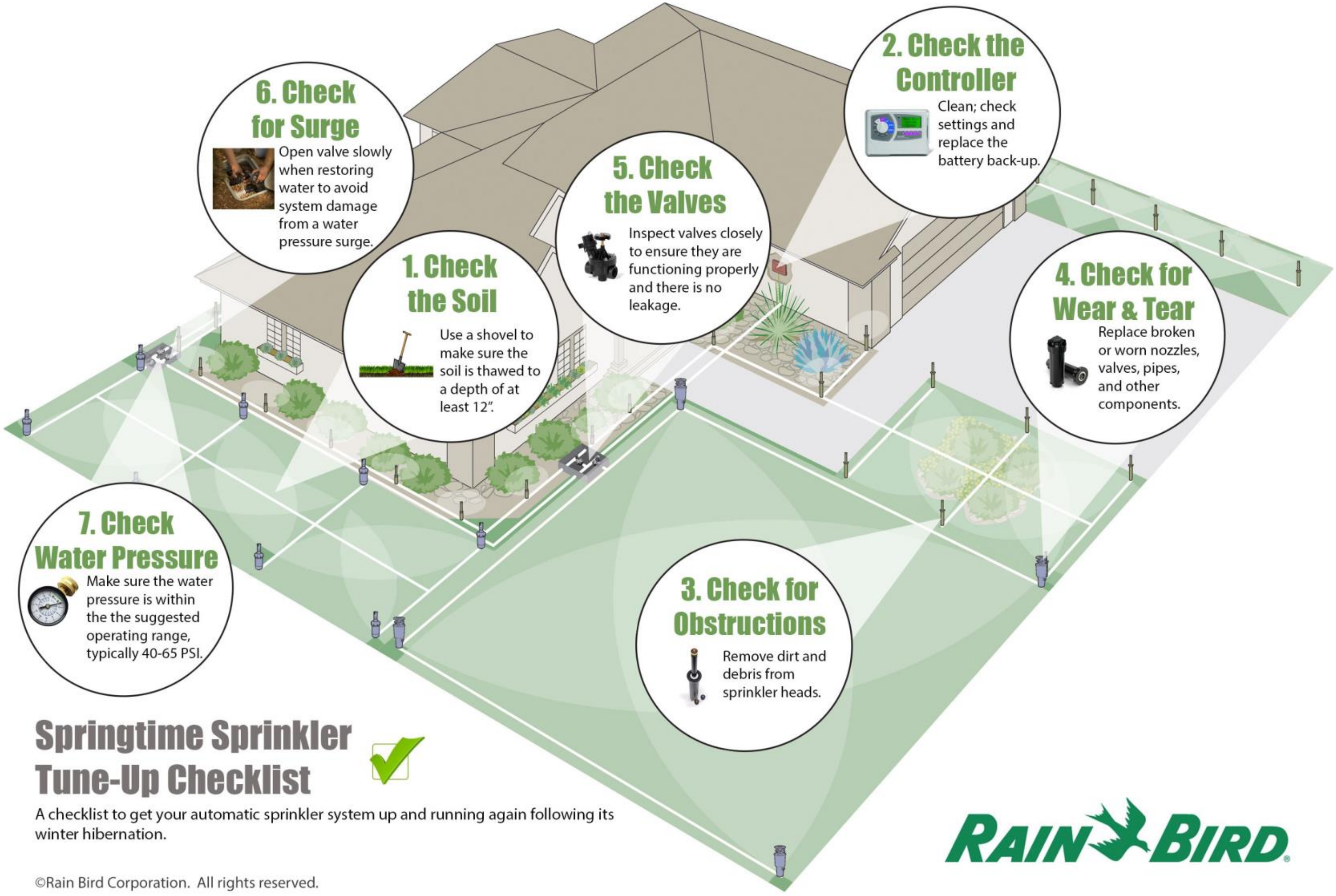
# Smart water recycling

- Grey and black water recycling




# Smart/efficient water irrigation, water agriculture, and water industrial

Smart sensors optimize water irrigation by measuring humidity, rainfall, wind speed/direction, soil temperature/moisture, atmospheric pressure, and solar radiation.

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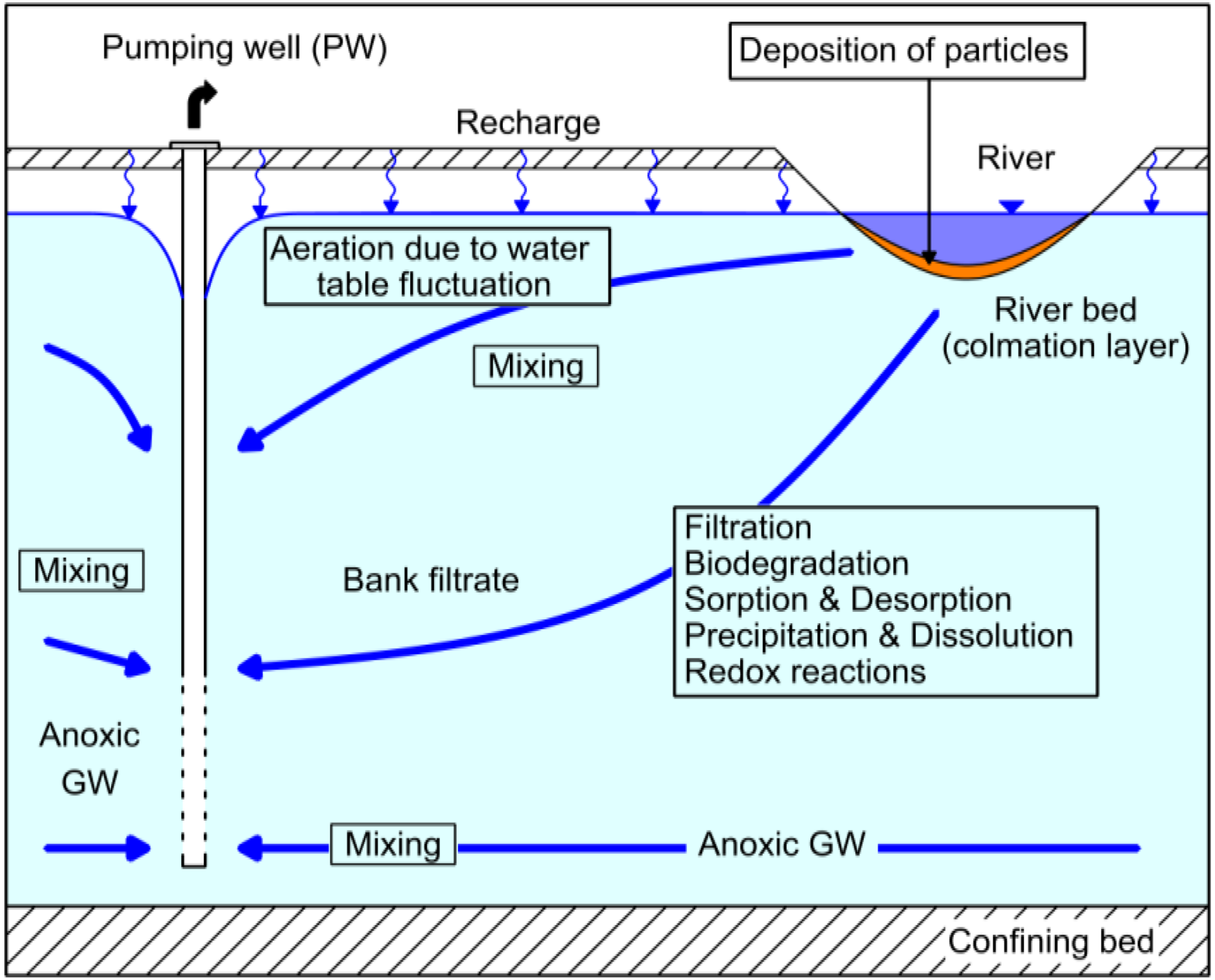
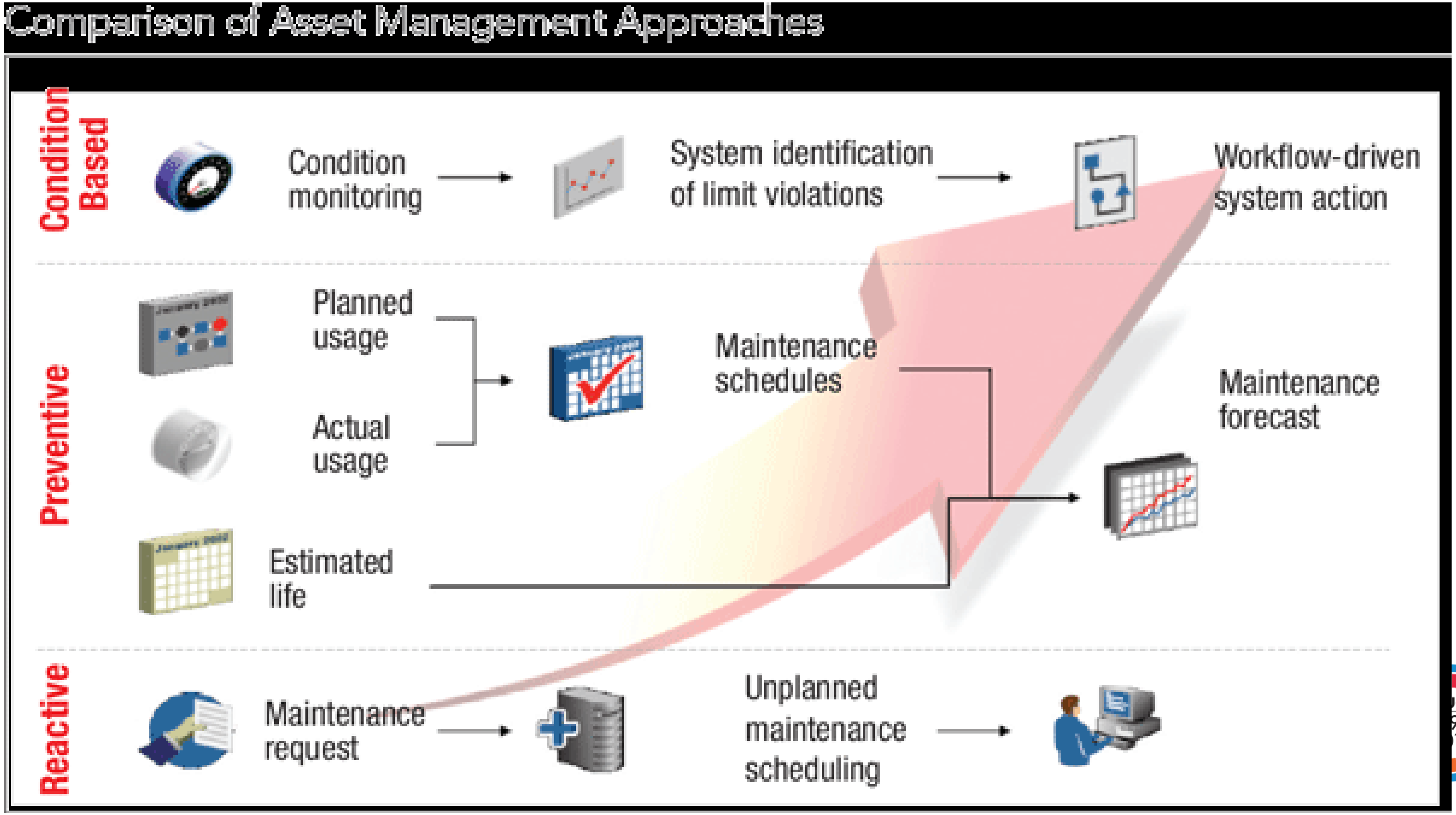
# Smart River Bank Filtering System



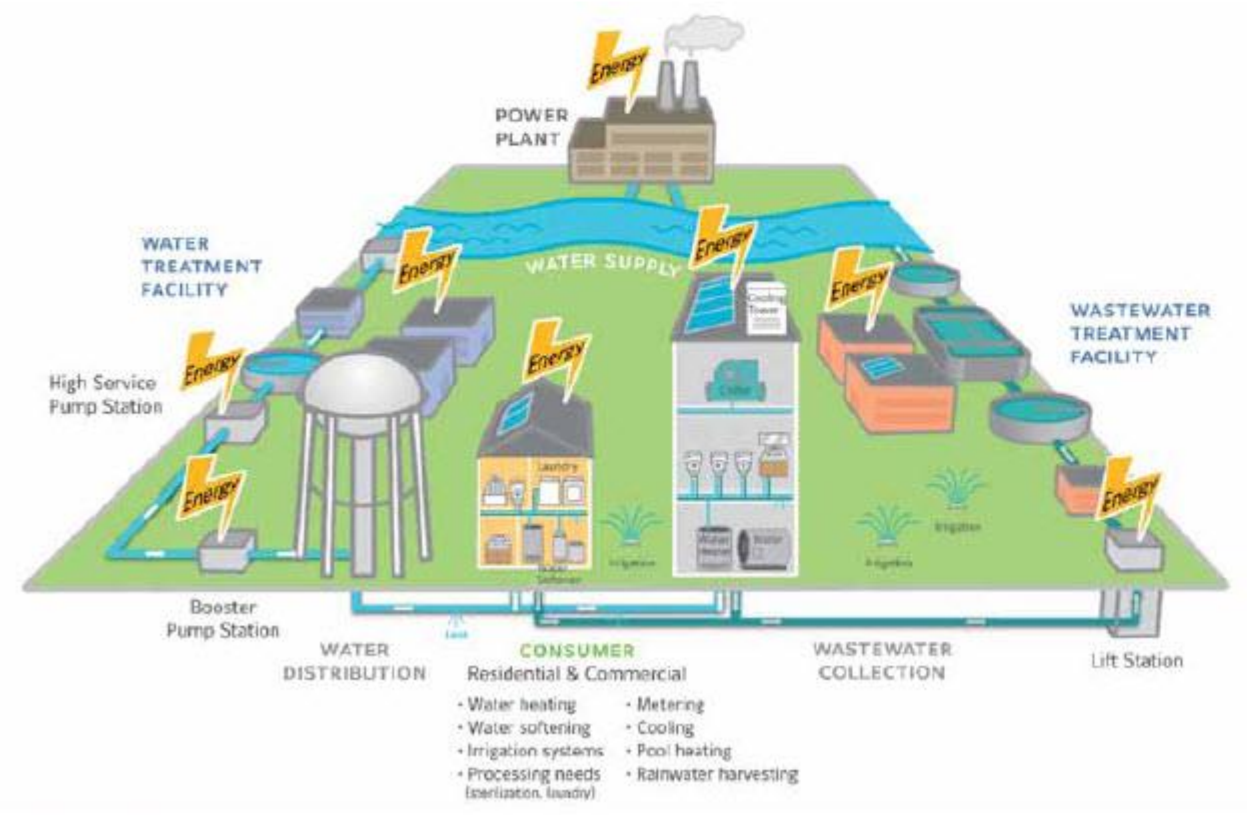
# Smart Water Infrastructure Asset Management

Smart asset management optimizes capital, operations, and maintenance expenditures by providing the desired level of service at the lowest infrastructure life-cycle cost

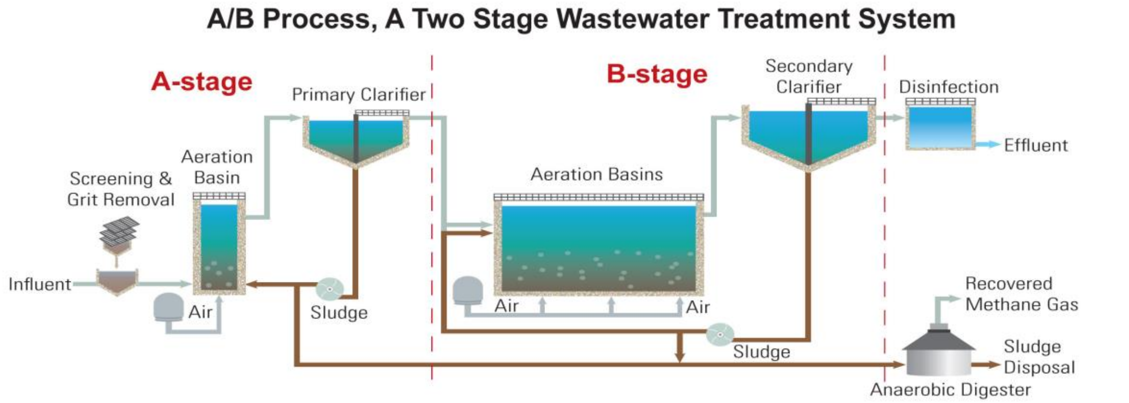


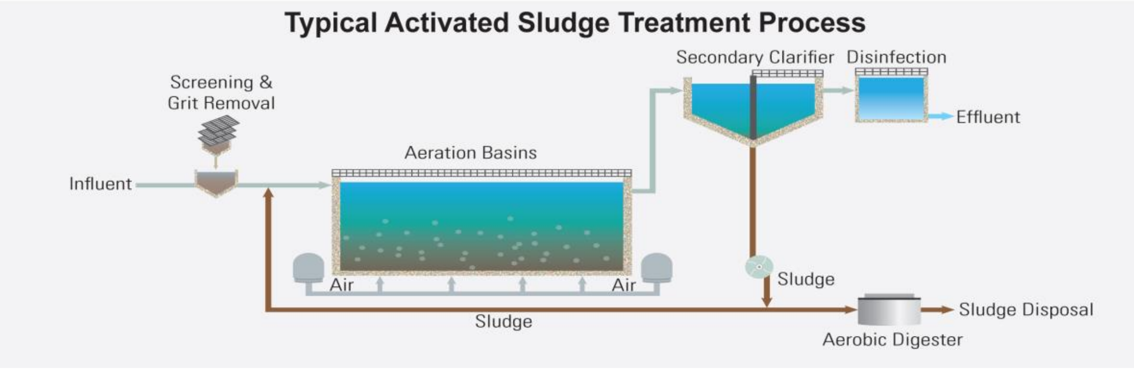
# Energy efficiency in water and wastewater systems

- Integrate renewable source of energy such as solar cells, wind turbines, and run-of-river hydropower.
- Burn biogas from anaerobic digesters to generate some or all of their own electricity.

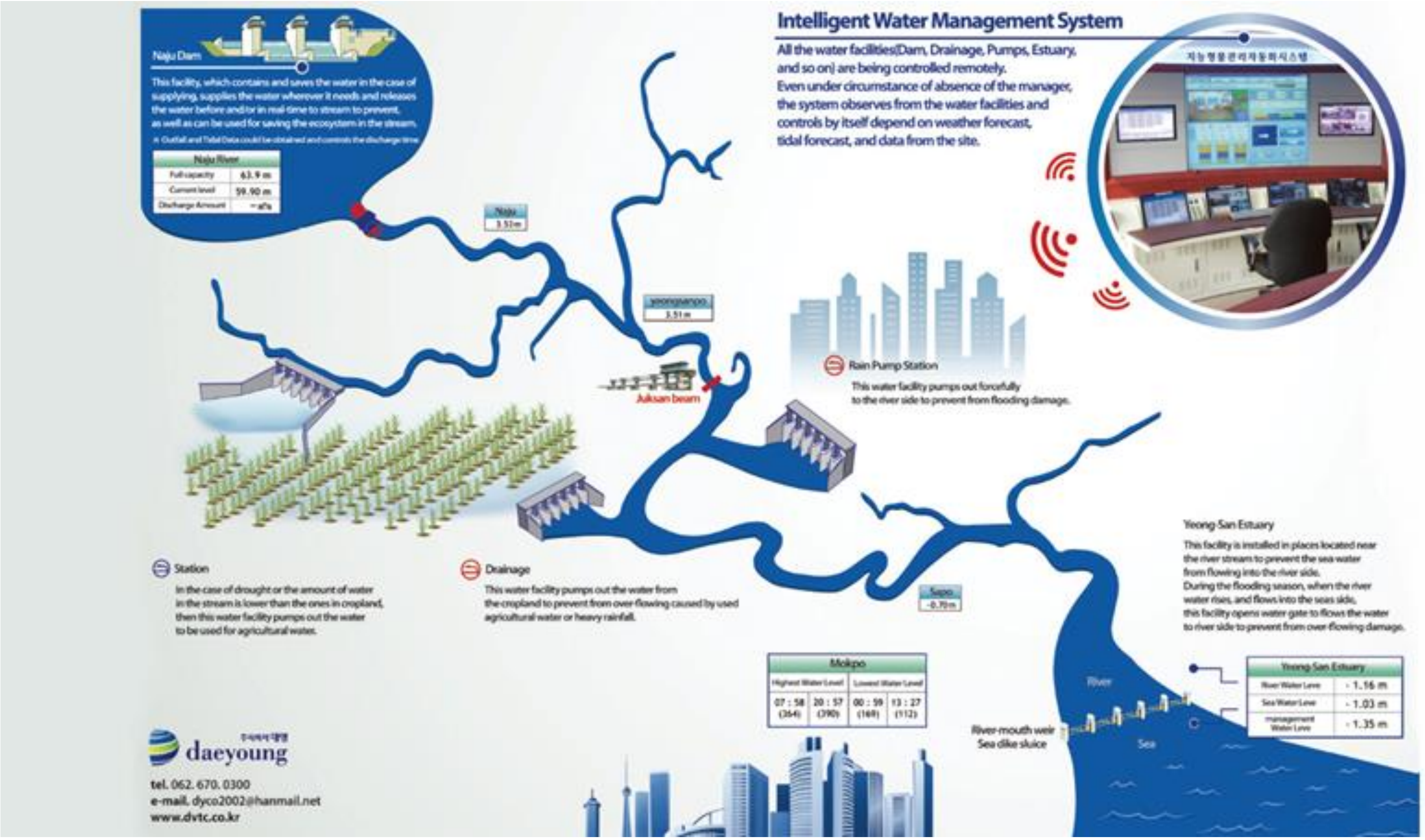



Conserve water and energy to maximize efficiency



# Integrated Water Resources Management (IWRM) & Urban Water Efficiency (UWE)



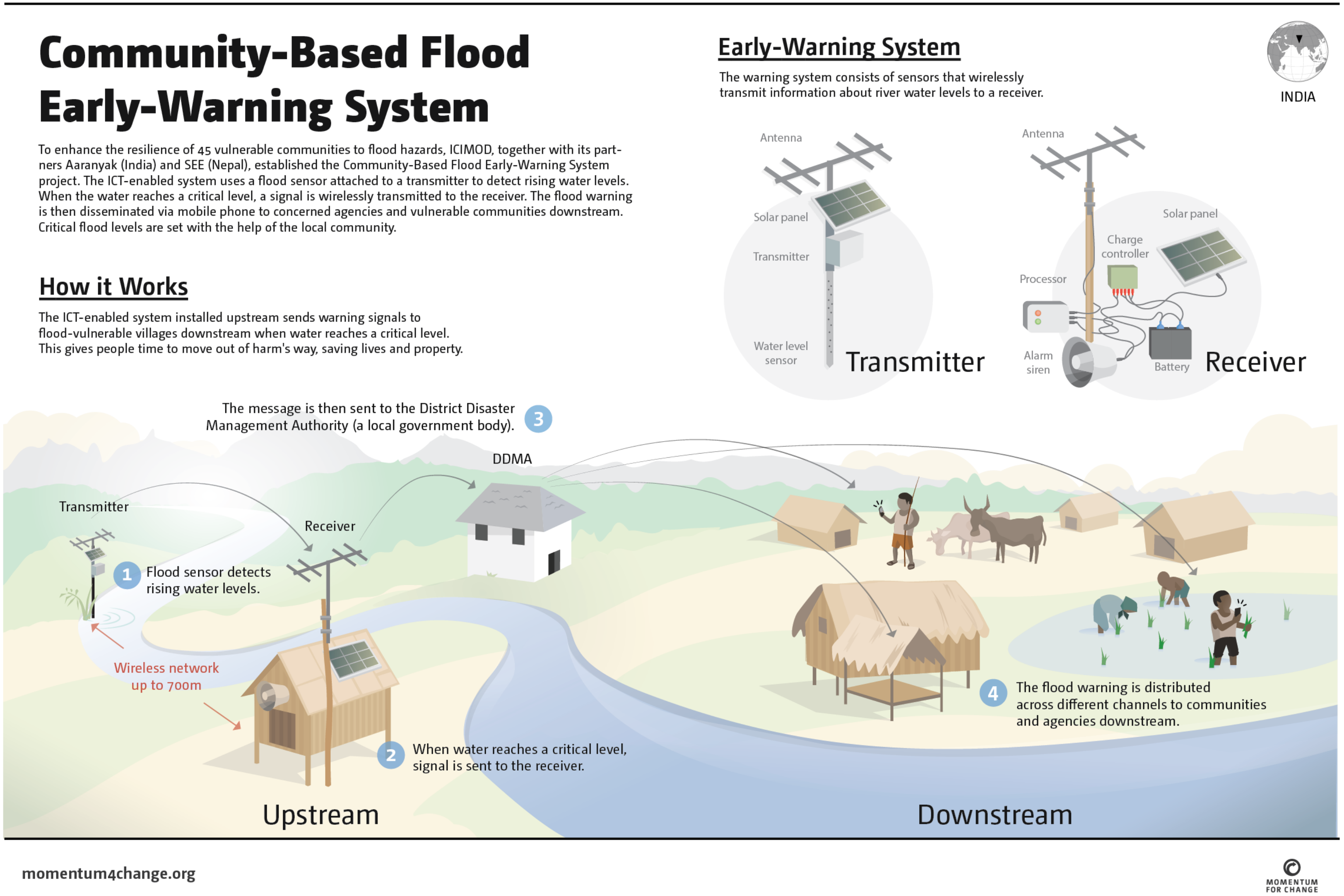

Intelligent water management system applied in Yeong-San, South Korea

## Water Regulatory Efficiency

Can be improved by collaboration between governments, water supply agencies, NGO, private sector,…etc.

# Smart Stormwater System

# Decision Support System (DSS), Disaster Risk Management (DRM), Early Warning System (EWS) for; Droughts, desertification, urban flooding management, intense rainfall, stormwater management, and watershed analysis;




INDIA

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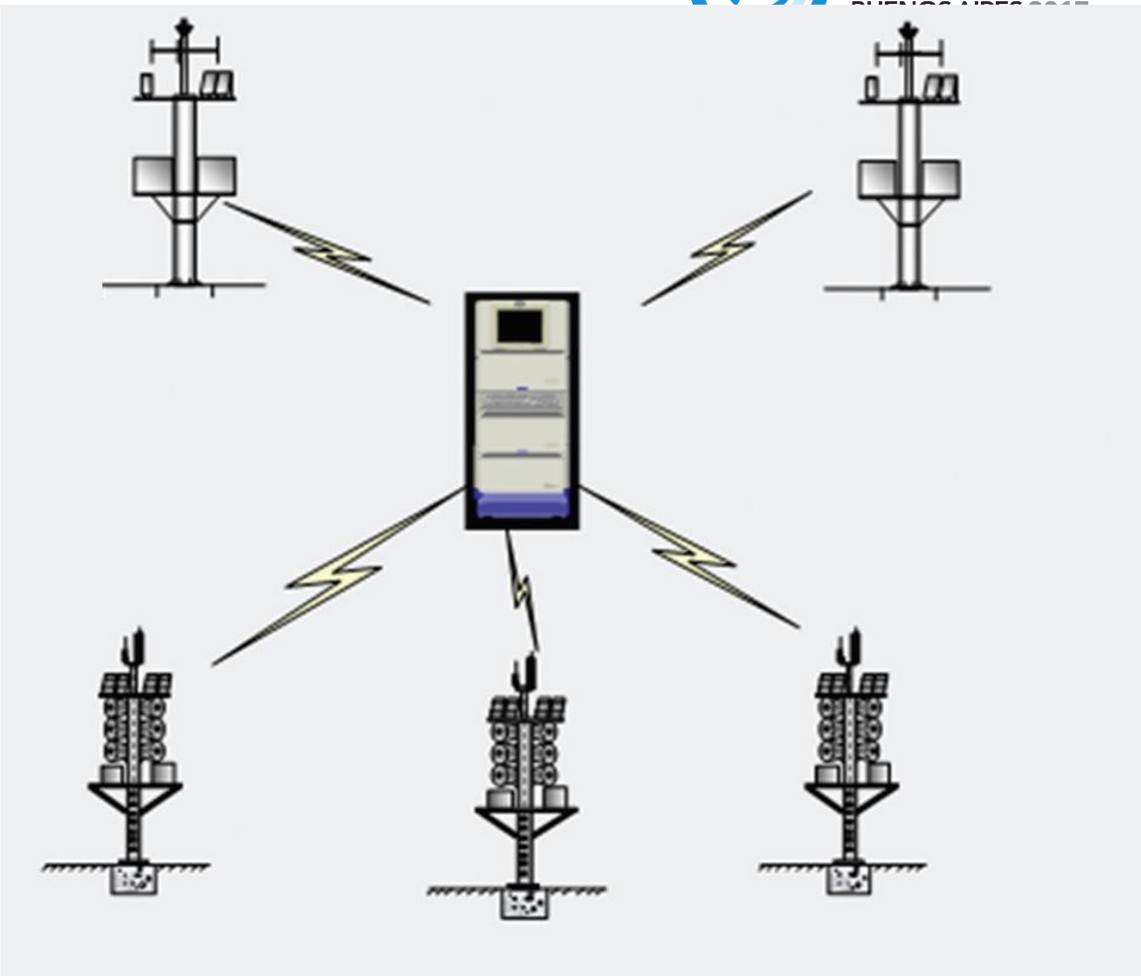
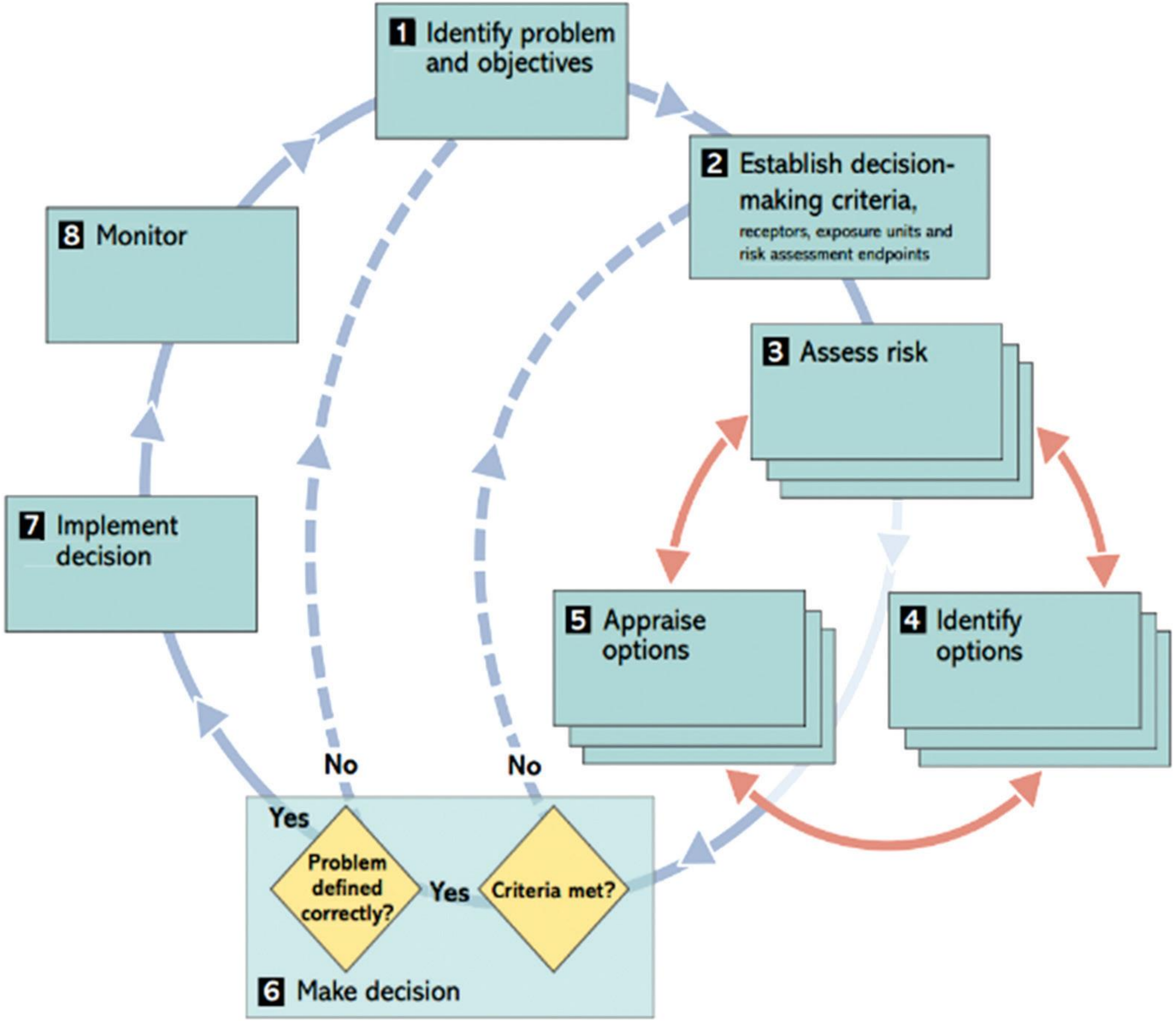
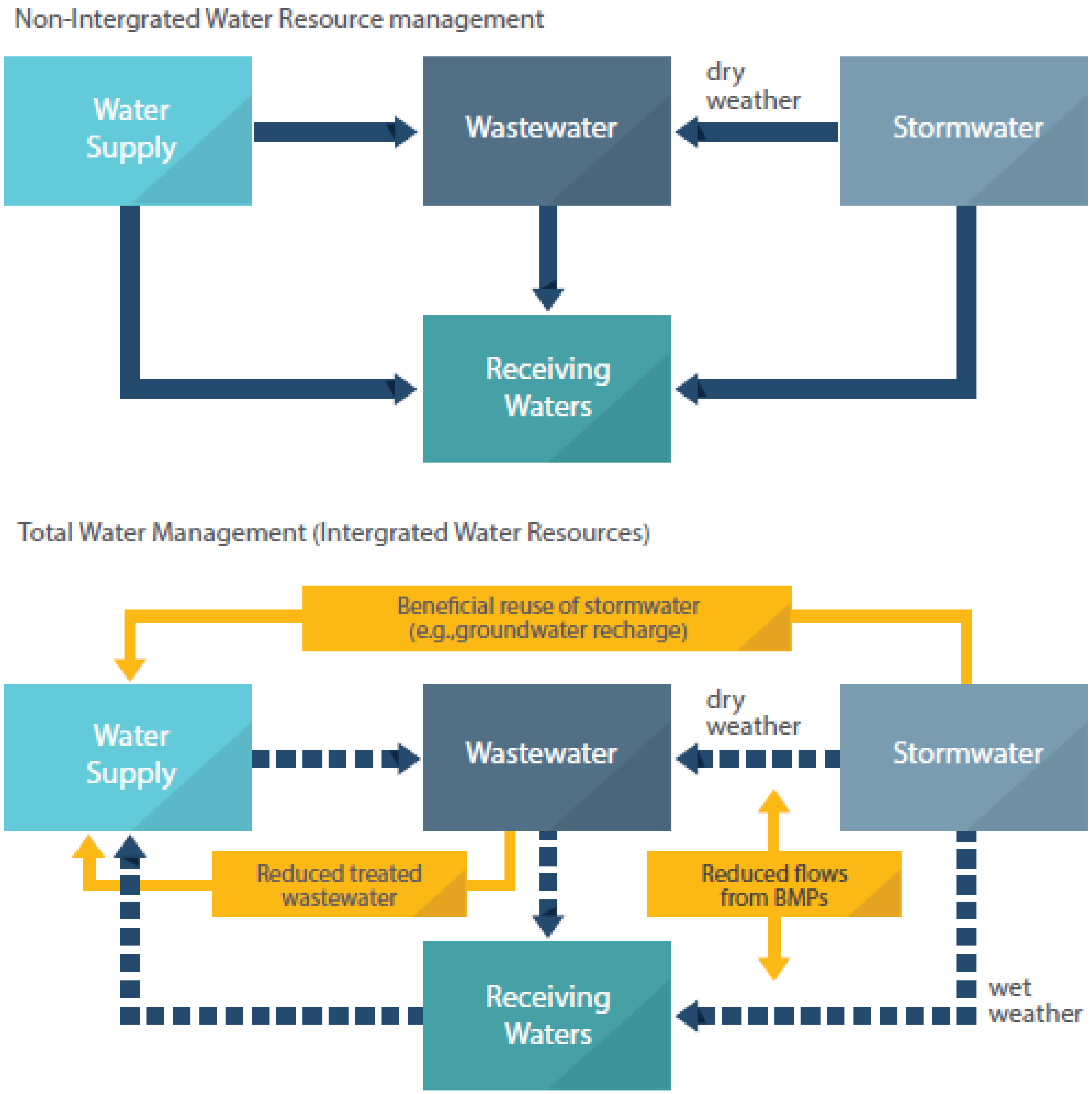


Automated rainfall warning system to disseminate early warning massage which help people to escape from lowland and mountain valley in Korea




A framework to support good decision-making
in the face of climate change risk (Willows et al. 2003)

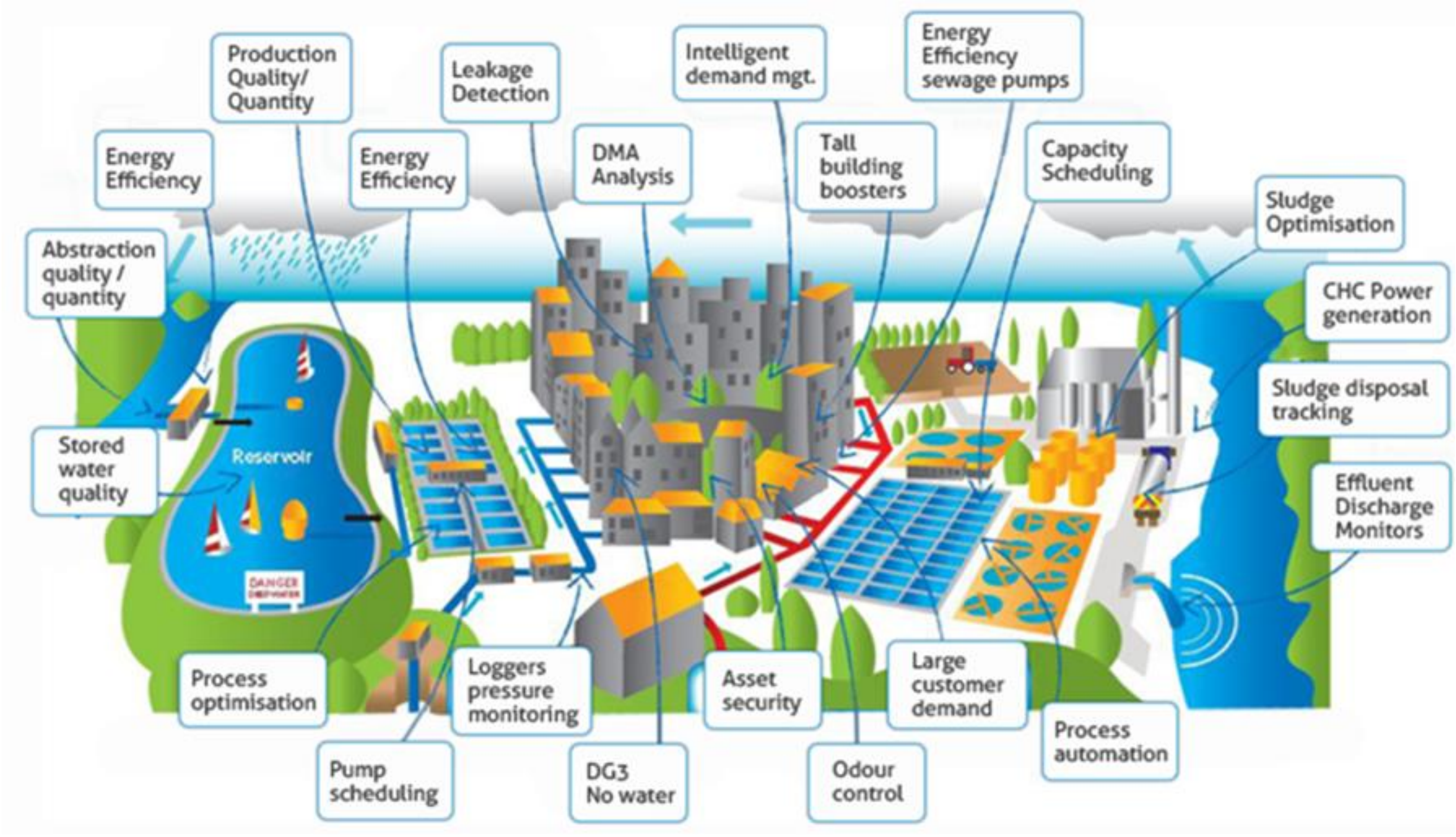
# Integrated Enterprise Web and Mobile Based ICT Smart Water Management




Traditional versus integrated water management including best management (US EPA, 2012)

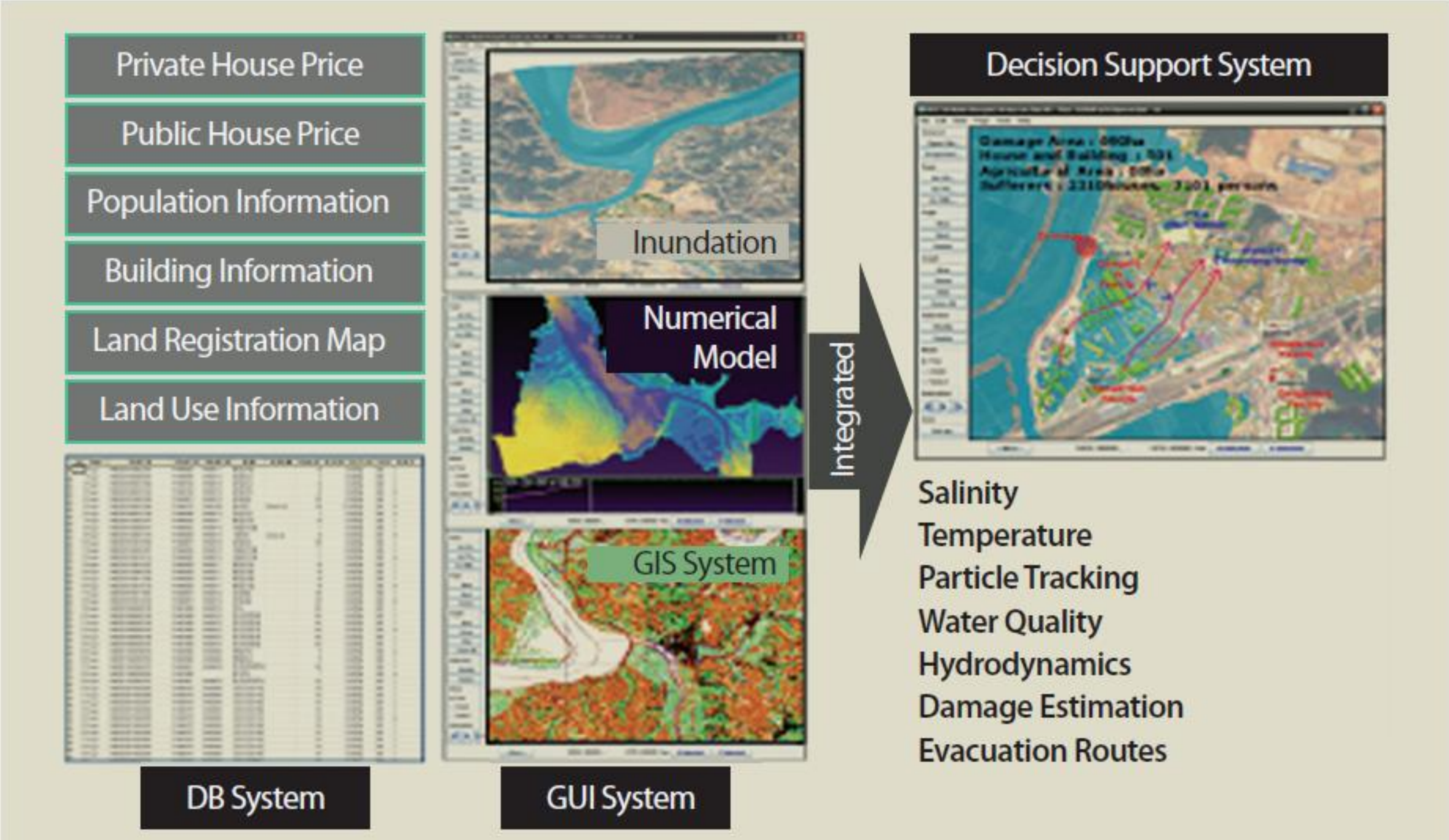
# • Smart Water Grid

Managing at scales ranging from basins to households.



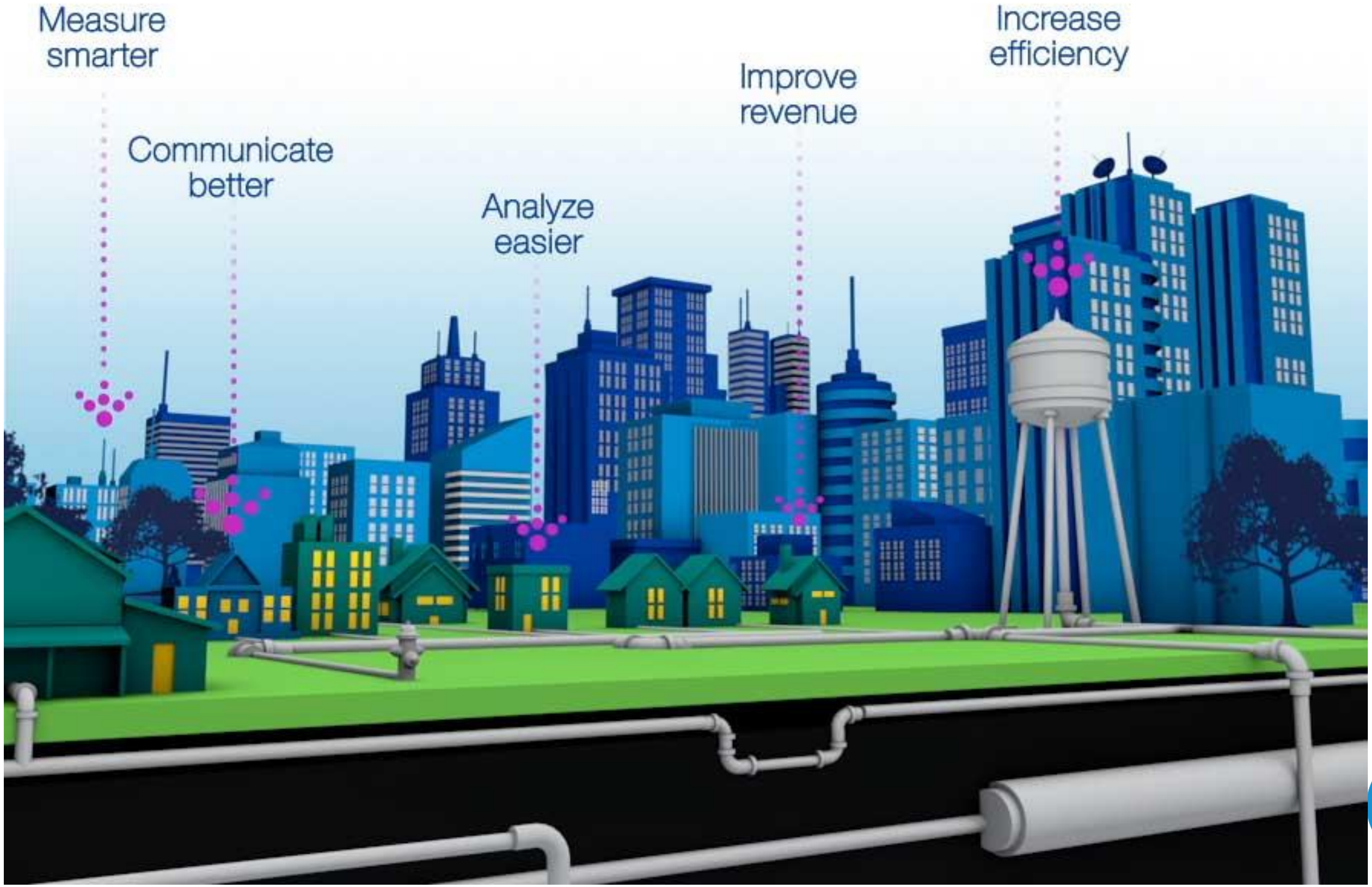
- **Enable robust management of Big Data**






Design of decision support system for flood disaster management in Korea (Cheong, 2012)

# ICT in Smart Water Management



# ICT in Smart Water Management Tangibly Effect Water Efficiency in;

**1. City Solutions:** Efficient urban water management, reduce water losses, and shrink the gap between supply and demand.

**2. Agricultural Advances:** Smart irrigation systems can grow more food, and earn more per drop, even with 43% less water.

**3. Industrial Innovations:** Corporations that push for internal and external efficiency both increase outputs and reduce exposure to risks, even within zero increases in water supplies.

**4. Power Shifts:** Judicious early investment can achieve carbon and energy neutrality, or generate net gains, through efficient water and wastewater processes.

**5. Smart Systems:** Advanced water technologies when nested within rigorous legal, administrative, and economic institutions will enable and accelerate ‘smart systems’.

**6. Standard Metrics:** More inclusive, exacting, and uniform ways of measuring water will yield efficient outcomes both quickly and affordably.

**7. Stress Relief:** The fastest, fairest, cleanest and cheapest path to efficiency involves carefully optimizing water pressure to maintain priorities while eliminating excessive strains.

# Thank You