Towards Water-Smart Cities

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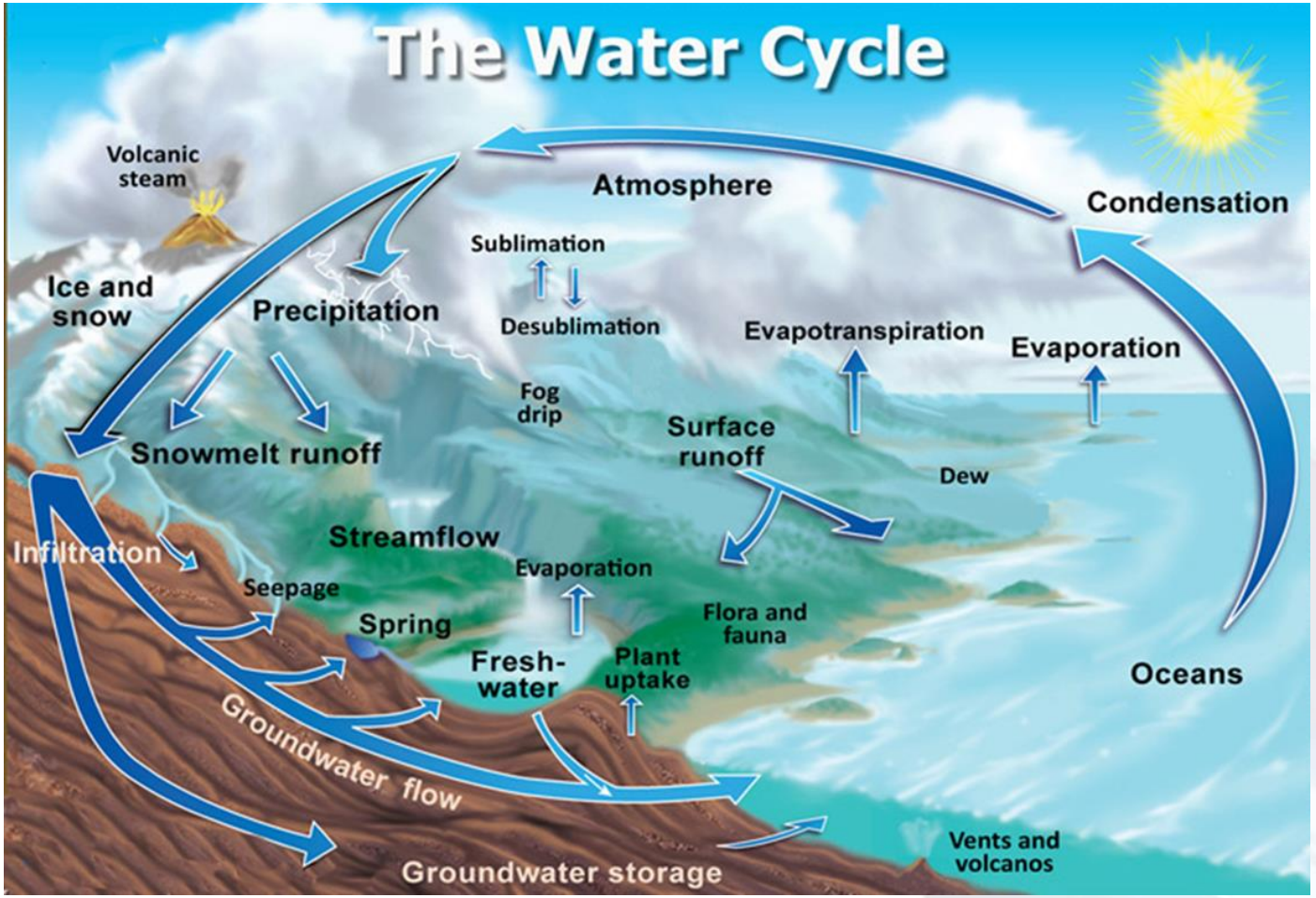
Introduction

- **Water scarcity** is the lack of sufficient available water resources to meet the demands of water usage within a country or a region, which is, according to the “United Nations Development Programme,” caused mainly by **poor management** of those resources, affecting around **1.2 billion people** around the world,
- Water develop cities and civilizations across the globe. Both **water quality and quantity** are essential for our communities,
- **Water Smart City** starts with **water policies** that promote water efficiency regulations and improve water management practices,
- We at the **Water Research Center of KISR** support different stakeholders for **developing technologies and proposing plans** to increase water use efficiency and reuse leading to enhance Kuwait water security,


The Water Cycle
Volcanic steam
Atmosphere
Condensation
Sublimation
Desublimation
Ice and snow
Precipitation
Evapotranspiration
Evaporation
Fog drip
Surface runoff
Snowmelt runoff
Dew
Streamflow
Infiltration
Evaporation
Seepage
Flora and fauna
Spring
Fresh-water
Plant uptake
Oceans
Groundwater flow
Vents and volcanos
Groundwater storage

What is Smart Water City?

"Smart Water" is simply: to upgrade the water infrastructure with innovative and smarter technology.

Smart water system is designed to gather necessary and integrable data about the flow, pressure and distribution of a city's freshwater & wastewater.

Municipal leaders can make better and faster decisions about their operations, which can result in up to ***30% energy savings*** *and up to* ***15% reduction of non-revenue water (NRW)***

Smart Water Infrastructure

Within the CITY:

Sensor technology, automation and control devices, and data analytics software throughout the infrastructure system are all needed to make a system "smart."

Water UTILITIES:

Upgrades throughout the system including more efficient plant operations, optimization of pumping, asset management, power usage optimization, leak detection, detection of contaminants, and consumer access to individual usage. **This is no small undertaking!**

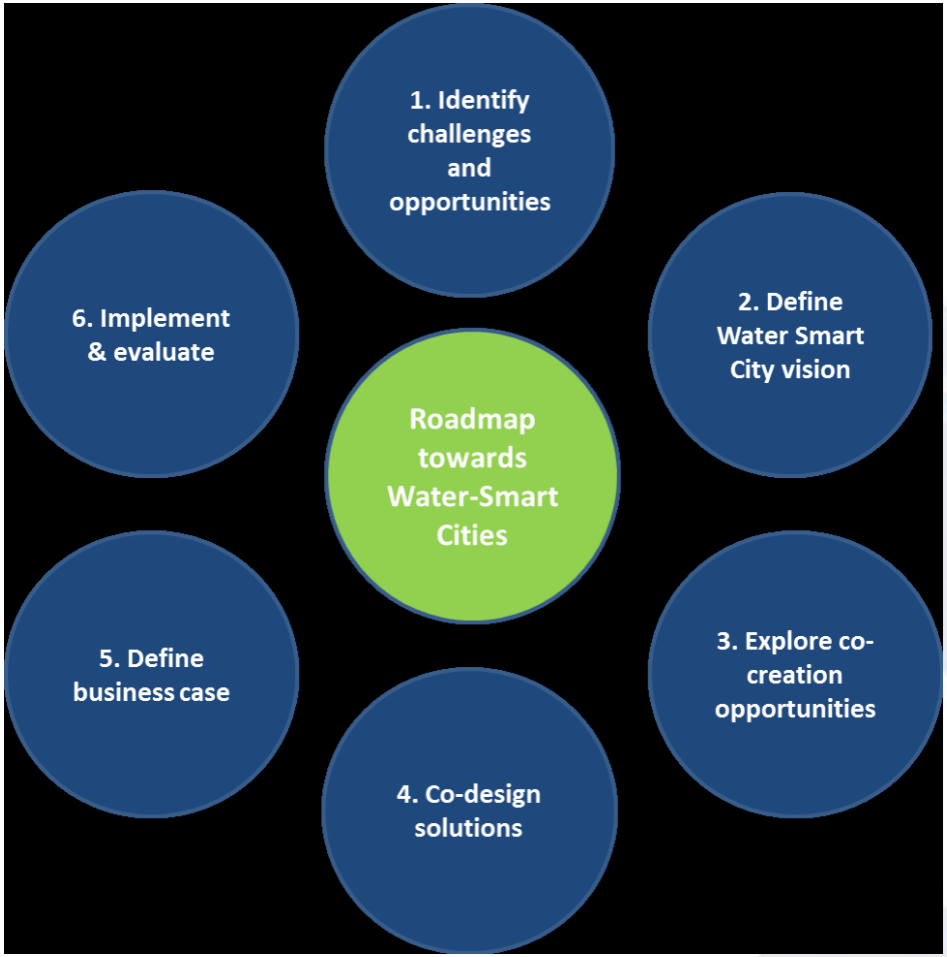
"***The U.S. water infrastructure breaks once each minute and about 540,000 times each year. The entire network is comprised of about 2.9 million KM of water distribution lines. Because of the age of the infrastructure, it leaks about six billion US gallons of fresh water per day"***,
American Water Works Association (AWWA).

Intelligent Water Management

- **Water Sectors** are under pressure from growing demand, cost of new infrastructures, increasing energy prices and aging water systems.

- **Cloud Connection** for real-time analyses and automated alerting sensors and meters;
  - Enable data capture over **Large Distances**,
  - Accurately **Map Losses** due to leaks and evaporation, and take targeted **Corrective Action**.

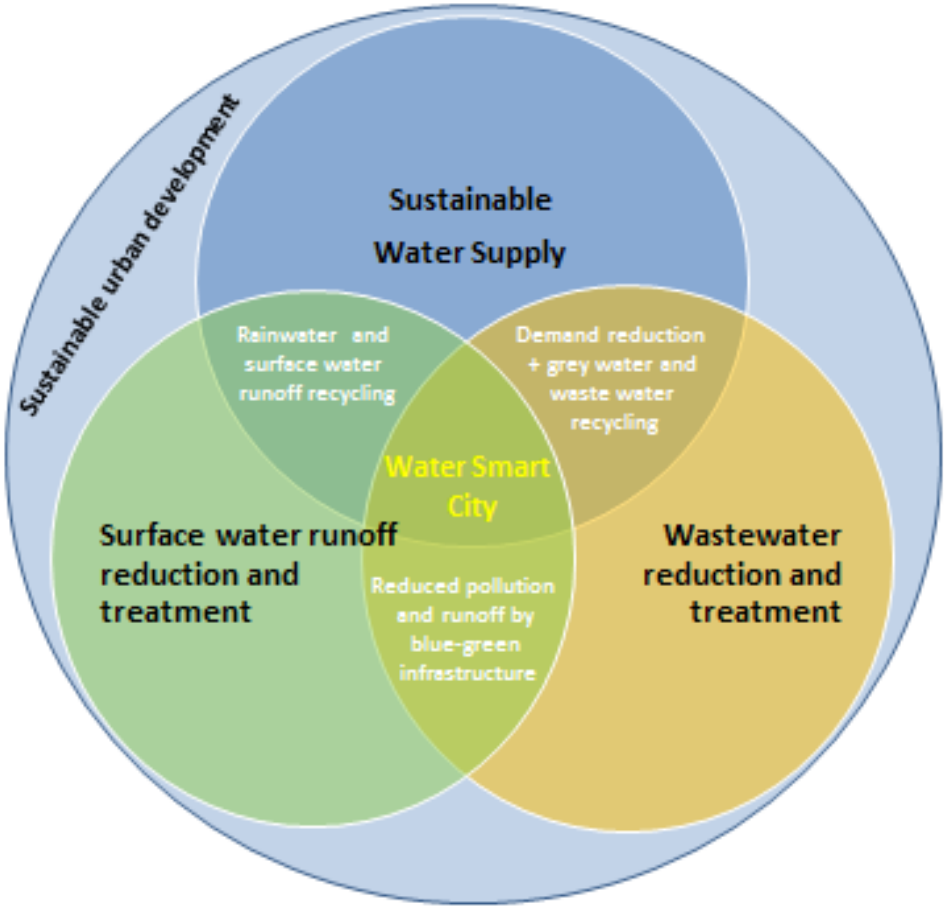
- Through **Intelligent Water Network** solution, **water utilities will account for every drop.** Smart Water Network



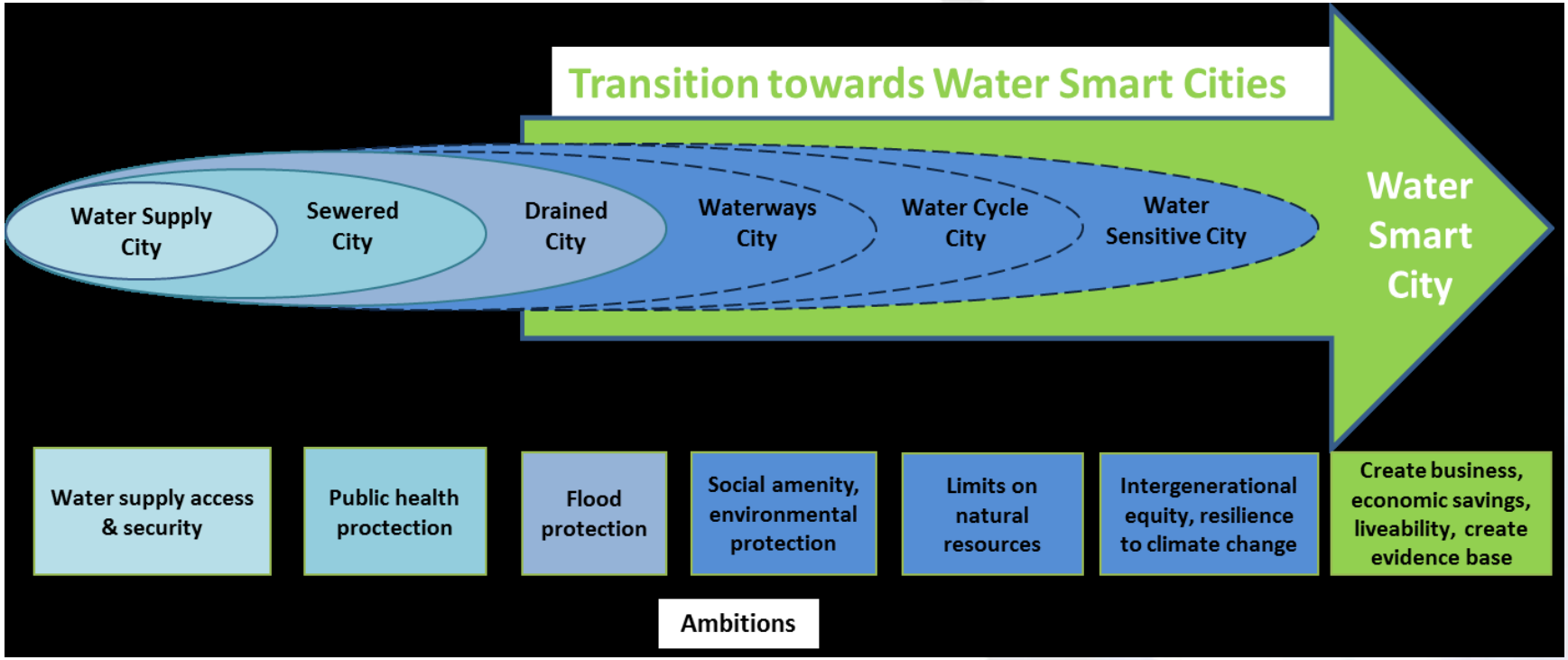
After Tim van Hattum, et al, 2016

Steps towards Water Smart Cities

SMART WATER within SMART CITY



Integrating Sustainable Urban Development & Urban Water Management


Transition towards Water Smart Cities
Water Supply City
Sewered City
Drained City
Waterways City
Water Cycle City
Water Sensitive City
Water Smart City
Water supply access & security
Public health proctection
Flood protection
Social amenity, environmental protection
Limits on natural resources
Intergenerational equity, resilience to climate change
Create business, economic savings, liveability, create evidence base
Ambitions

Closing the Urban Water Cycle

Smart Practices

Industry:

- **Remote Alerts**:

Send instant alerts of machine ***breakdowns, rejections or deviations*** to the corresponding persons,

- **Track Quality**:
  - **Monitor the Water Quality** and chemical discharge in storage and transmission points. Combined with GIS and map data,
  - **Identify Sources of Pollution Discharges**. Quantify the level of pollution over time for regulatory action. Also, monitor deterioration of water quality due to pipe corrosion.

Smart Practices

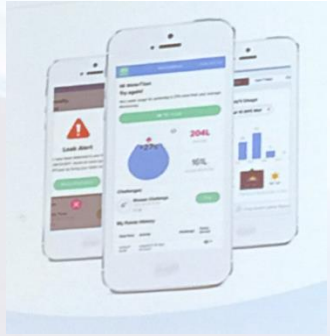
- **Industry:**
  - **Smart metering system:**
    - **Turbine Meters** designed for bulk flow applications to **Monitor Flow and Leakage** in distribution systems,
    - **Combination Meters** designed for bulk flow applications where **Large Variations in Flow Rate** occur, making them suitable for metering applications such as **Schools and Hospitals**,
    - **Static Meters** with no-moving parts are not affected by the wear and subsequent accuracy problems, such as sand and grit, resulting in **Long Term Accuracy** over the whole life of the meter **,**
    - **Volumetric Meters** available in a range of sizes covering a wide breath of flow rates, provide **Optimum Accuracy, Durability and Performance**. These meters are easily integrated into an AMR/AMI system.

Smart Practices

- **Industry:**
  - **Efficiency:**
    - Remotely **Monitor** the state of equipment like pumps, pipes, valves and **Plan** replacement or service.
    - Reduce **Maintenance Cost** based on failure prediction results.
    - **Optimum Manpower** deployment and service routes based on real-time and prediction of events.
  - **Central Control:**
    - **Remotely Control and Operate** treatment plants, pumping stations and reservoirs using advanced control systems; telemetry and cloud connectivity, and
    - **Compare Performance** of different systems on the same distribution network.

Smart Practices

- **Urban Out-door:** Salt & heat-tolerant landscaping **(No-mow grass),** water-efficient fixtures, and timely leak repairs.
- **Urban In-door:** water saving fixtures, water harvesting and reuse, **mobile applications.**
- **Agriculture:** Salt & heat-tolerant crops, smart irrigation system, **water treatment and re-use**, **metering and monitoring of groundwater wells** and irrigation**.**
- **Wastewater Reuse:** Several examples of wastewater treatment facilities are now **produce more energy than required for their operations and sell the excess energy back to the grid**. While this is not practical for all treatment plants, it is a worthy research to be invested.



Urbanization and Climate Change

- **In 2050 worldwide over 6 billion people will live in cities**. Europe is one of the most urbanized continents in the world. More than two thirds of the European population lives in urban areas and this share continues to grow.
- City densification is both, an **opportunity for economic growth and a threat for liveability**. Urban growth will put large pressure on the availability of water, food and energy. **Climate change** will put more pressure on cities by increasing the risk for floods, droughts and heat waves. The sense of urgency for climate mitigation and adaptation is growing.
- **Megacities**: City with a population of more than **10 million**.*(UN HABITAT)*

Urbanization and Opportunities

- Sustainable urban infrastructure is receiving increasing attention from the **private sector, governments and researchers.**
- **This decade, cities around the world will invest $108 billion in smart city infrastructure**, such as smart meters and grids, energy-efficient buildings and data analytics, according to Navigant Research.
- **Worldwide US$ 90 trillion** will be invested in urban infrastructure over the **next 15 years** to replace ageing infrastructure and realize urban densification (GCEC, 2016).
- Every redevelopment project offers huge opportunities to create value and **synergy with climate mitigation and adaptation goals** by applying the **Water Smart City** approach.

Climate Change and Solutions

- More frequent droughts & floods, unpredictable temperatures, growing populations and high consumption rates mean **our water security is at risk**. There is a need for rapid, cost-effective actions that can save water on a large scale.
- **Cutting Edge Technologies: *Less waste, less pollute, less leak and less cost.***
- **Demand Management Policies:** Effective tariff system, effective water management, effective long-term water strategy

Smart Water Management & I of T Technologies

- IoT helps in **Scheduling the Maintenance and Shutdown of Pumps** of **DESALINATION PLANTS** and treatment stations on a regular basis through optimization techniques. This helps the water regulation authorities not only in meeting the adequate water demands in a city; rather it also aids in the **Conservation of Water and Energy**

Smart Water Management & I of T Technologies

- IoT has the ability to analyze trends and **PEOPLE BEHAVIOR** that affect water distribution programs and plans,
- IoT provides the **Consumer** with proper tools to **Stay Tuned and Alerted** to water usage, consumption and cost, which will lead to water consumption,
- IoT can determine the amount of water **CONSUMPTION** for any particular city during the next day. This can be calculated to precision with the use of **Predictive Analytics**. This is done by keeping a track on the history of water consumption in the city on any given day combined with other factors.
- When we know the amount of water that is required for overall consumption in a city on any given day, it becomes easy for the water authorities to manage its storage and distribution system and optimize usage with a holistic view of the entire network and **Real-time Demand-Supply Balancing.**
- IoT can be used for getting the **Right Amount** of water for **IRRIGATION** at the **Right Destination** for the **Right Duration** and only when needed.

Investment in SMART CITIES Research

In USA:

More than $35 million spent in new grants and over $10 million in proposed investments to build a research infrastructure for SMART CITIES including SMART WATER by the National Science Foundation and National Institute of Standards and Technology.

In the GCC:

we need to start investing in Smart Water Cities, the first step is already started by introducing the Unified GCC Water Strategy. However, further individual steps is still to be taken, all stakeholders to be involved; businesses, public authorities, researchers and citizens to ensure rapid transition from drained cities to smart cities.

Challenges & Opportunities

Challenges:

- Transition towards Water Smart Cities faces many barriers. **Sectoral thinking** and **finance**, **lack of awareness**, **short term investments versus long term benefits**, **current regulations supporting conventional approaches** and **lack of knowledge about cost and benefits** all hinder more integrated approaches.

Opportunities:

- For a solid business case, there is a need for **Evidence Based Measures**. **Scientific Research**, where the effectiveness and cost-benefits of measures can be monitored through pilot projects will contribute to this and show that the Water Smart City approach creates value for citizens, government, private sector and the environment.

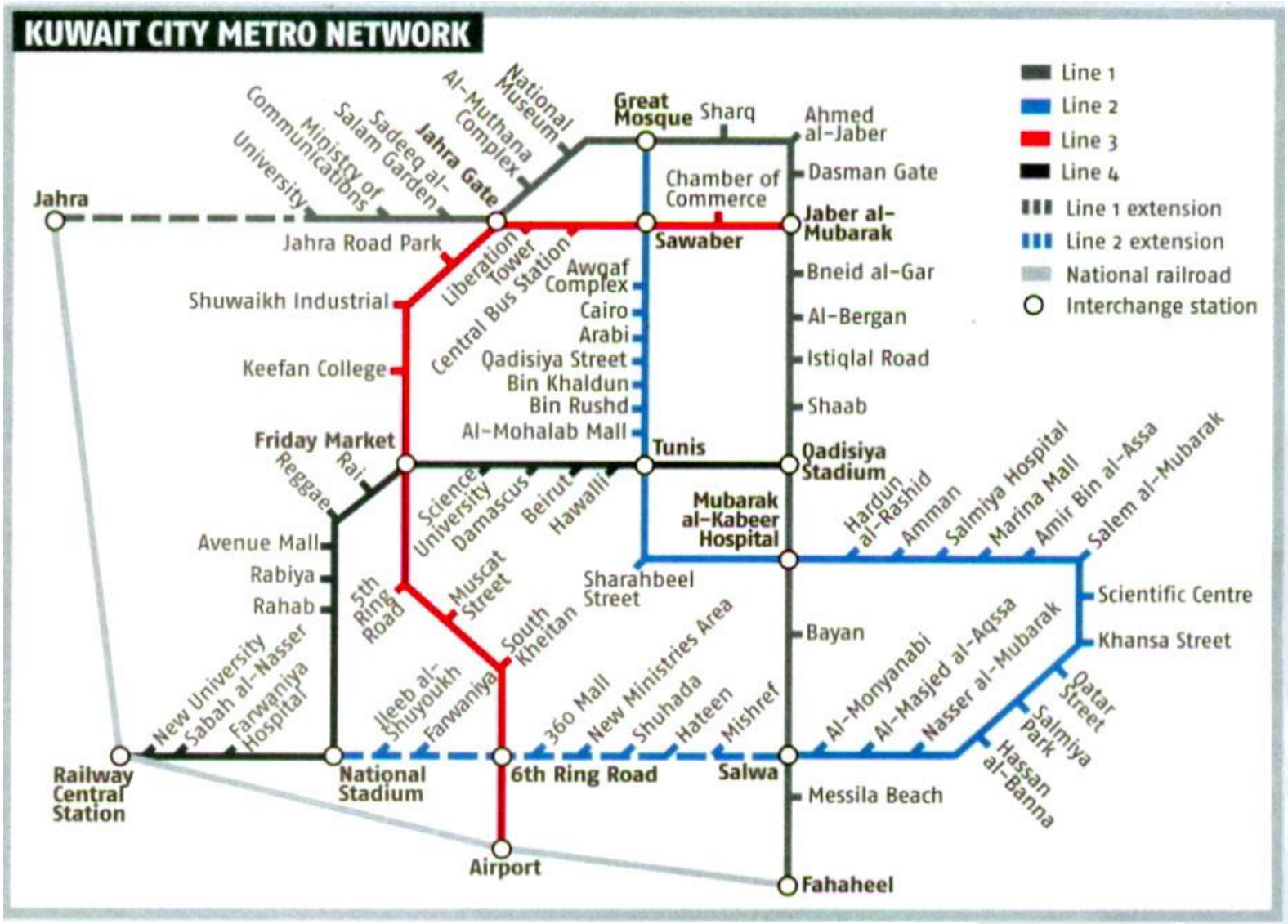
Achieving a Smart Water Future

One very effective path to achieve a capital-intensive project like a smart water city is through leveraging **energy-saving performance contracts (ESPCs).**

ESPCs are a form of a public-private partnership (PPP or P3), a financial model that capitalizes on the flexibility and resources of the private sector to pay for energy-saving capital upgrades using future energy savings. The initial investment is provided by the private financial community, and services are delivered by **energy service companies (ESCOs).** The financier is paid from the accrued energy savings, with the ESCO guaranteeing the savings amount.

An **ESPC** starts with an **energy audit**. After identifying opportunities and quantifying the **potential savings**, the **ESCO** recommends any number of **energy conservation measures**, such as ***equipment retrofits***, ***pumping optimizatio***n, ***demand monitoring and control***, and/or ***load-shedding and cogeneration*** which will save energy through more efficient operations.

THANK YOU


KUWAIT CITY METRO NETWORK
Line 1
Line 2
Line 3
Line 4
Line 1 extension
Line 2 extension
National railroad
Interchange station
Jahra
University
Ministry of Communications
Sadeeq al-Salam Garden
Jahra Gate
Al-Muthana Complex
National Museum
Great Mosque
Sharq
Ahmed al-Jaber
Dasman Gate
Chamber of Commerce
Jaber al-Mubarak
Sawaber
Jahra Road Park
Liberation Tower
Central Bus Station
Awqaf Complex
Cairo
Arabi
Qadisiya Street
Bin Khaldun
Bin Rushd
Al-Mohalab Mall
Bneid al-Gar
Al-Bergan
Istiqlal Road
Shaab
Shuwaikh Industrial
Keefan College
Friday Market
Reggae
Rai
Tunis
Qadisiya Stadium
Science University
Damascus
Beirut
Hawalli
Mubarak al-Kabeer Hospital
Hardun al-Rashid
Amman
Salmiya Hospital
Marina Mall
Amir Bin al-Assa
Salem al-Mubarak
Avenue Mall
Rabiya
Rahab
5th Ring Road
Muscat Street
Sharahbeel Street
Scientific Centre
Khansa Street
South Kheitan
Bayan
Al-Monyanabi
Al-Masjed al-Aqssa
Nasser al-Mubarak
Qatar Street
Salmiya Park
Hassan al-Banna
New University
Sabah al-Nasser
Farwaniya Hospital
Jleeb al-Shuyoukh
Farwaniya
360 Mall
New Ministries Area
Shuhada
Hateen
Mishref
Railway Central Station
National Stadium
6th Ring Road
Salwa
Messila Beach
Airport
Fahaheel