AI as a Tool for Economic Sustainability and Water Security in the GCC Countries

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Introduction

- **The world smart water management market size** is expected to double by 2028 at a compound **annual growth rate of 11.3%** due to the optimum maintenance of infrastructure and reduction of loss due to NRW [1].
- **AI could contribute up to $320 billion to the Middle East economy by 2030**. One of its primary goals, then, must be to eliminate water scarcity and effectively address other significant environmental challenges [2].
- With its flourishing tech and business environment, the **GCC** has experienced a **significant rise in AI applications** that are transforming our lifestyle and work dynamics.

AI and Economic Sustanability

- The Gulf Cooperation Council (GCC) is undergoing a transformation, driven by two powerful forces: **sustainability and artificial intelligence (AI)**. Green projects across six core industries are expected to contribute up to $2 trillion to the region's GDP by 2030, creating over one million jobs and attracting foreign investment. At the same time, the **GCC's AI market is projected to grow to $15.4 billion by 2030, expanding at an annual rate of 28.63%.** [3]
- Artificial intelligence (AI) has the **potential to deliver real value in the GCC countries as much as $150 billion, according** to a McKinsey research. That's equivalent to **9% or more of GCC countries' combined GDP**, although the speed at which AI technologies like generative AI are developing suggests that figure could be quickly surpassed[4].

AI and Economic Sustanability

- Ratings agency S&P Global recently issued a warning that water stress from rising temperatures and demand is already above globally recommended sustainability thresholds across the GCC nations. Meanwhile, research by PwC, commissioned by Microsoft, estimates that **using AI for environmental applications could contribute up to $5.2 trillion to the global economy in 2030, a 4.4 per cent increase relative to business as usual.**

Economic Benefits of Using AI in Water Sustainability

1. Reduced Water Production Costs

- **Optimization of desalination plants, pumping stations, and water treatment processes by:**
  - Predicting demand to avoid overproduction
  - Energy optimization(desalination is energy-intensive)
  - Detecting inefficiencies early
- **Benefit**
  - Lower energy bills, less chemical use, and reduced operational costs.
- **Example:**
  - AI-controlled desalination systems can **cut energy consumption by 10–20%**, translating into millions of dollars saved yearly for utilities.

1. Reduced Water Production Costs

- A recent study found that AI-driven desalination systems can **reduce energy consumption by up to 50%**, and predictive maintenance/minimized downtime significantly cut maintenance costs.[5]
- Another review documents how **AI, IoT and data-driven models help optimize water distribution, demand forecasting, and overall resource management** — shifting from reactive to proactive operations and enabling cost-effective management at scale.[6]

2. Minimizing Water Loss (“Non-Revenue Water”)

- **AI uses sensors + machine learning to**:
  - Detect leaks early
  - Predict pipe failures before it happen
  - Identify illegal water connections
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- **Benefits:** Governments and utilities recover water that would normally be lost (often 20–40% in many countries).
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- **Economic impact:**
- **Saving even 1% of water loss in a city can save millions of dollars annually.**

2. Minimizing Water Loss (“Non-Revenue Water”)

- According to a study summarizing IoT-based leak detection systems, **AI-driven anomaly detection reduced undetected leaks by ~42%, decreased non-revenue water losses by ~23%, and cut overall operating costs by ~18%.** [6]
- General reviews of AI-based water-distribution system management highlight how **AI “significantly reduces water waste and saves costs for repairing extensive damage caused by undetected leaks.”.** [7]

3. Better Agricultural Efficiency & Higher Yields

- **Agriculture is the largest consumer of water.**
- **AI improves:**
  - Irrigation timing
  - Soil moisture prediction
  - Crop water requirement estimation
  - Early detection of crop stress
- **Benefits: Up to 30–50% savings in irrigation water and 5–25% increases in crop yield.**
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- **For Kuwait and GCC farms:**
- AI-based irrigation can reduce water and energy use, increase profits, and lower reliance on imported crops.

3. Better Agricultural Efficiency & Higher Yields

- A 2025 article in the context of climate-resilient agriculture shows that **combining AI + IoT for irrigation management leads to more sustainable water use under changing climate conditions**.[8]

- A broader review of **machine learning, remote sensing and IoT** in yield prediction and water-use optimization argues that these technologies can deliver improved yield predictions and efficient irrigation management — which implies both **water savings and higher agricultural output**. [9]

4. Lower Infrastructure Costs Through Predictive Maintenance

- **AI predicts when pumps, pipelines, sensors, or valves will fail.**
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- **Benefits:**
  - Lower maintenance costs
  - Avoid expensive emergency repairs
  - Extend the life of existing infrastructure
-
- **Economic Benefit:**

Predictive maintenance **reduces breakdowns by up to 50% and maintenance costs by 20–30%.**

4. Lower Infrastructure Costs Through Predictive Maintenance

- A desalination-review paper highlights that **fault-detection algorithms and predictive maintenance — enabled by AI — help minimize downtime and reduce lifetime cost of expensive machinery**. [5]
- · More generally, literature on smart water networks notes that **AI-driven monitoring and analytics support better scheduling, maintenance prioritization and reduce unplanned failures — cutting maintenance and replacement costs. [6]**

5. Improved Water Quality Monitoring & Reduced Sampling Costs

- A systematic review of AI-based water quality monitoring (2011–2025) found that **AI + IoT + remote sensing yield high predictive accuracy (~94%) and reduce field-sampling costs by about 60% compared to traditional methods**. [10]
- More broadly, AI in water-quality management is described as **enabling real-time data integration (sensor + satellite + environmental databases), earlier contamination detection, and better resource allocation — which translates to efficiencies, reduced health/environment costs, and savings compared to slower, manual approaches**. [11]

6. Improved Decision-Making & Resource Allocation

- **AI creates:**
  - Real-time dashboards
  - Demand forecasting
  - **Scenario planning** for droughts or peak use
- **Benefits:**
  - More efficient use of budgets and staff.
  - Utilities avoid building unnecessary infrastructure **(saving millions).**

7. Supports Circular Economy and New Revenue Streams

- **AI enables new business models:**
  - Water trading / smart pricing
  - Reuse of wastewater for agriculture, industry, cooling towers
  - Optimized recycling systems
- **Benefits:** Creates new revenue and reduces dependence on costly freshwater sources.

8. Boosts National Competitiveness & Attracts Investment

- **Countries adopting AI for water sustainability:**
  - Reduce cost of utilities
  - Improve reliability of water supply
  - Attract investments in agriculture, industry, and technology
- **This supports long-term economic growth and diversification (important for GCC Vision programs).**

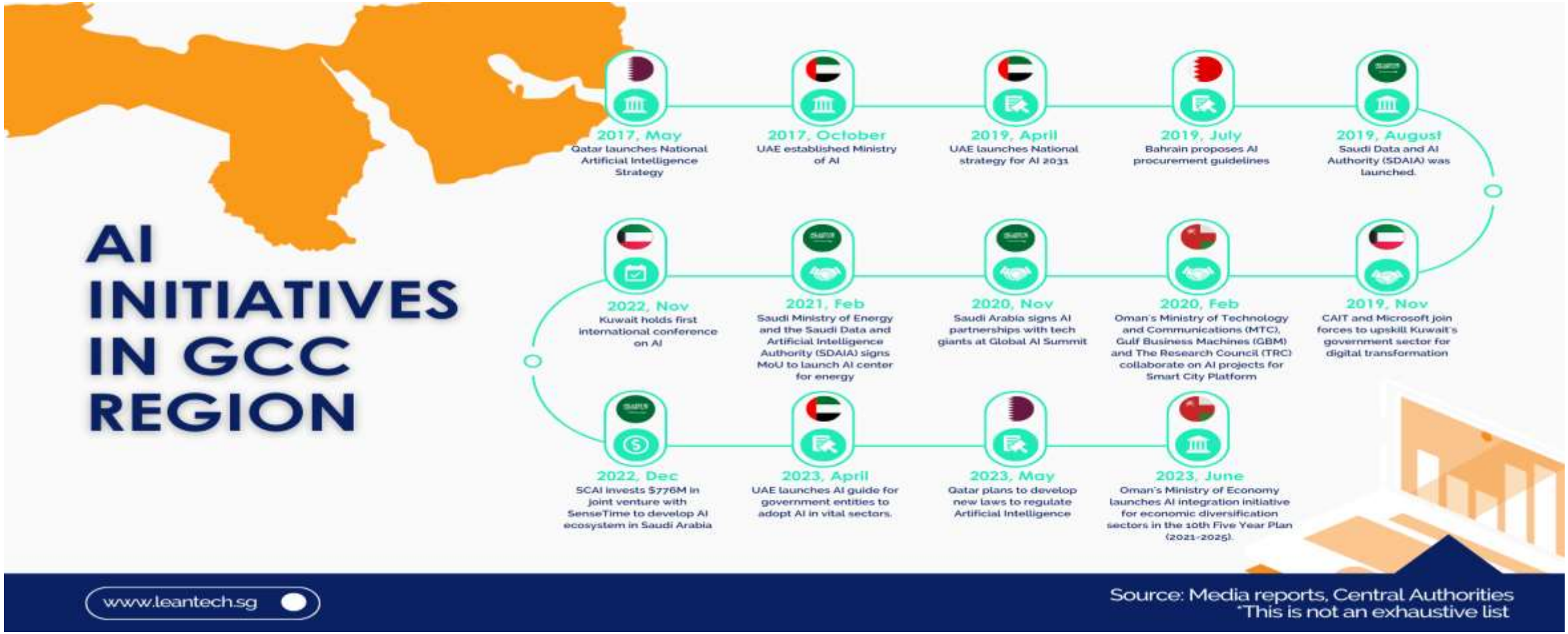
AI and Desalination in the GCC

- It is in desalination, a critical water source, that the GCC of AI could be felt most, as the technology is employed to **make the desalination process more energy-efficient and cost-effective.** This is a vital factor in a region that needs to dramatically **reduce dependence on oil for desalination in order to reduce carbon emissions, while at the same time, meeting a rising demand for water.**

AI and Agriculture

- We can expect the continued advancement of AI technologies to deliver more innovative solutions for optimizing water resource management, boosting efficiency in agriculture, and improving overall water sustainability.
- Smart irrigation systems powered by AI will evolve to become more sophisticated, adapting in real-time to changing environmental conditions and ensuring precise water usage in agriculture. Additionally, AI-driven predictive models will enable proactive measures in addressing water quality issues and detecting potential infrastructure vulnerabilities.

AI Initiatives in the GCC Countries



Examples of AI Applications from the GCC

AI and Water Resources in KSA

- the **Fourth Industrial Revolution Center at Saudi Arabia's Aramco says it has reduced flare emissions by 50 percent since 2010 by using data and AI to monitor conditions and take preventative action.**
- **In 2019**, the Kingdom launched the **Saudi Data and Artificial Intelligence Authority (SDAIA) that aims to drive the data and AI agenda, and it has set out to attract investments worth $20 billion and train up to 20,000 data and AI specialists by 2030**. This can only be good news in the battle to clean up and simplify desalination, which makes freshwater from seawater through a complicated process involving filtering, removing salt and adding minerals.
- Saudi Arabia aims to grow its current population of more than 35 million to 100 million by 2040. **It was reported that more than 15 per cent of today's oil production consumed by desalination plants**. Therefore, Saudi Arabia is already making big strides in the right direction, **investing heavily in AI to enhance the efficiency of desalination plants,** reducing energy consumption and operational costs.

AI and Water Resources at UAE

- UAE used in **Smart Irrigation Systems,** such as the one in **Abu Dhabi's Masdar City,** using real-time data to water plants at the best time to cut wastage. In disaster management, AI analyses various data sources for **proactive measures**, helping the **National Emergency Crisis and Disaster Management Authority (NECDMA)** to **monitor weather conditions and give timely warnings.**
- It is also transforming the UAE's agricultural sector. The **Emirates Institution for Advanced Science and Technology** has **developed an AI-based agricultural monitoring system** that uses satellite imagery and AI algorithms to assess crop health, detect pest infestations, and make sure water is used wisely.
- The **Dubai Electricity and Water Authority (DEWA) uses AI to analyze data for water management,** studying past information and current trends to make smart decisions about water policies and infrastructure development.

AI and Water Resources at Kuwait

- As the nation pursues its **Transformative Vision 2035**, AI is weaving itself into the fabric of Kuwaiti society, from **smart city initiatives to efficient resource management and modernized education**.
- The momentum is building. Initiatives like the **Kuwait National AI Strategy and the Digital Transformation Strategy** provide crucial frameworks.
- **Kuwait recently joined a $100 billion AI infrastructure partnership with MGX and Microsoft** [14].
- The journey towards Vision 2035 will be powered by **intelligence, both human and artificial.**

AI and Water Resources at Qatar

- Meanwhile, the **Qatar Environment and Energy Research Institute (QEERI)** has been using AI for **water quality monitoring.** They study information from different sources, such as remote sensing and IoT devices, to give precise and timely details about water purity.
- **Qatar together with Google Cloud and Microsoft Azure exploring floating solar platforms to power integrated water-energy systems.**

AI International Example

- **In 2020, the city of Tucson, Arizona** implemented AI technology in an effort to be more proactive in managing its 7,400 KM of distribution water main pipes.
- The city used **machine learning** technology, which discovers **patterns from historical pipe failures**, and evaluates data on **soil, weather, land use**, and more, to develop targeted and **precise pipe break predictions**. The AI technology then calculates the **Likelihood of Failure (LoF)** and **Consequence of Failure (CoF)** scores for each pipe segment. From these two scores, the technology generates a quarterly **Business Risk Exposure** score, allowing utilities to focus their resources on the most important assets. With machine learning technology, smart decisions can be made, save valuable resources, and protect water infrastructure, also, **coupling human experience with AI technology** will make better-informed decisions with greater confidence

AI Summary Table

- **Benefit**
- Reduce water production costs
- Reduce water loss
- Better irrigation efficiency
- Predictive maintenance
- Improved planning
- New circular economy models
- Greater national competitiveness

- **Economic Impact**
- Millions saved in energy & chemicals
- Recover up to 40% non-revenue water
- Up to 50% savings + increased yields
- 20–30% cost reduction
- Avoids overbuilding infrastructure
- Creates revenue from reuse & recycling
- Attracts foreign investment

Challenges facing AI in Water Sector

- They can only **correctly predict within the constraints of their training d**ata. This is also the case for large language models, such as Chat GPT, which often **cannot provide meaningful information beyond their training data.**
- They have been criticized as **“black boxes”,** i.e. users often have no idea what is happening in the background.
- It is expected that the world will see an astonishing 74 million metric tons of e-waste by 2030. With AI technologies being developed and integrated into daily life at a quick pace, it’s expected **that the world’s e-waste problem will worsen**, as there’s a higher demand for CPUs, GPUs, and memory chips.
- **High Carbon Footprint of AI models**
- **High Resource Utilization; Energy and Water**
- **The problem of Bias**
- **Reliance on Incomplete Data**, missing key perspectives, and information from various regions and communities results in unreliable climate predictions.

Conclusions

- How much **Energy or Water** does AI consume versus how much does it save? **In the GCC**, annual AI-related data center water usage could reach **426 billion liters by 2030**. This can be reduced by:
  - Closed-loop cooling systems
  - Air-cooled and geothermal designs
  - Using treated wastewater instead of freshwater
- AI should always be a **Decision-Support Tool**, not an autonomous **Decision-Maker.** The responsibility for **final decisions must always rest with a human expert**. AI can provide insights, but it should not be making operational control decisions, such as adjusting valves or pumps.
- **Data Privacy should be protected** since water-use data is incredibly sensitive. It can reveal personal behaviors, and it must be carefully anonymized and aggregated before being used in AI models.

Conclusions

- **Human Collaboration** is necessary to get the best from AI. Different stakeholders need to align on worst-case scenarios and mitigation strategies. **The best AI tools are useless if people don't understand or trust them.**
- From constructing **energy and water-efficient smart cities** and **managing precious water resources** to personalizing education and modernizing public services, **AI is the key to unlocking a more prosperous, efficient, and sustainable future for the GCC.** The algorithms are ready; the time for decisive action is now.
- AI can be a powerful tool in addressing the **GCC's escalating water crisis**. Whether through **optimizing desalination, enabling precision irrigation, or building smarter resource management systems**, AI offers pathways to conserve and better allocate scarce water supplies. Yet, adoption must be integrated into sustainable system design to balance the benefits with AI's hidden costs.

Recommendations

- **Investment**: Continued funding for AI research, startups, and infrastructure (cloud, data centers).
- **Data Governance**: Establishing clear frameworks for secure and ethical data sharing, crucial for training effective AI models.
- **Talent Development**: Intensifying STEM education, specialized AI university programs, and upskilling/reskilling initiatives.
- **Public-Private Partnerships:** Collaboration between government, and industry (oil & gas, finance, telecoms) is essential to deploy solutions at scale.
- **Incremental Adoption:** is also an important focus. **Running small AI trials** across different use cases to **build confidence** and refine best practices is a safe way to work through new approaches. **Iterative improvement** is another approach that should be kept front of mind in the years to come.

The AI industry represents a multitrillion-dollar opportunity to diversify GCC economies away from oil dependence and initiate water solutions as a tool for national economic security.

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Thank you

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