



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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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

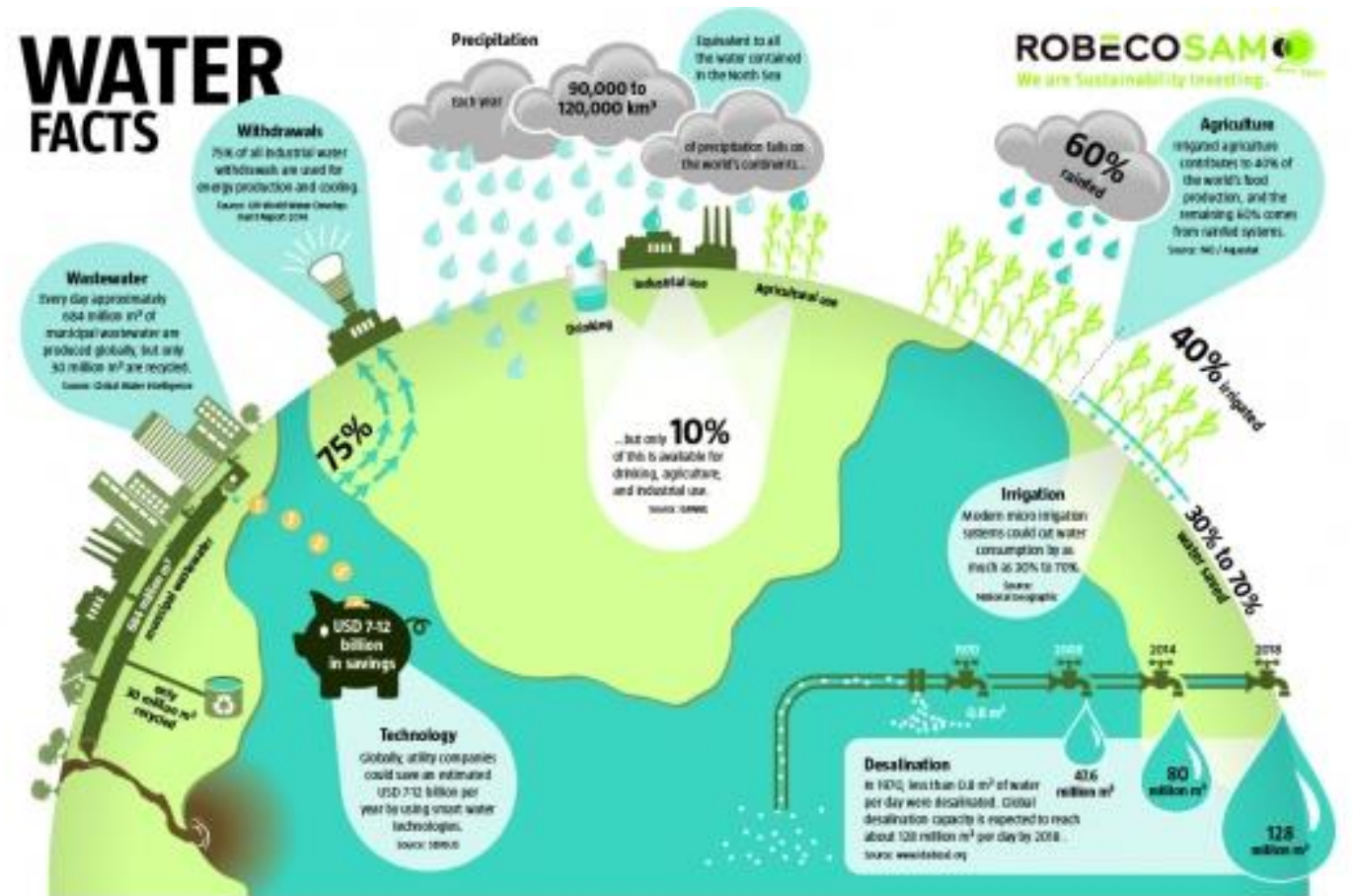
Integrated Enterprise Web and Mobile Based ICT Smart Water Management

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

Benefits of ICT in the Water Industry



Facts & Challenges



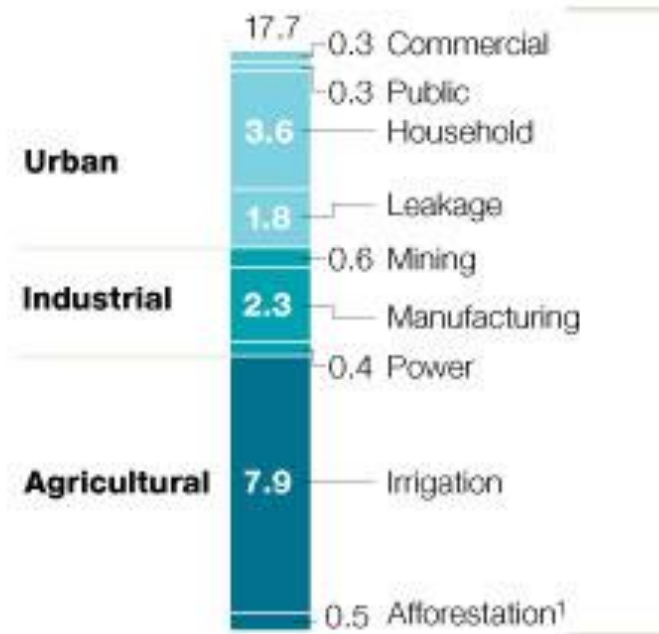
Facts & Challenges

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



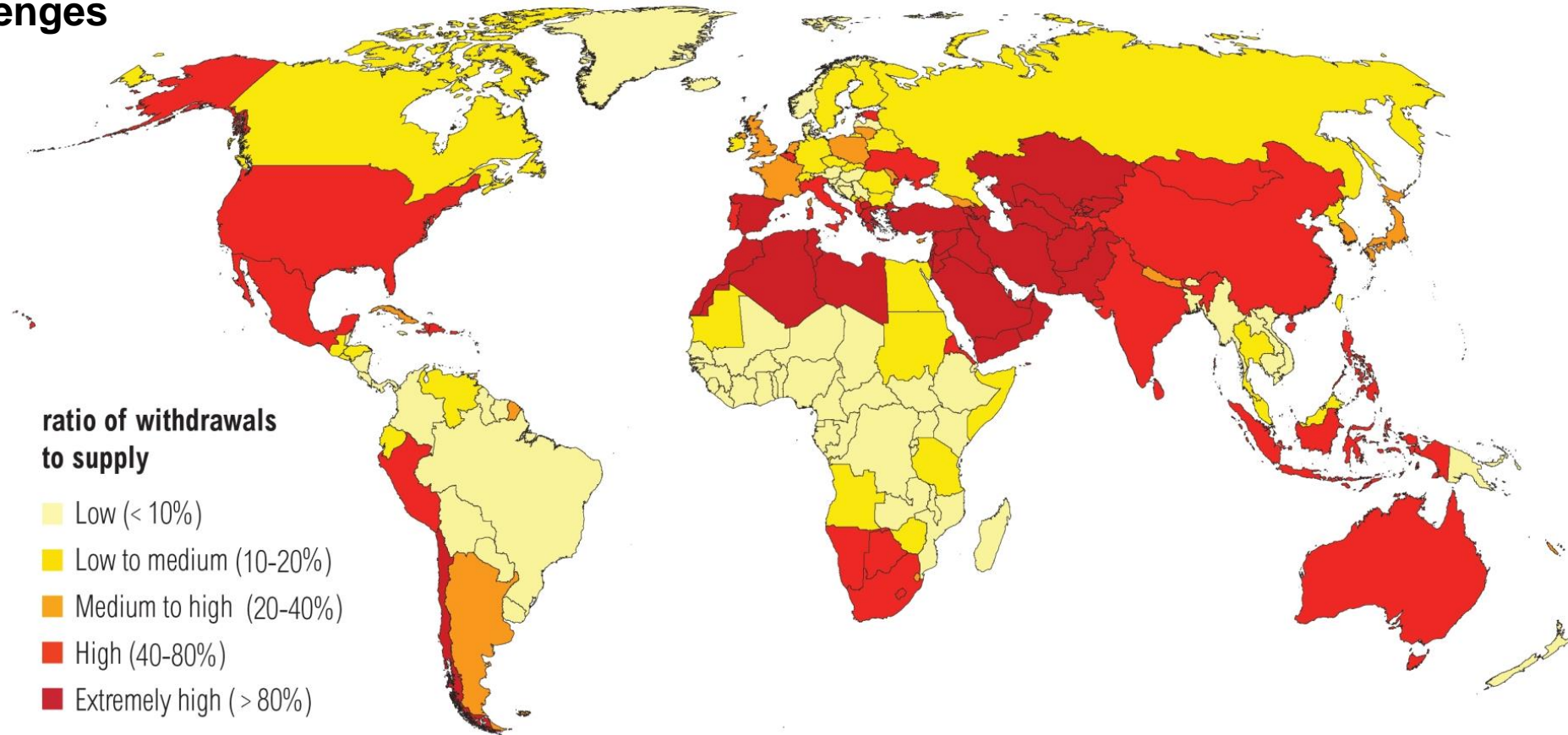
A projected 2030 supply of 15 billion cubic meters leaves a net deficit of 2.7 billion cubic meters. That gap between supply and demand could grow to 3.8 billion cubic meters under a plausible climate change scenario.²

¹Afforestation is considered a demand, as it reduces the supply available for delivery to reservoirs and then to demand centers.
²Assumes 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

Water Stress by Country: 2040

Facts & Challenges



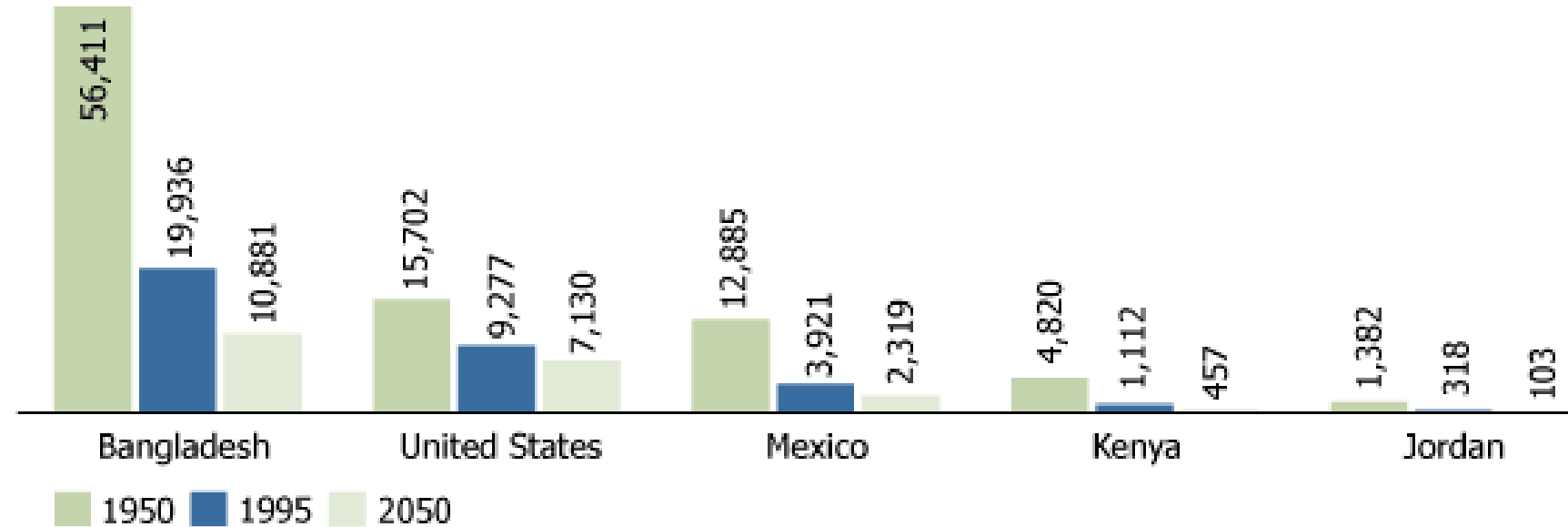
NOTE: Projections are based on a business-as-usual scenario using SSP2 and RCP8.5.

For more: ow.ly/RiWop

Facts & Challenges

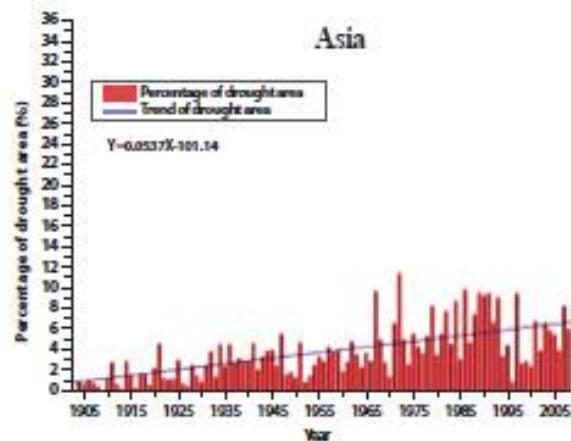
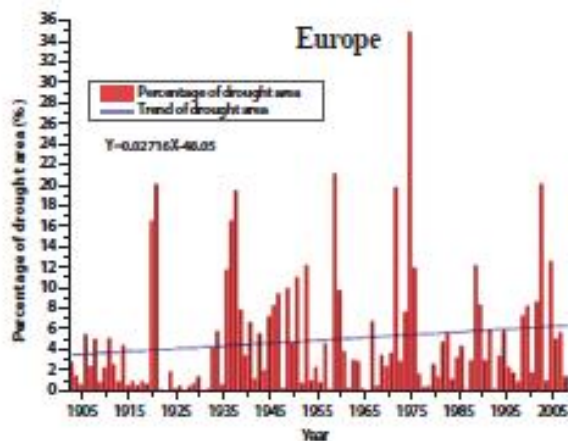
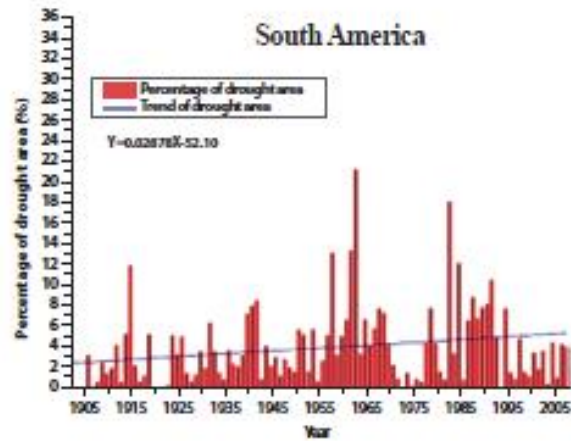
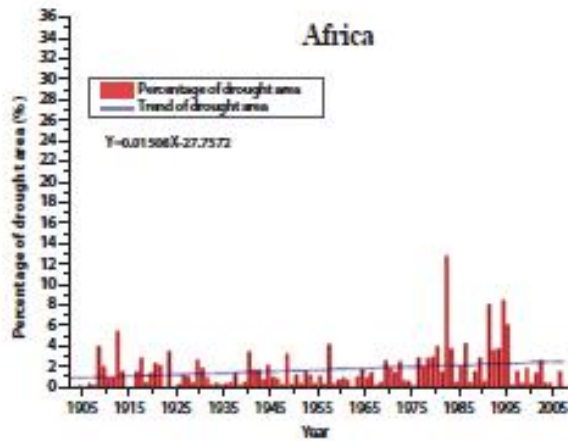
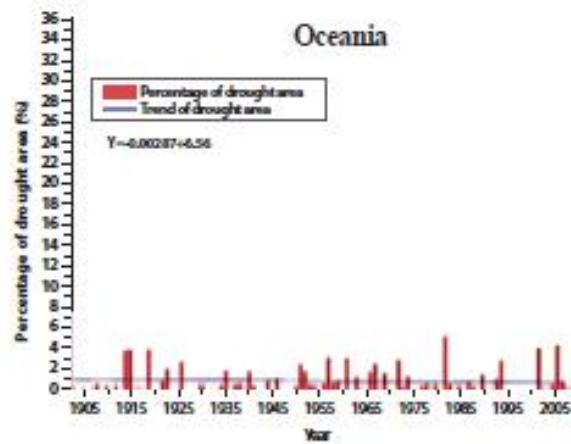
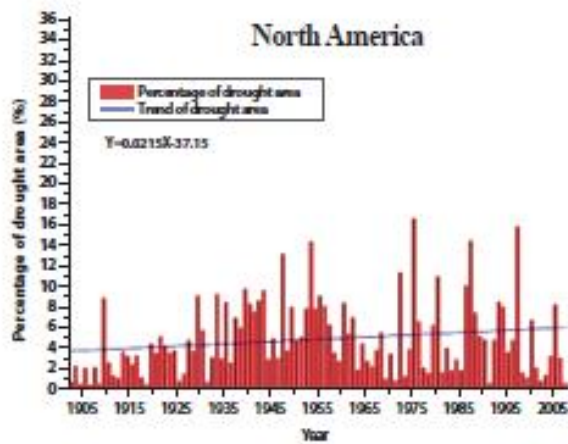
According to a World Bank study (2007), the renewable fresh water availability per capita is expected to halve by 2050 (relative to 2007).

Water in cubic meters



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

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

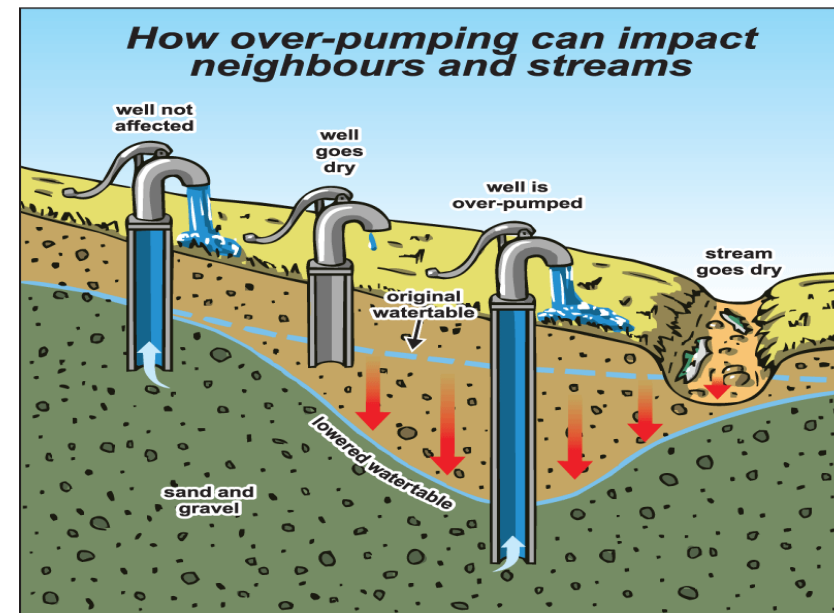


Climate change effects;
Droughts, Desertification, and
Urban Flooding,.....,etc.

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)

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

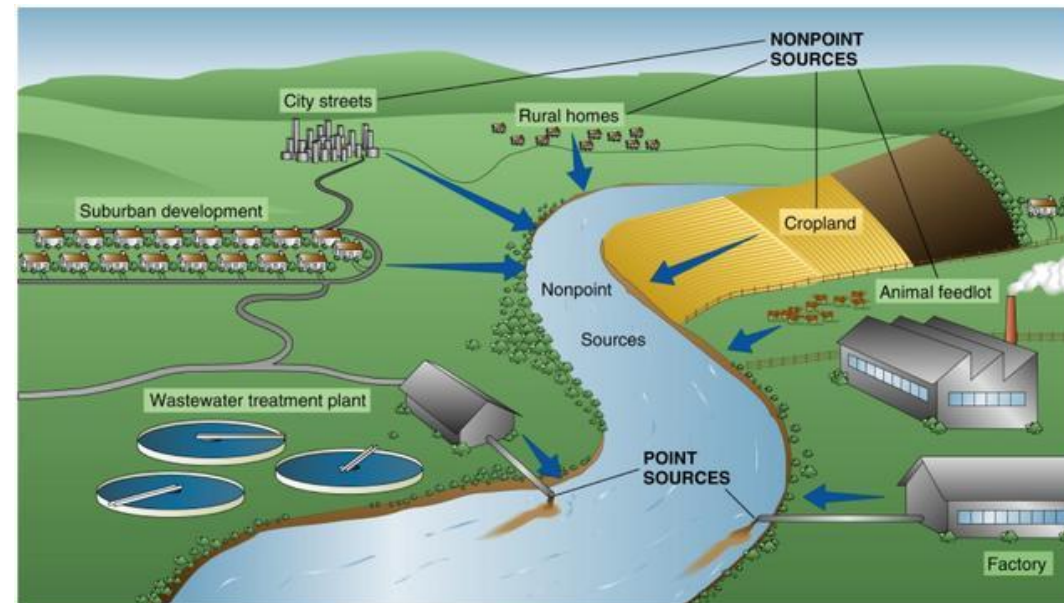
Excessive extraction of groundwater



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



Physical water losses



Apparent losses



Inaccuracies associated with production metering and customer metering



Unauthorised consumption (theft or illegal use)

Unbilled Authorized consumption



Fire fighting and training



Watering of municipal gardens

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.



A small component of NRW includes necessary but unbilled activities such as firefighting, hydrant flushing, municipal construction, and street sweeping.



Main Breaks

There are 650-700 main breaks per day in the U.S., or roughly 240,000 per year.

Tank Overflows

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%

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



Unsurpassed Solutions in the Water Environment



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 carry out the necessary changes



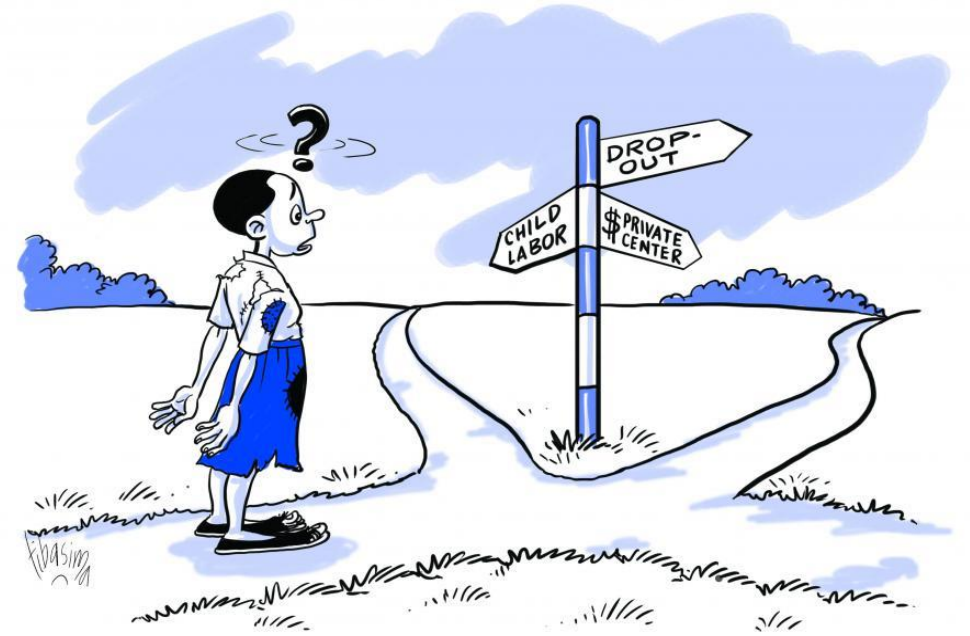
- Unskilled human resources in the water industry
- Inefficient Water Regulatory & Policies
- Underestimated Water Price/Political Constraints.



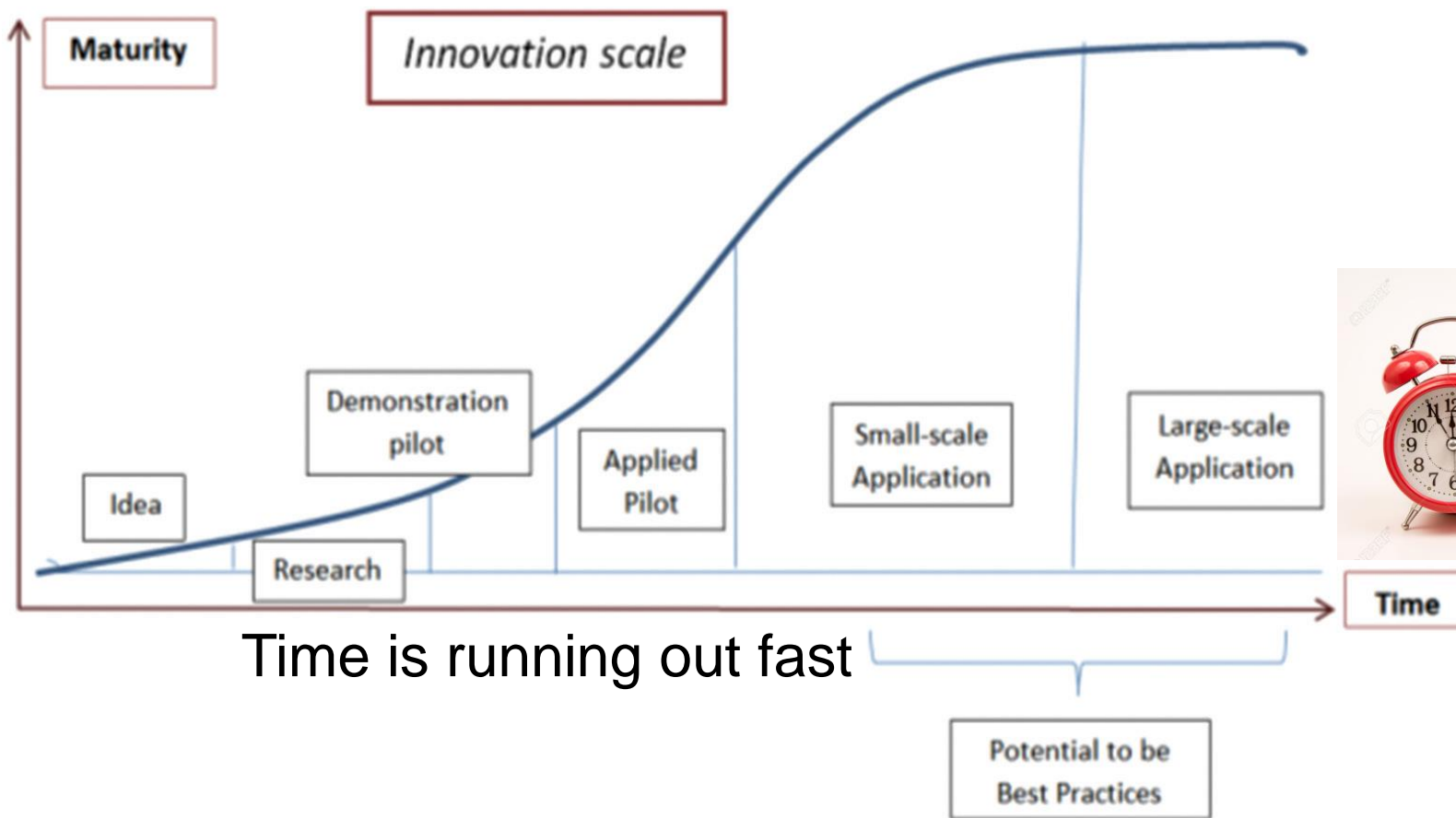


Facts & Challenges

- 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)



Facts & Challenges



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**

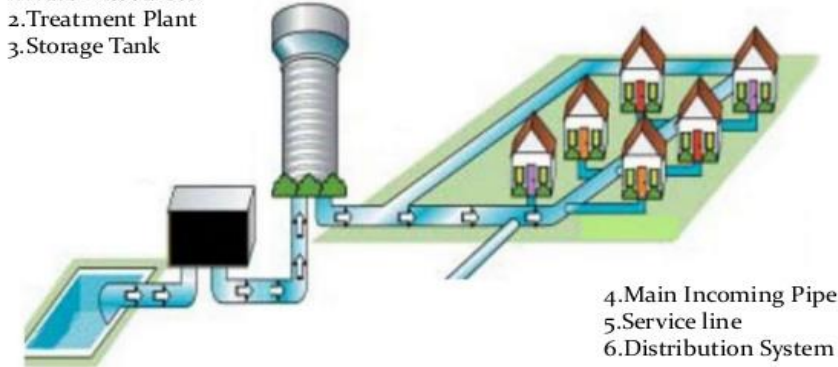
Deal with having enough capacity based on water demands and reducing water losses.

- **Smart Stormwater System**

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

Water Supply Infrastructure

1. Water Resources
2. Treatment Plant
3. Storage Tank





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)

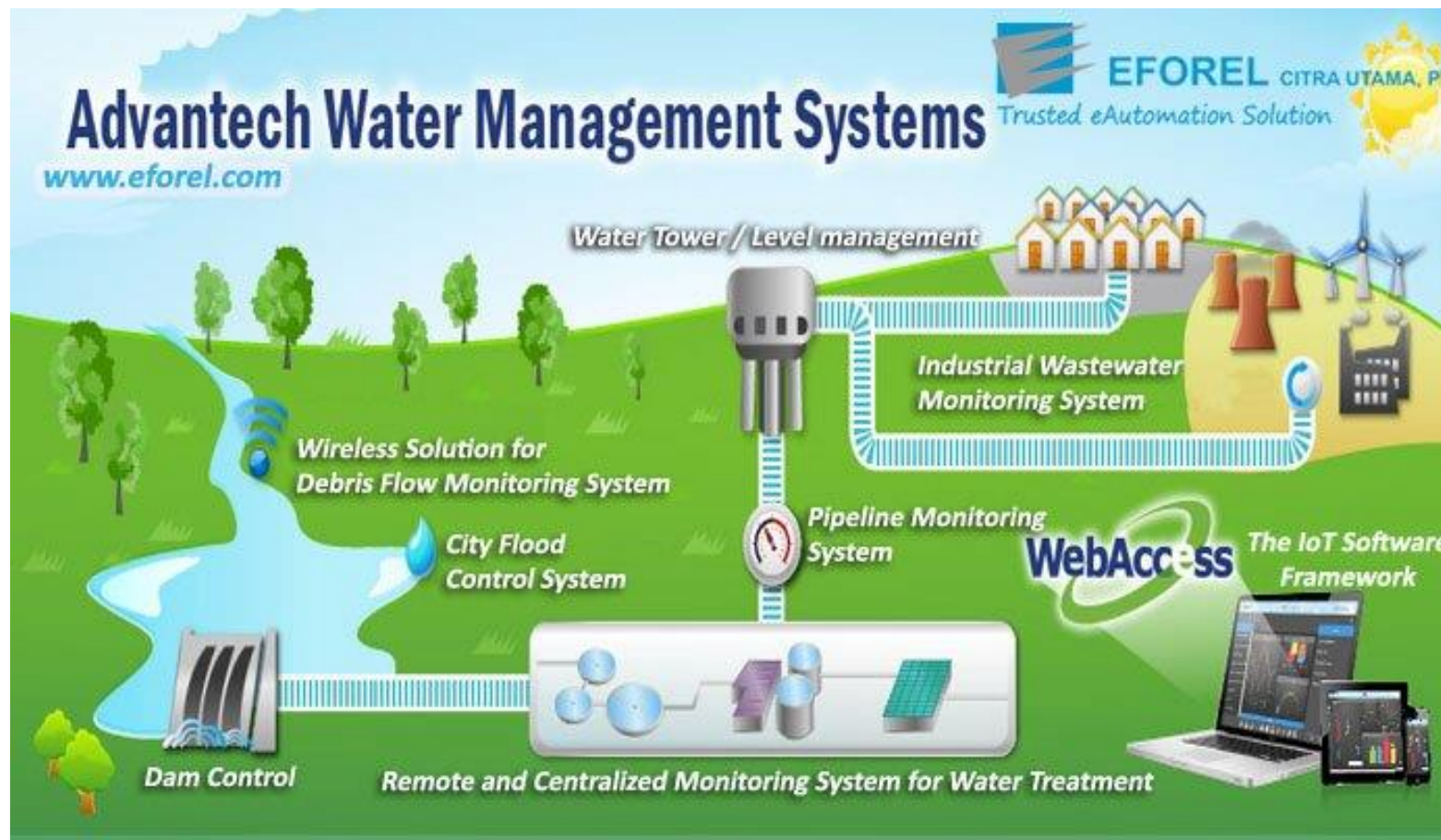
Water Regulatory Efficiency





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.





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

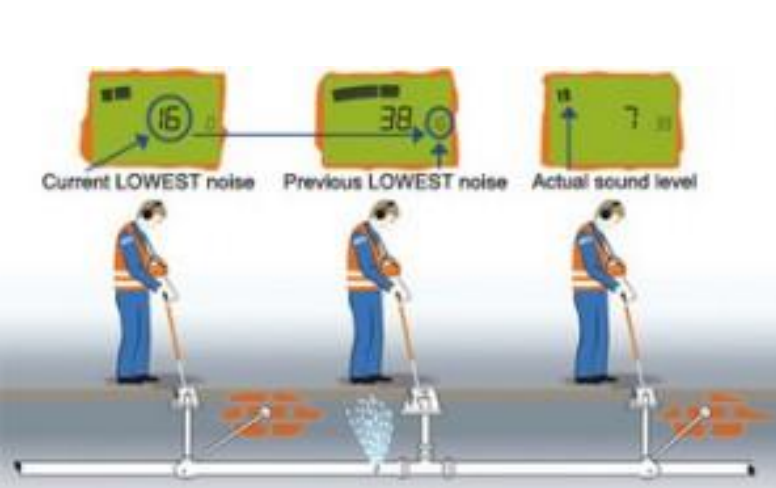
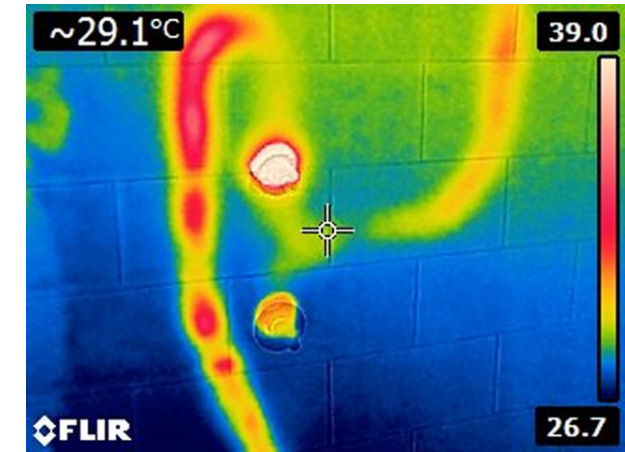
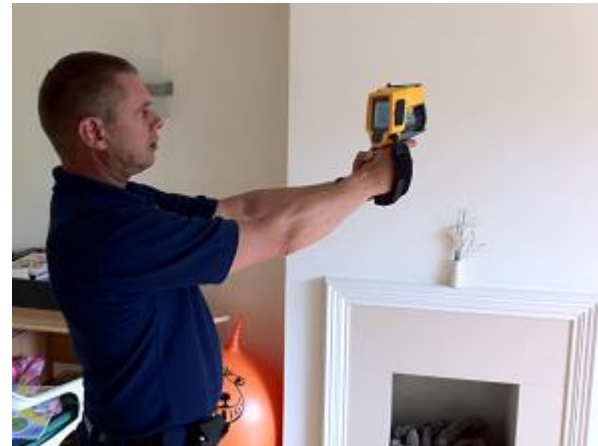
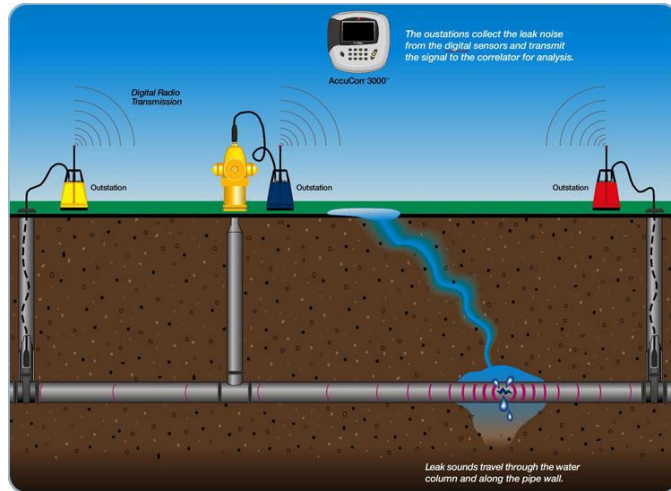
Water Commercial Loss

- 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.



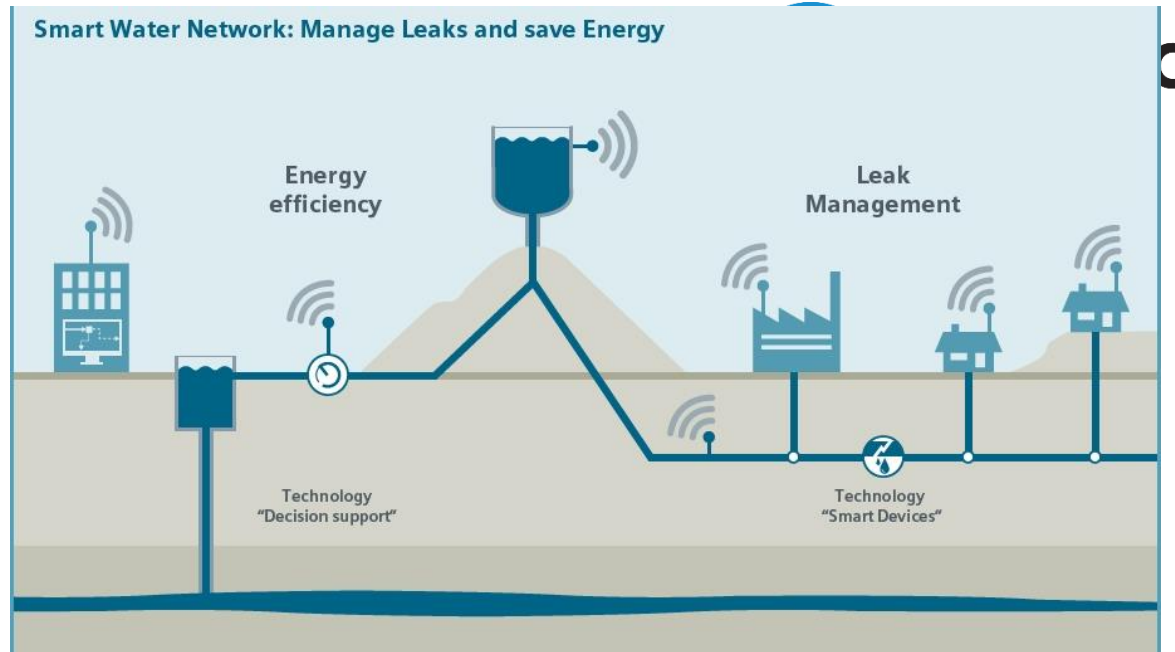


Water Physical Loss

- **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

- Smart rehabilitation & repair of the deteriorating infrastructure



Image diagnosing robot



Small diameter rehabilitation system



Line Care System

100 Years of Water Supply History in Korea, Innovative technology to give re-birth to worn-out large water pipe lines

Automatic remote control system

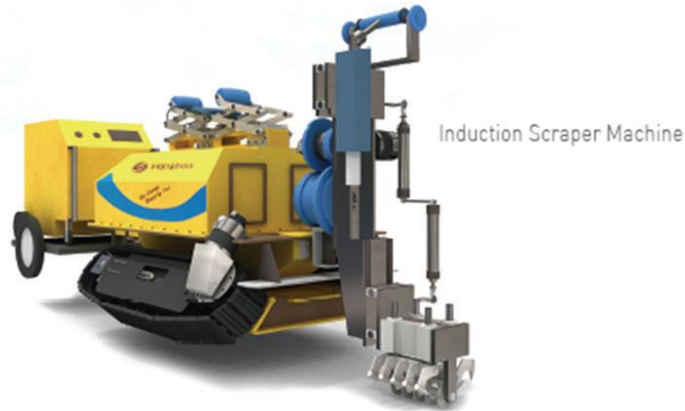
Travelling on the horizontally curved pipe area at 45° and vertically curved pipe area at 22.5°

Using an induction method to remove paint without damage to the pipes

Surface treatment with a high velocity small rotating impeller made available for recycling abrasives



WaterJet Cleaning Machine



Induction Scraper Machine



Inspect pipe drainage and condition

Wash inside of pipes

Remove inside paint

Surface treatment

Painting

Inspect paint, recovery of valve chamber



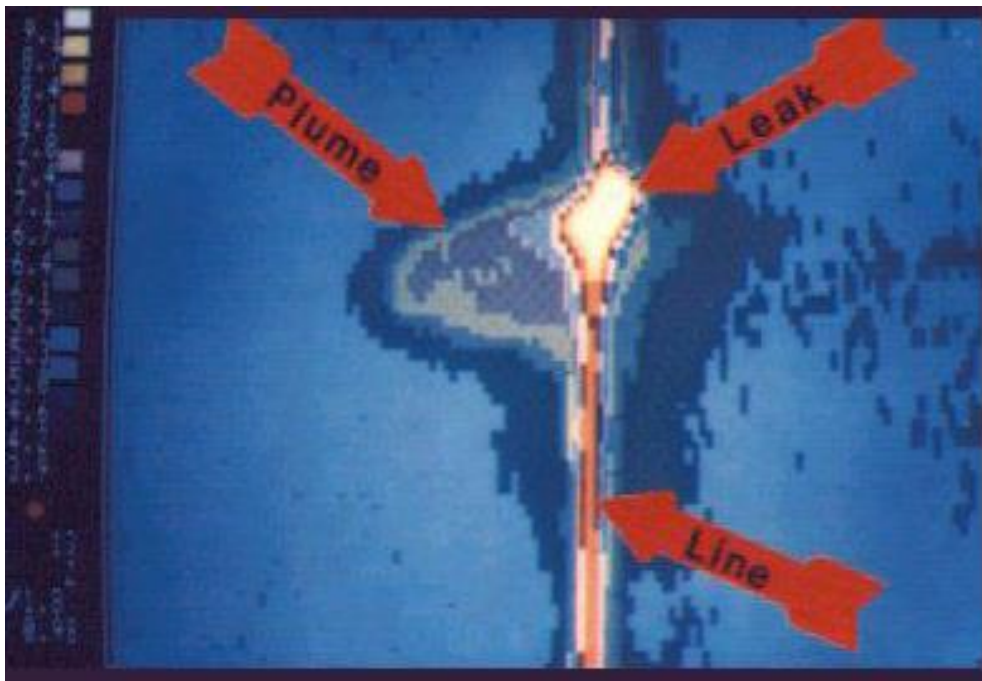
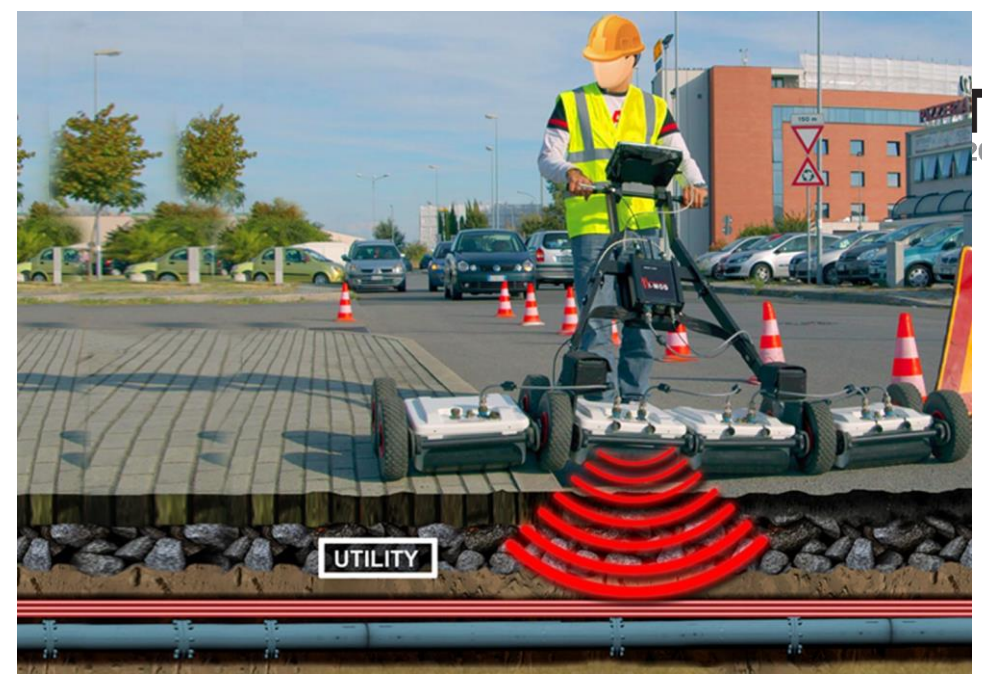
Impeller Blasting Machine

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



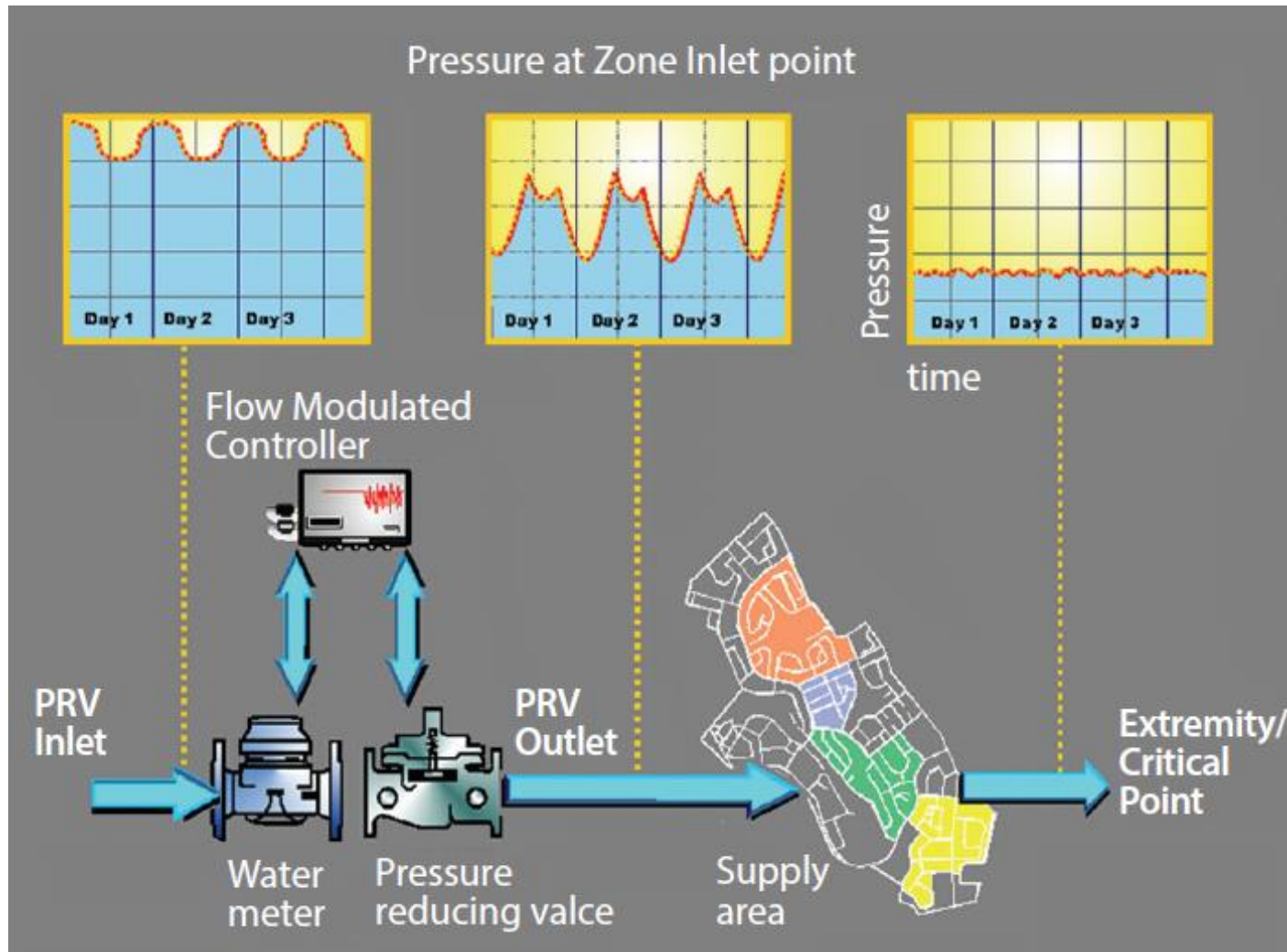
Underground leak running at low pressure
(Brothers K , 2002)



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

Reducing Pipe Losses from Networks by Pressure Management

Flow-modulated pressure

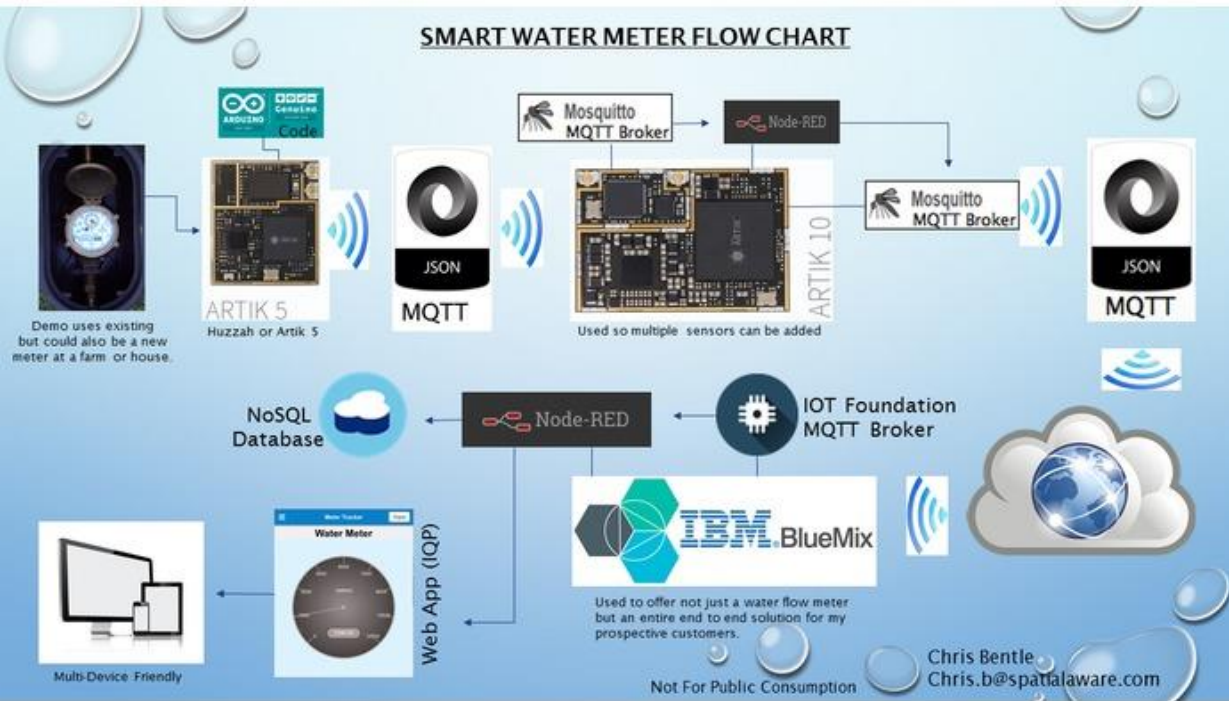


In Tokyo, a control room monitors pressure in each section of the city 24/7, and their role is to reduce pressure where possible.

Flow modulated pressure control (McKenzie R, 2001)

Water Commercial Loss

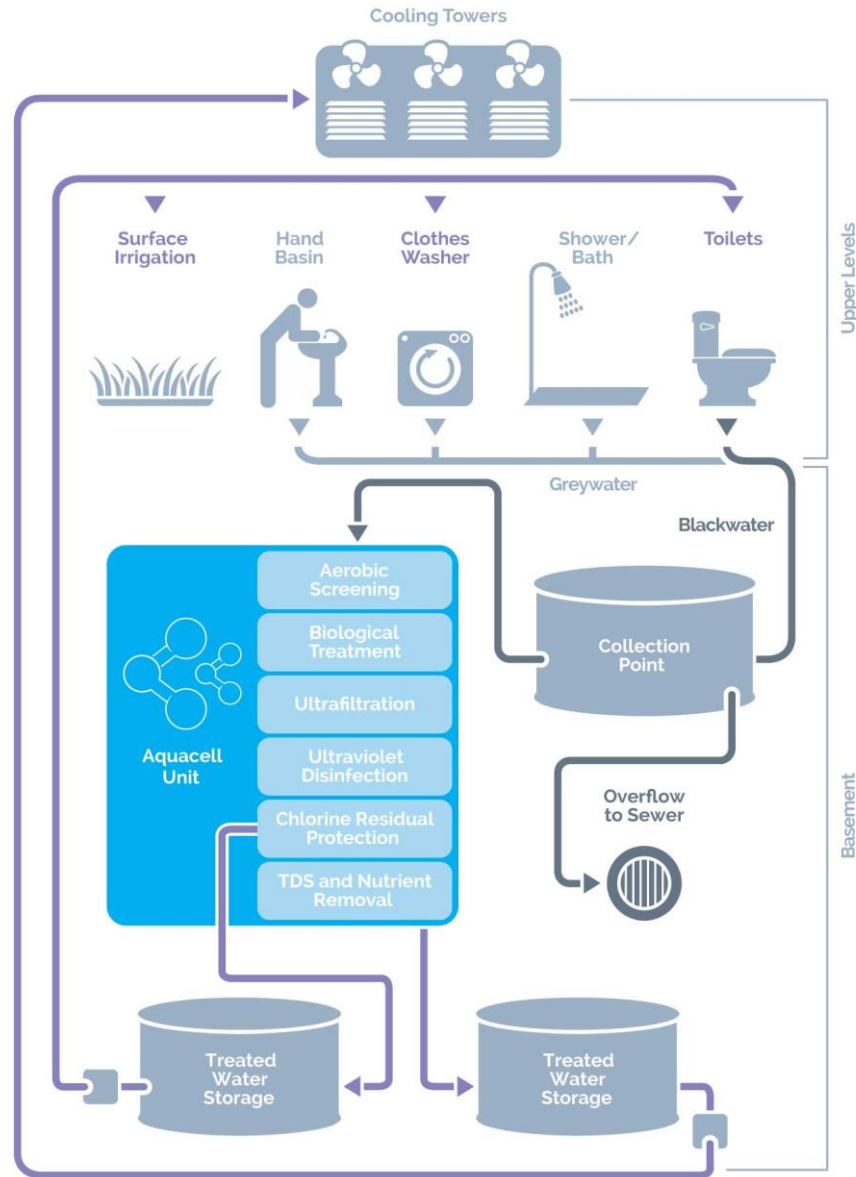
- Smart Meter
- Advanced Metering Infrastructure (AMI)



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

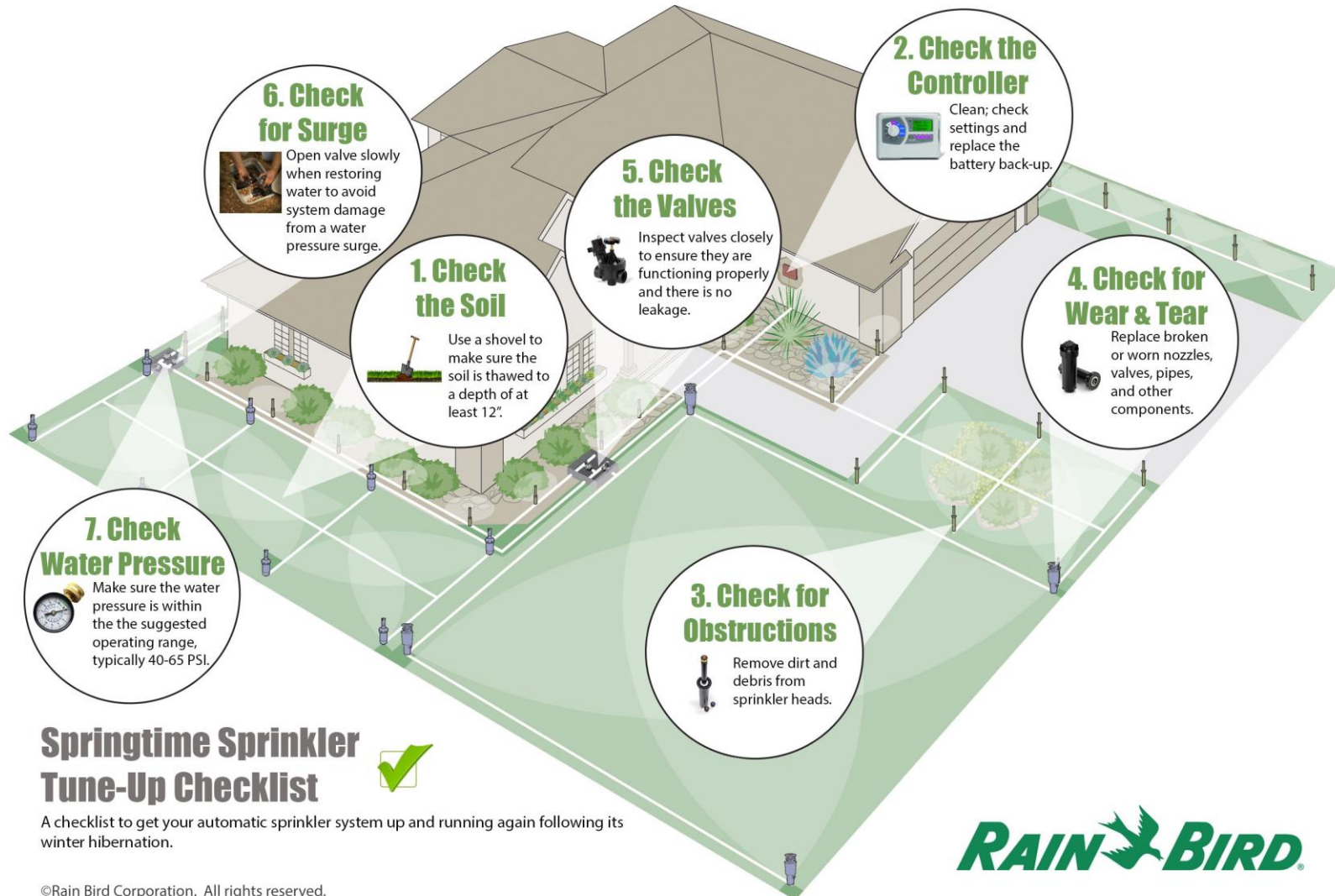
Smart water recycling

- 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.

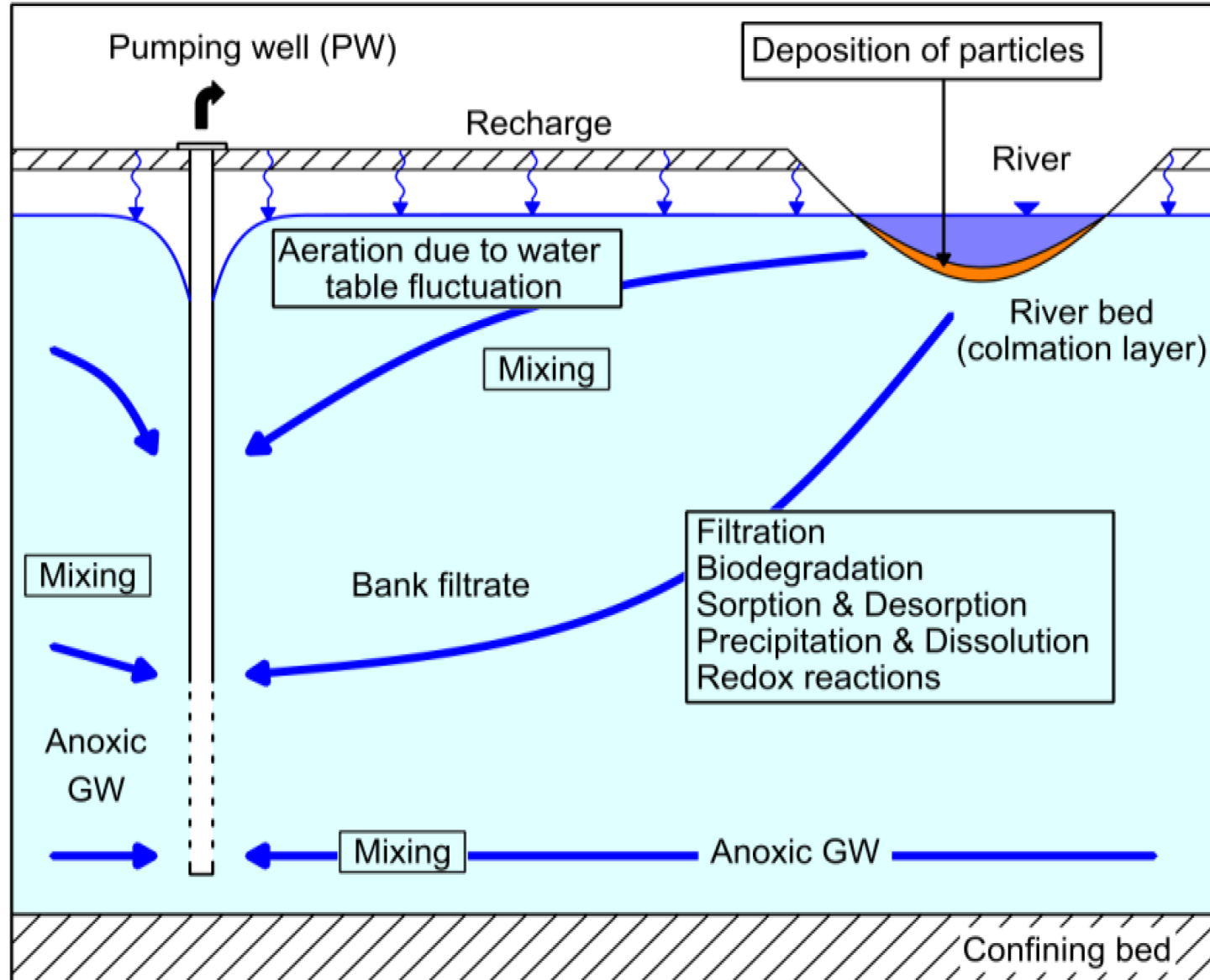


Springtime Sprinkler Tune-Up Checklist



A checklist to get your automatic sprinkler system up and running again following its winter hibernation.

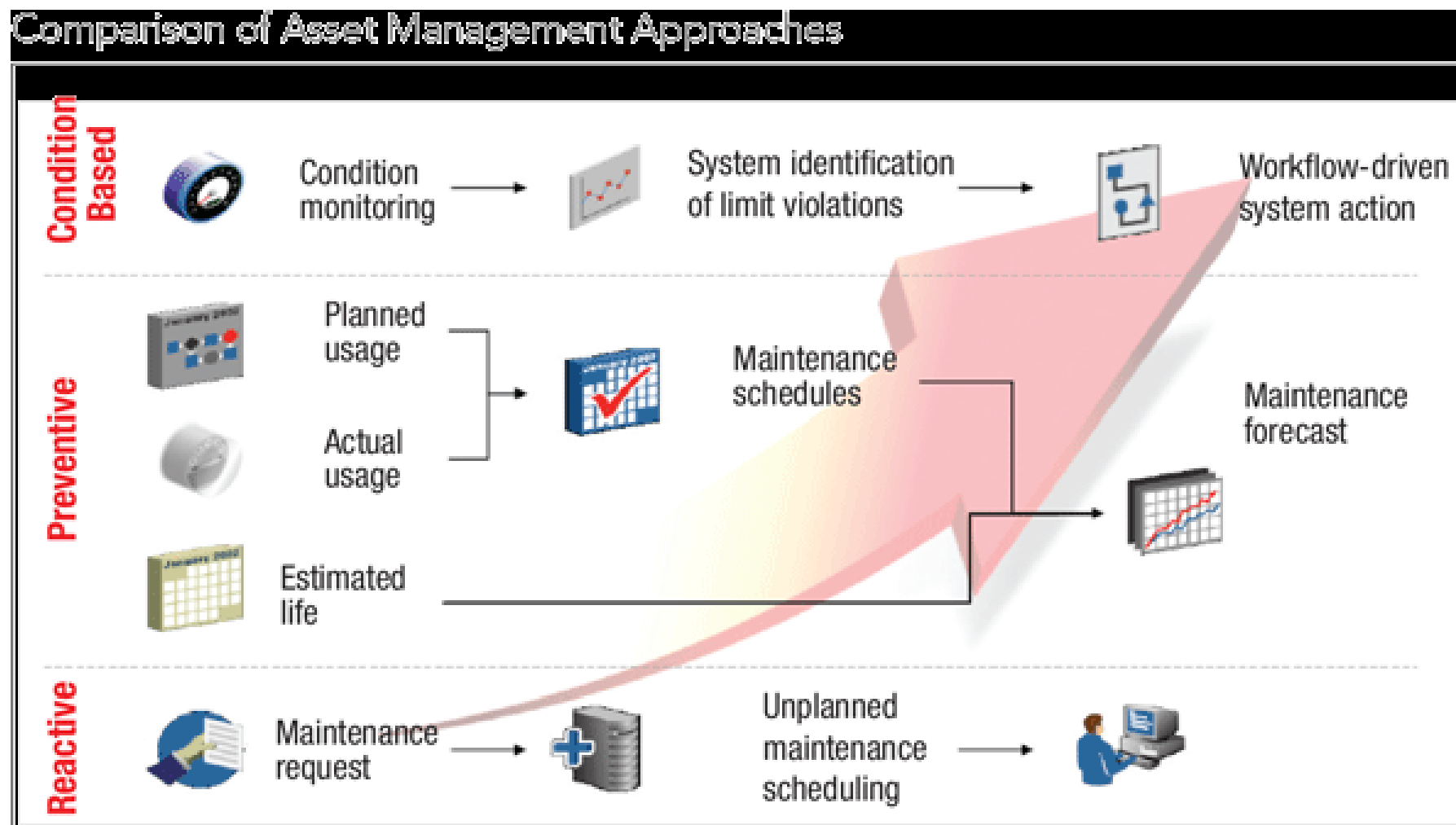






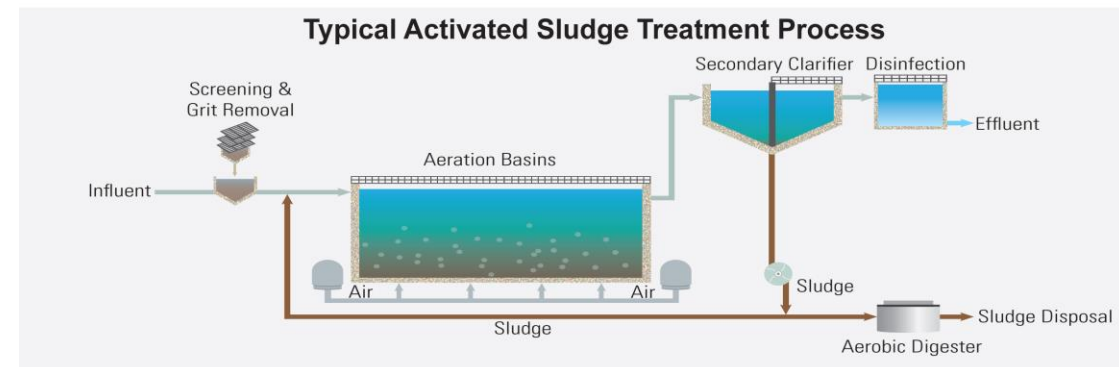
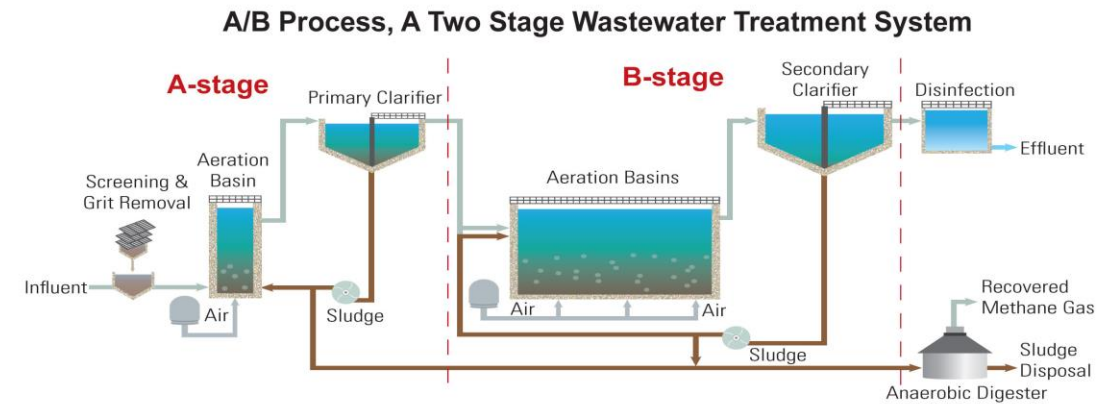
Smart Water Infrastructure Asset Management

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



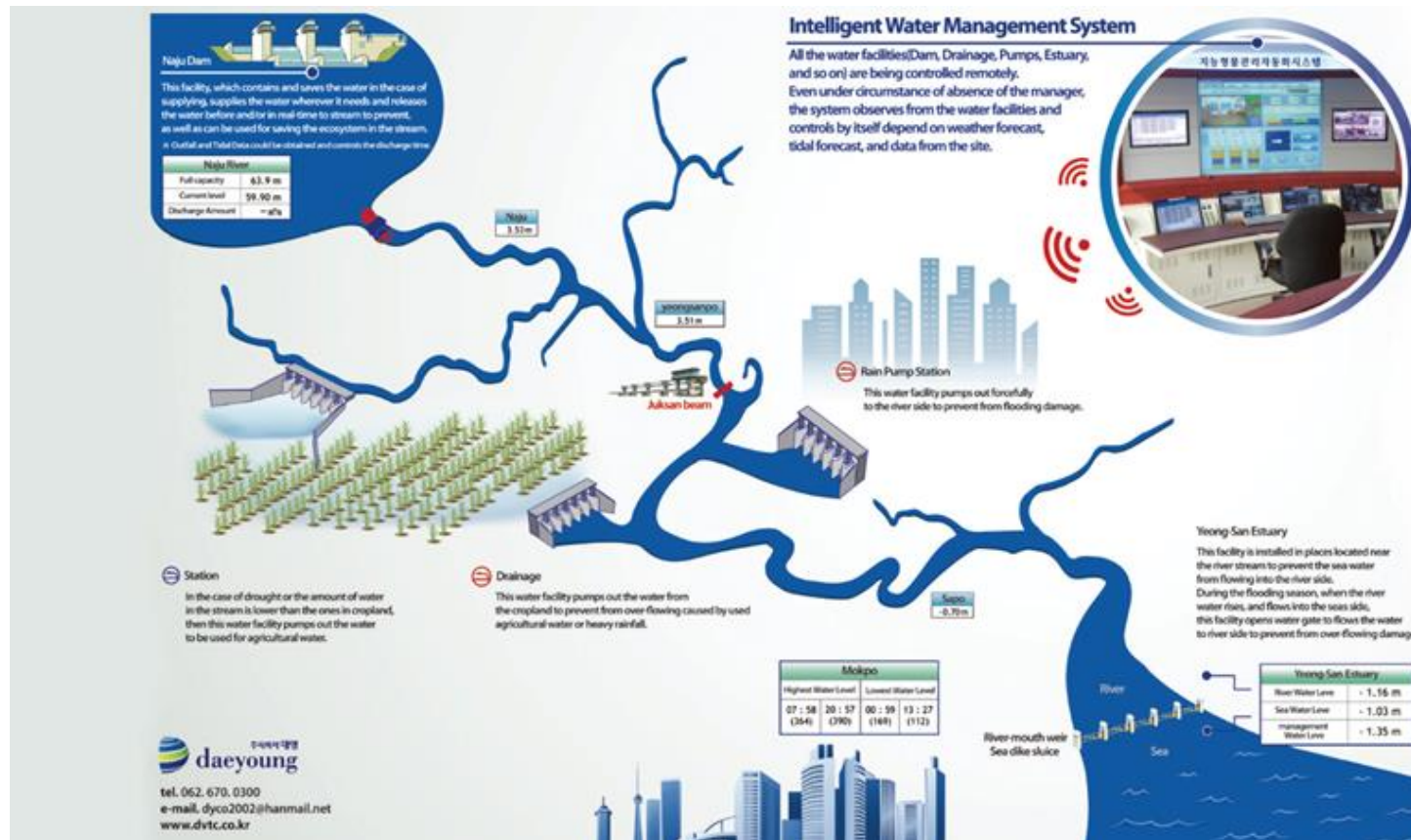
Energy efficiency in water and wastewater systems

- 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.





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.

Locked in one of California's driest winters ever recorded, on January 27 state officials released the final version of the California Water Action Plan. A high-level outline of the state's official vision and goals for water management over the next five years, the Water Action Plan describes 10 major actions intended to address the most pressing water issues facing California.

10 major actions intended to address the most pressing water issues facing California.

- 1** Make conservation a California way of life.
- 2** **INTEGRATED WATER MANAGEMENT** across all levels of **GOVERNMENT**
Improved environmental quality for the Delta
- 3** **quality for the Delta**
- 4** **Protect and Restore IMPORTANT ECOSYSTEMS**
- 5** **Manage and prepare for dry periods.**
- 6** **Expand water storage capacity improve groundwater management.**
- 7** **Provide safe water for all communities.**
- 8** **INCREASE flood protection**
- 9** **Increase operational and regulatory efficiency.**
- 10** **Identify sustainable and integrated financing opportunities.**

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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;

Community-Based Flood Early-Warning System

To enhance the resilience of 45 vulnerable communities to flood hazards, ICIMOD, together with its partners Aaranyak (India) and SEE (Nepal), established the Community-Based Flood Early-Warning System project. The ICT-enabled system uses a flood sensor attached to a transmitter to detect rising water levels. When the water reaches a critical level, a signal is wirelessly transmitted to the receiver. The flood warning is then disseminated via mobile phone to concerned agencies and vulnerable communities downstream. Critical flood levels are set with the help of the local community.

How it Works

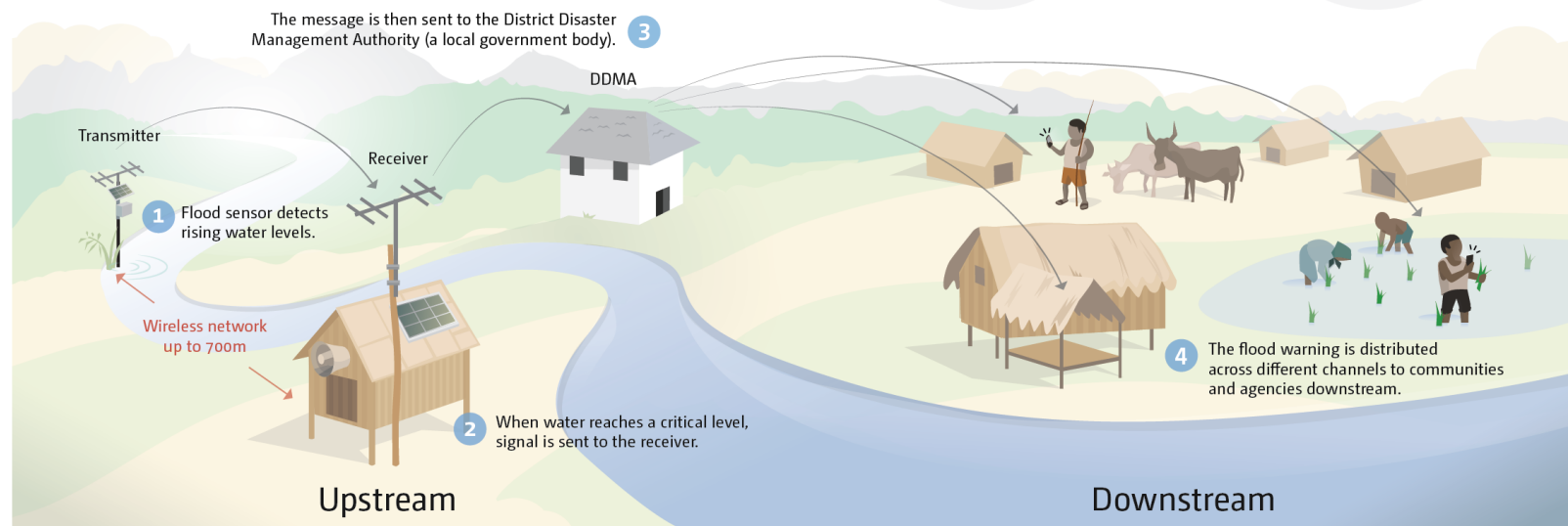
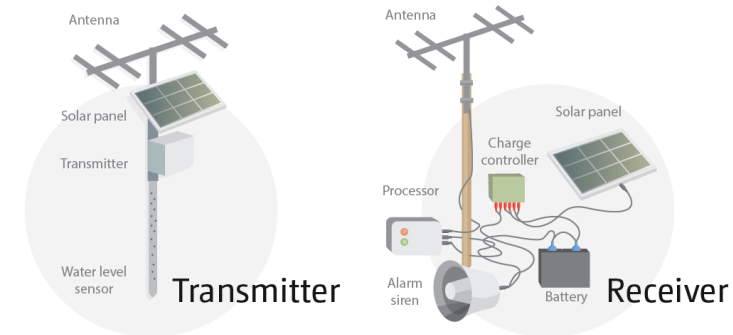
The ICT-enabled system installed upstream sends warning signals to flood-vulnerable villages downstream when water reaches a critical level. This gives people time to move out of harm's way, saving lives and property.

Early-Warning System

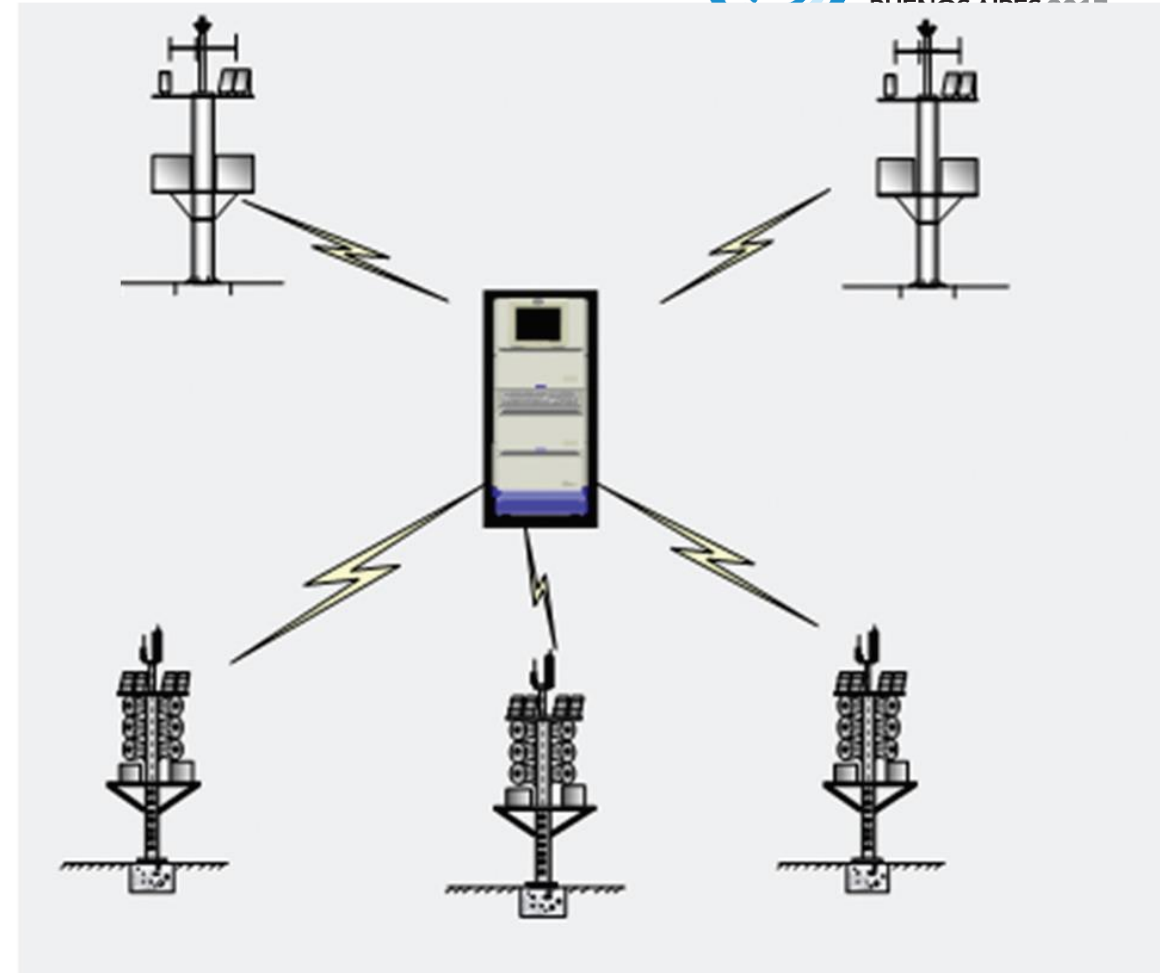
The warning system consists of sensors that wirelessly transmit information about river water levels to a receiver.



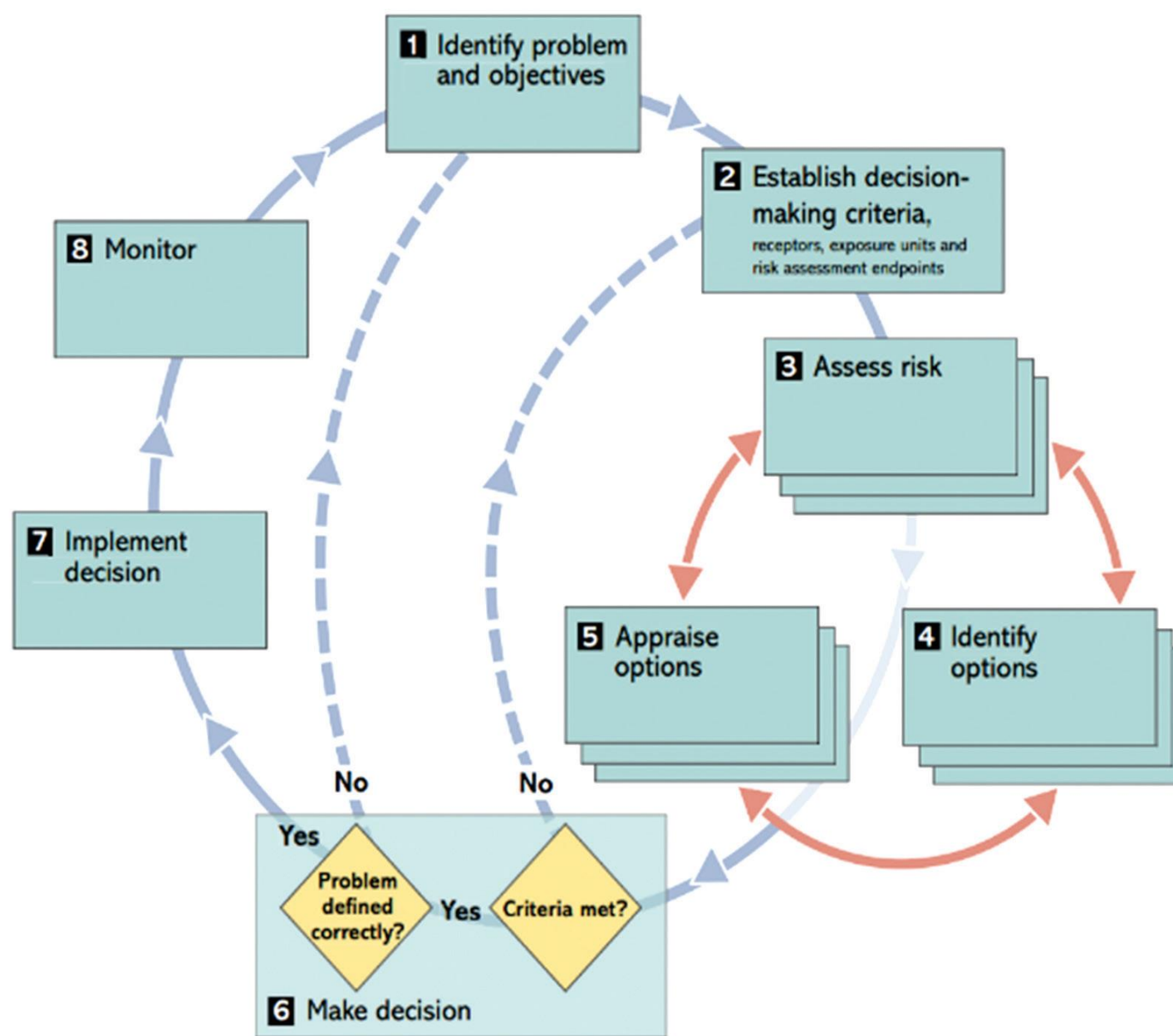
INDIA



INDIA



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



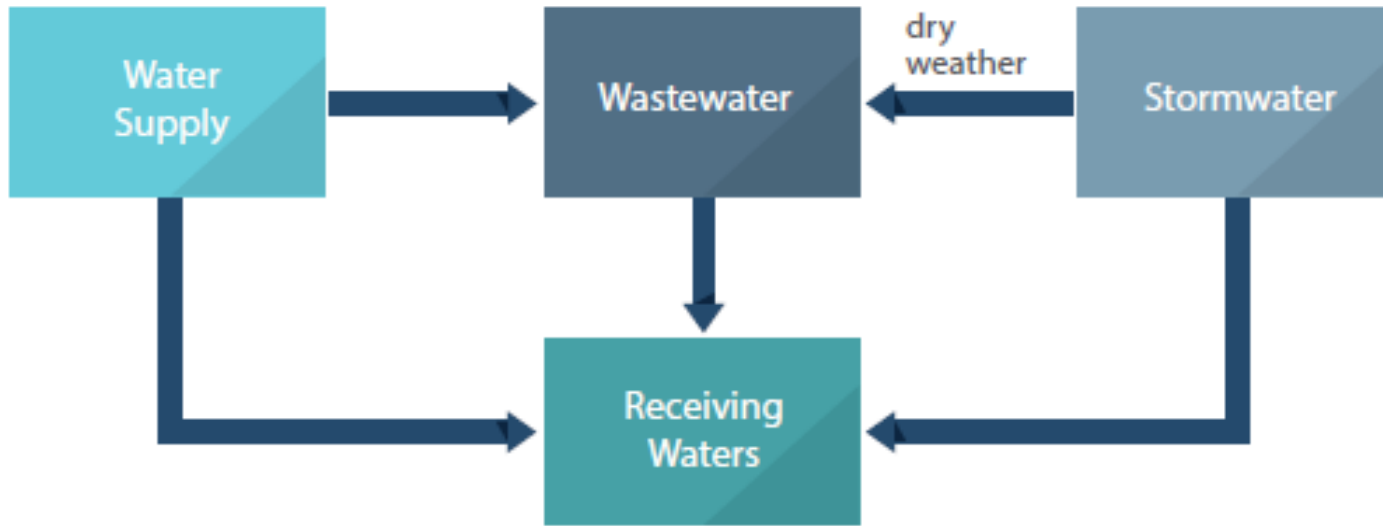
A framework to support good decision-making in the face of climate change risk (Willows et al. 2003)



Integrated Enterprise Web and Mobile Based ICT Smart Water Management

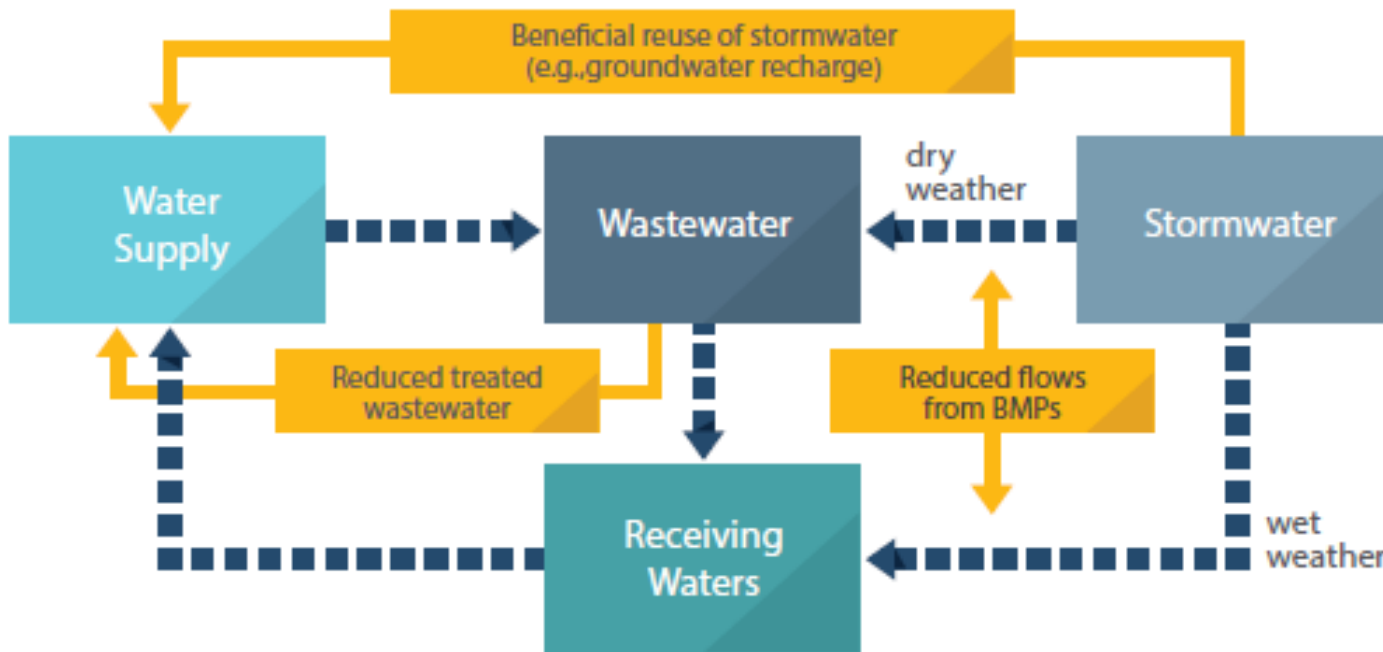


Non-Intergrated Water Resource management



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

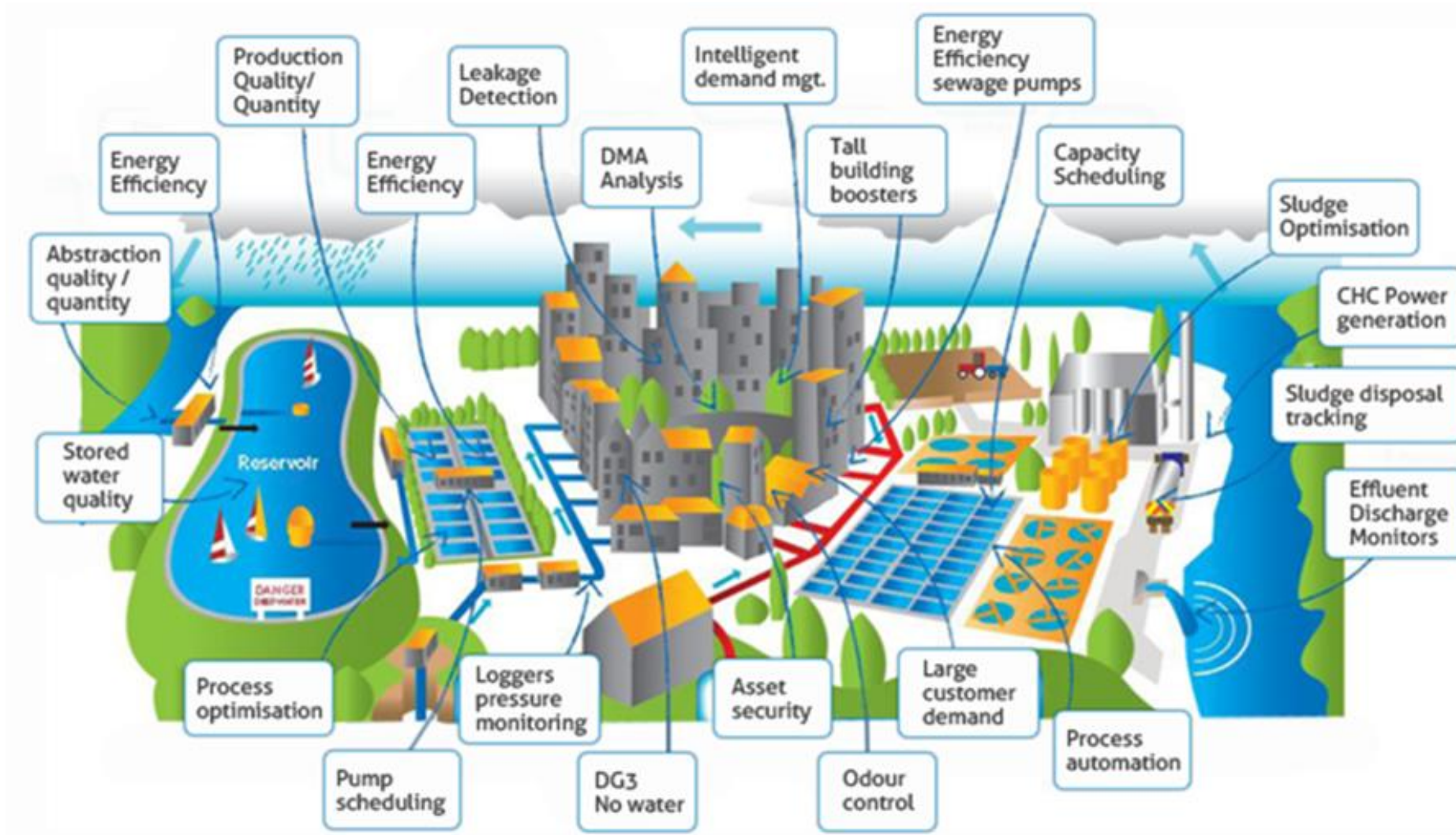
Total Water Management (Intergrated Water Resources)



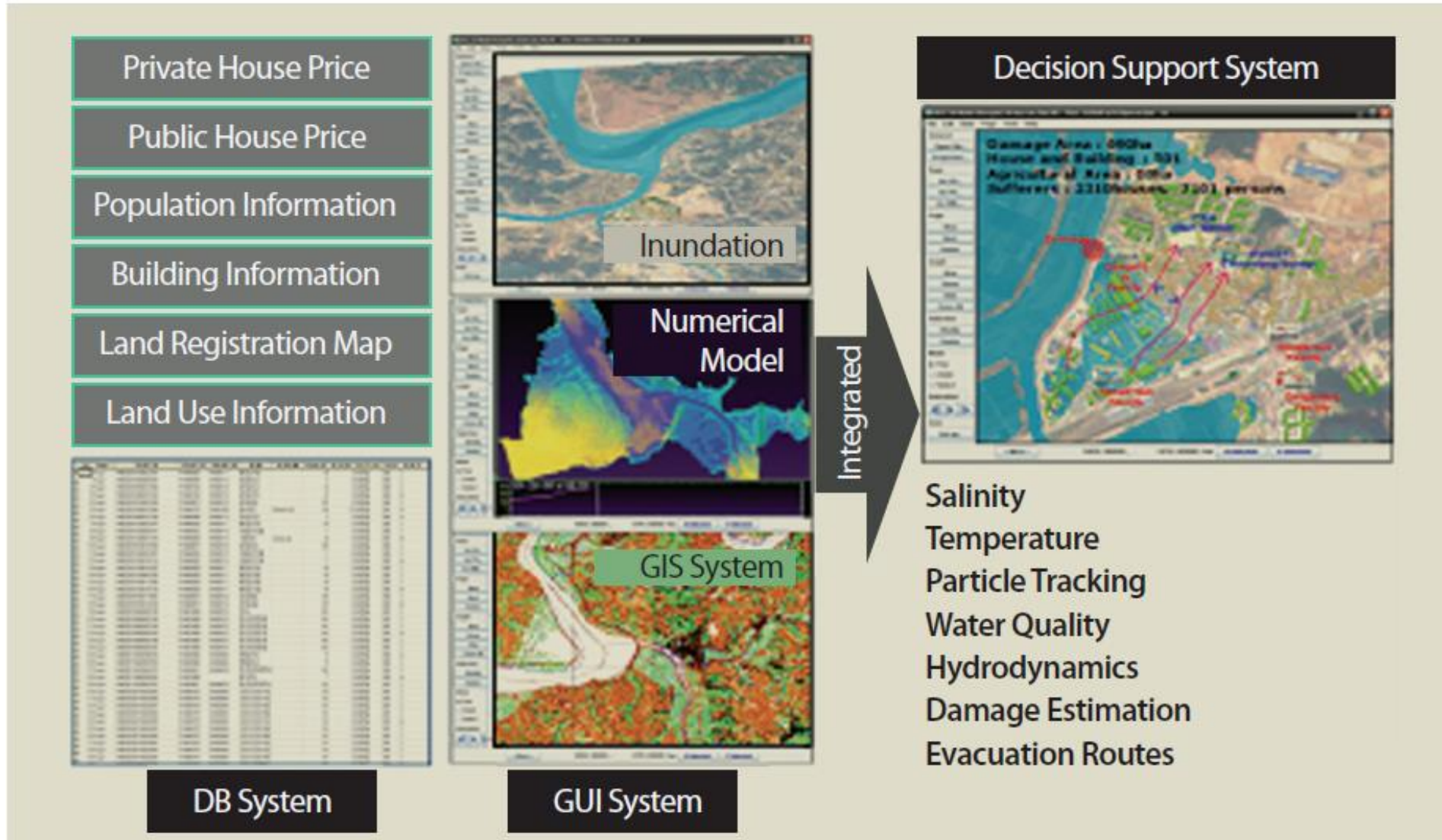


• Smart Water Grid

Managing at scales ranging from basins to households.

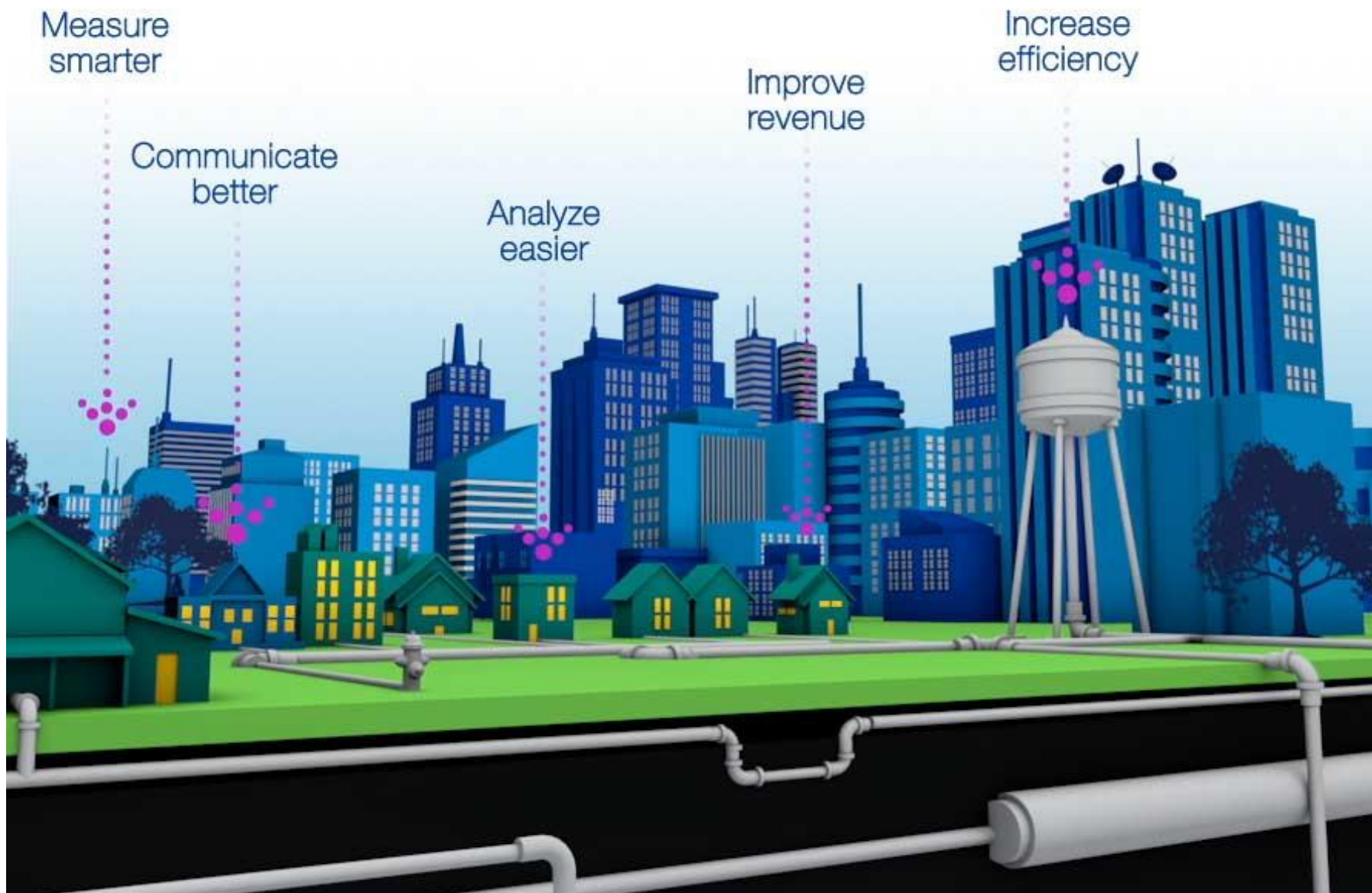


• Enable robust management of Big Data



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

