



# Renewable Energy Opportunities in the Water Energy Nexus: The MENA Context

Dr. Hosni Ghedira

Director of Research Engagement



جامعة محمد بن زايد  
للذكاء الاصطناعي  
MOHAMED BIN ZAYED UNIVERSITY  
OF ARTIFICIAL INTELLIGENCE

Optimistic Tunisia 3  
Tunisian Pavilion  
Blue Zone, Dubai Expo City  
30 Nov – 12 Dec 2023



# The Water Use Cycle and Energy Intensity in the GCC/MENA



Desalination



Pumping



Usage



Treatment

Desalination

Pumping to Reservoir

Usage by Consumer

Sewage Pumping

Sewage Treatment

TSE Pumping

# RE Opportunities in the Water-Energy Nexus:

## Renewable energy can boost water security by:

- Improving affordability and safety of supply
- Reduce water-intensity of power sector
- Improve access to water in off-grid areas
- Enhance reliability of water supply
- Bridge the water gap in arid regions
- Replace traditional water heating

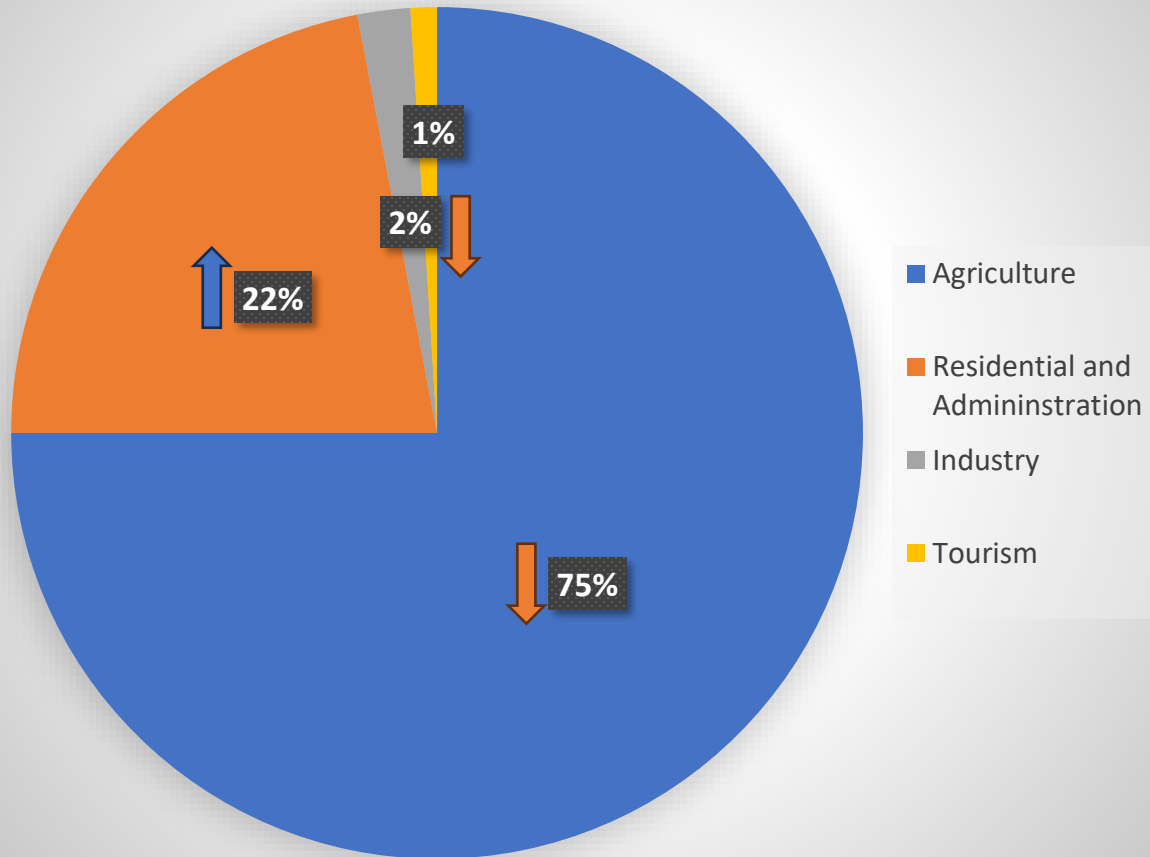




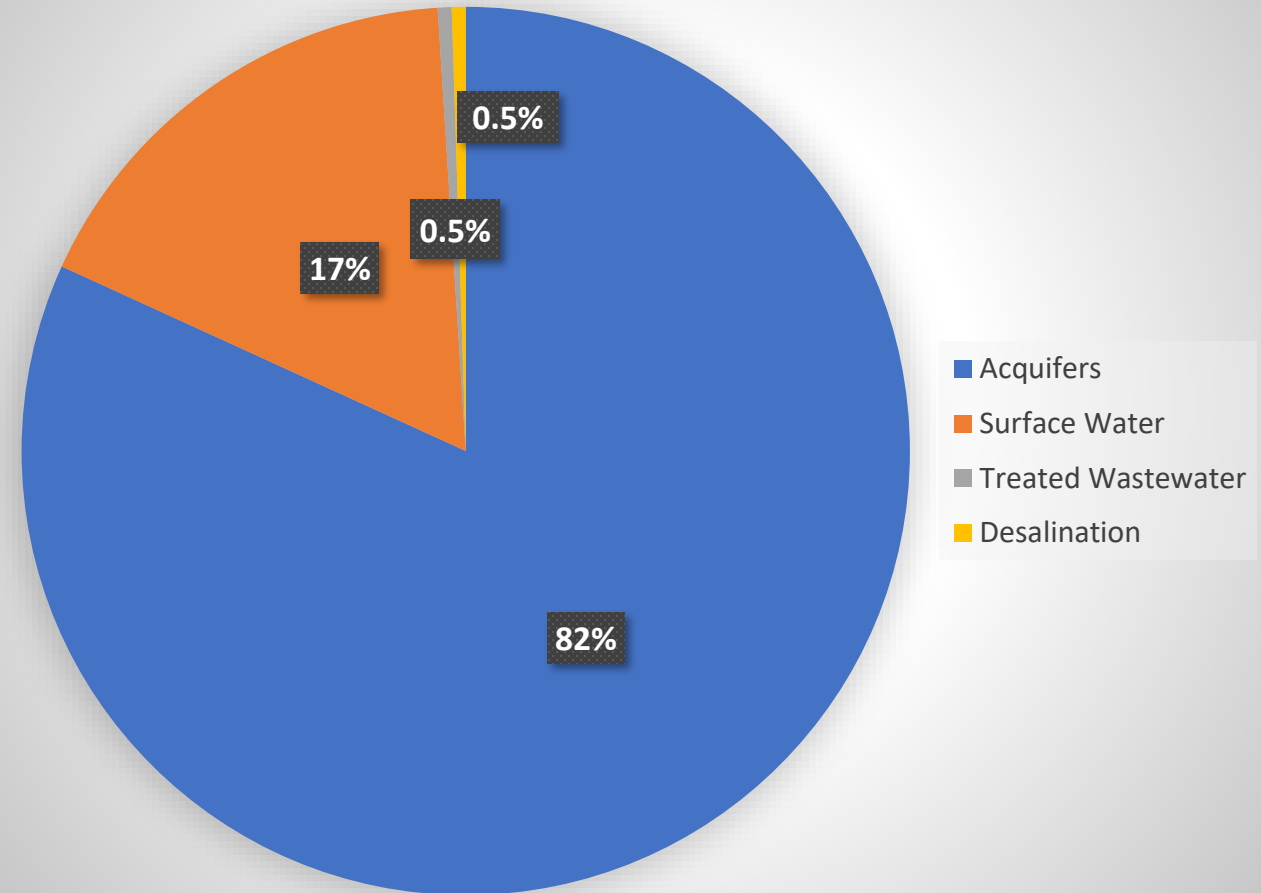


# Water Sources and Demand in Tunisia

## Water Demand (2020-2023)



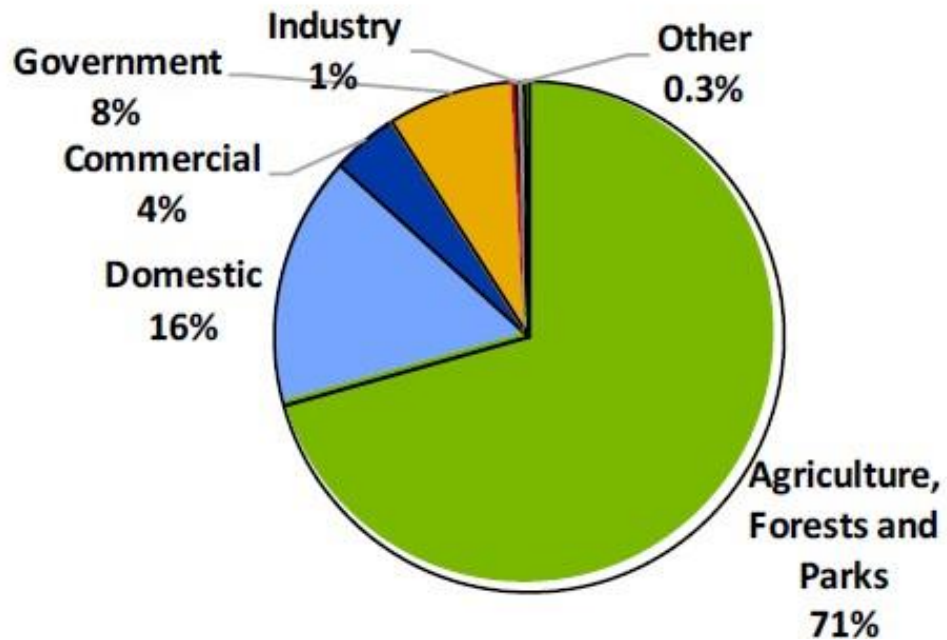
## Water Sources



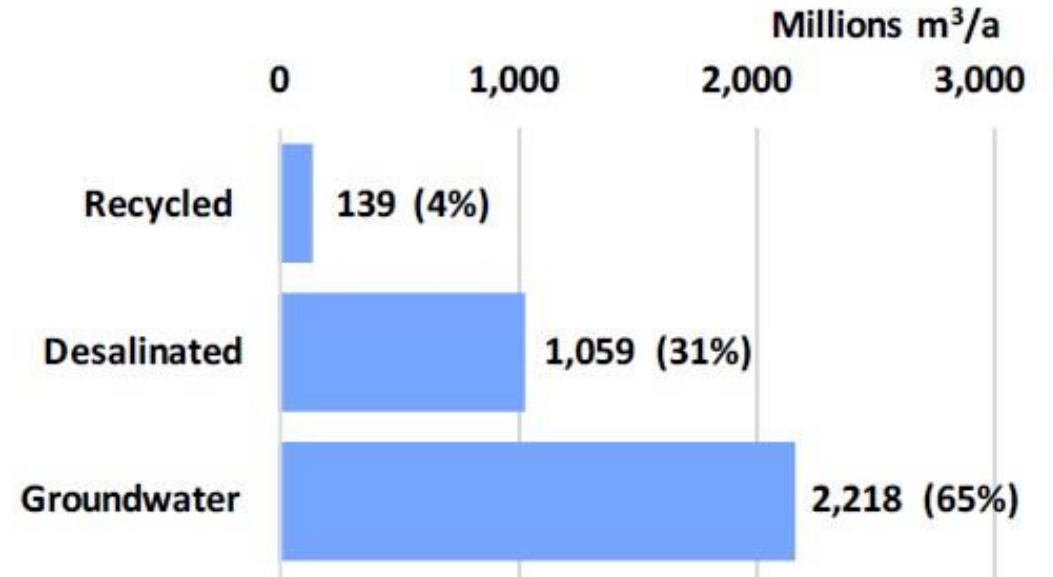


# Water Sources and Demand in the UAE

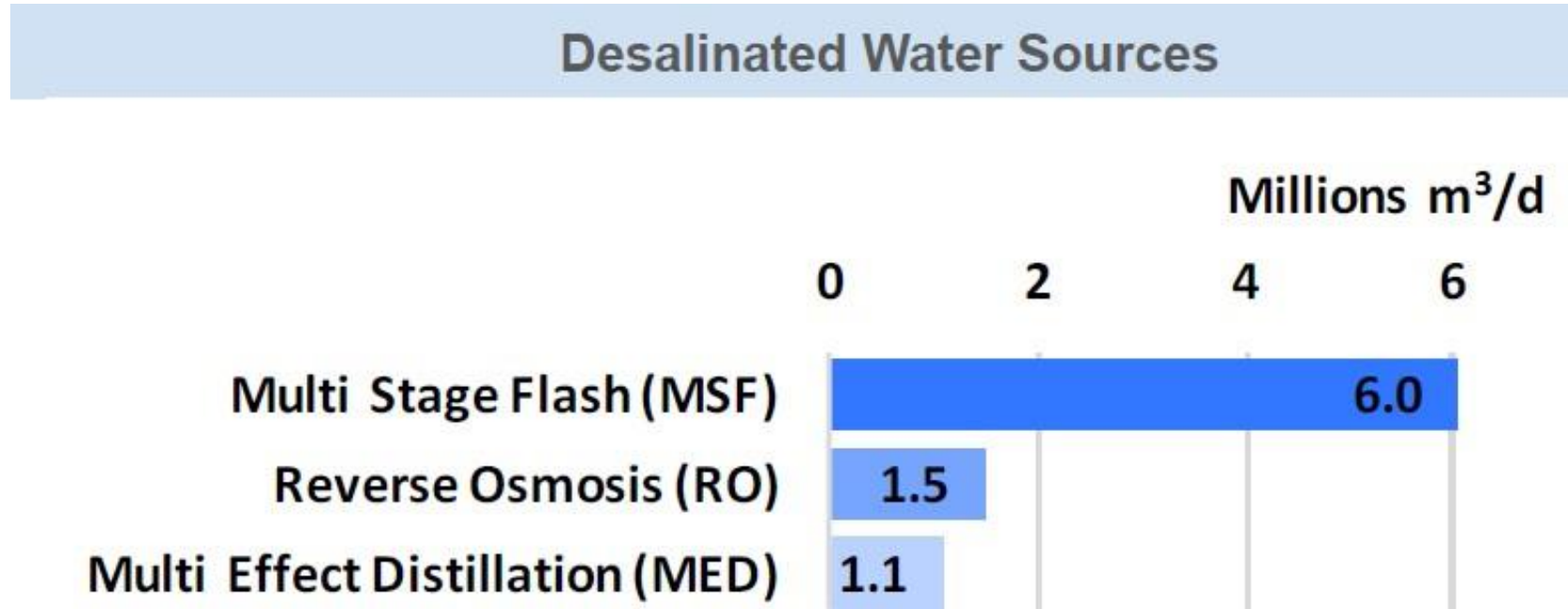
## Water Demand



## Water Sources








# Water Challenges in the Emirate of Abu Dhabi



- Reliance on very energy intensive technologies (MSF and MED), consuming about 3.5 times energy compared to RO technology
- Integration of power and water production (co-generation) leads to energetic inefficiencies
- Desalination plants are powered by natural gas: finite source of energy
- Desalination represents roughly 22% of the CO<sub>2</sub> emissions of the Emirate

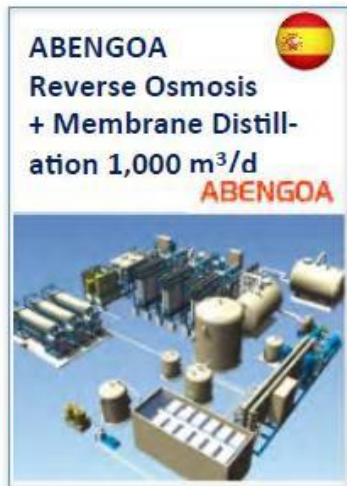
# MASDAR's Renewable Energy Water Desalination Program

The objective of this program is to **develop and demonstrate** advanced and innovative seawater desalination technologies that:

-  are more energy efficient than current state-of-the-art systems;
-  are suitable to be powered by renewable energy sources;
-  are cost competitive with non-renewable energy powered seawater desalination;
-  have minimal environmental impact; and
-  are resilient in challenging seawater and environmental conditions

# MASDAR's Renewable Energy Water Desalination Program

- 5 pilot plants located in Abu Dhabi
- Each pilot plant operated over 18 months
- Masdar implements the program in close collaboration with the Abu Dhabi governmental agencies in the water sector
- The pilot plants demonstrate different advanced and innovative desalination technologies.



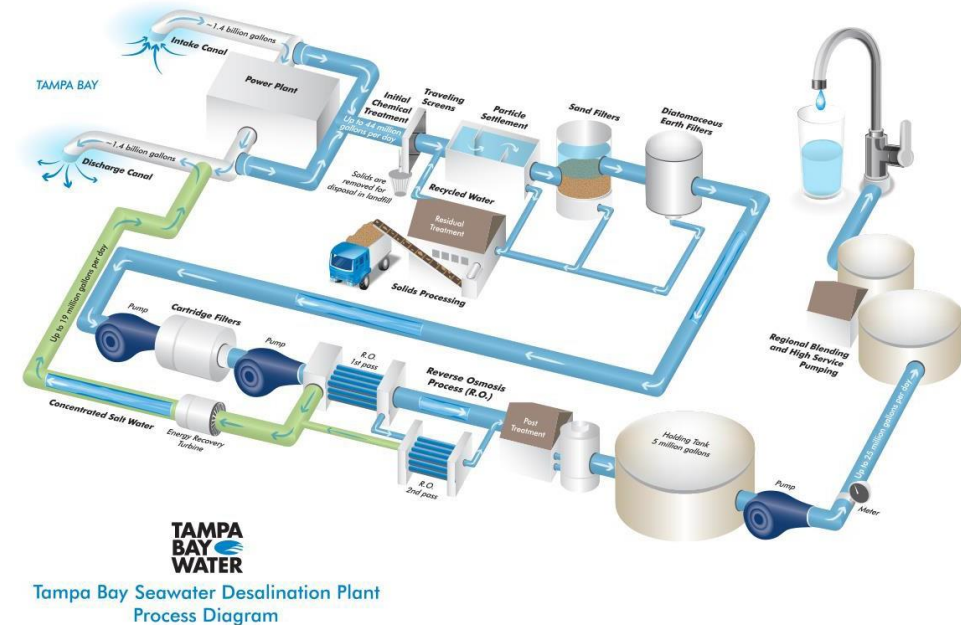
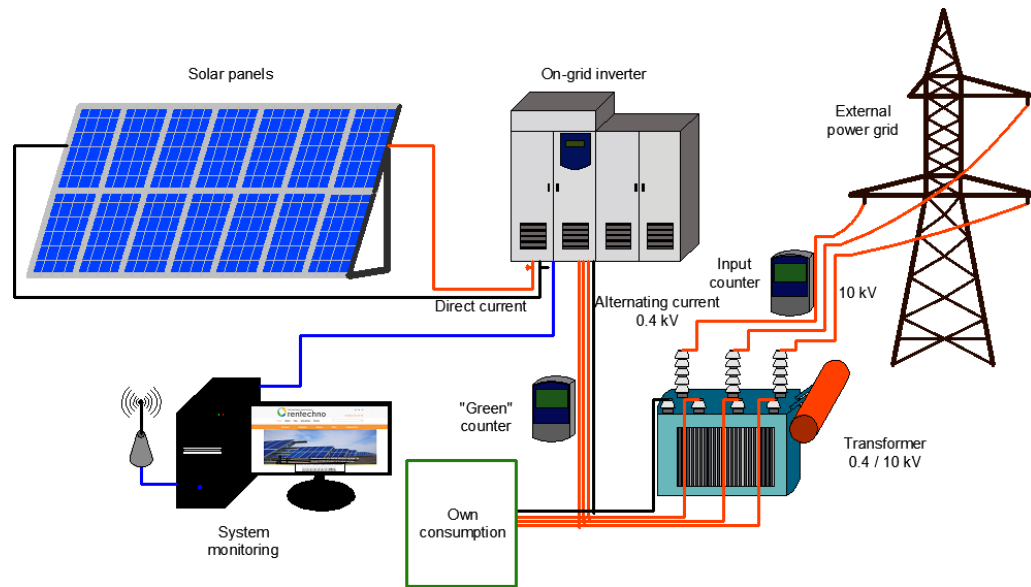


# MASDAR's Renewable Energy Water Desalination Program

## Key takeaways from the Program:

- All pilot plants met Masdar's performance expectations in terms of energy consumption, reliability and water quality.
- Arabian Gulf seawater has proven to be challenging especially due to the high organic and biological content.
- Reverse Osmosis has proven to be a reliable desalination technology to produce drinking water even with challenging seawaters.
- Dissolved Air Flootation process has proven to be crucial to enhance the performance of the pre-treatment and consequently of the desalination unit.
- The advanced design solutions for Reverse Osmosis piloted in Ghantoot can be easily scaled up to utility size.

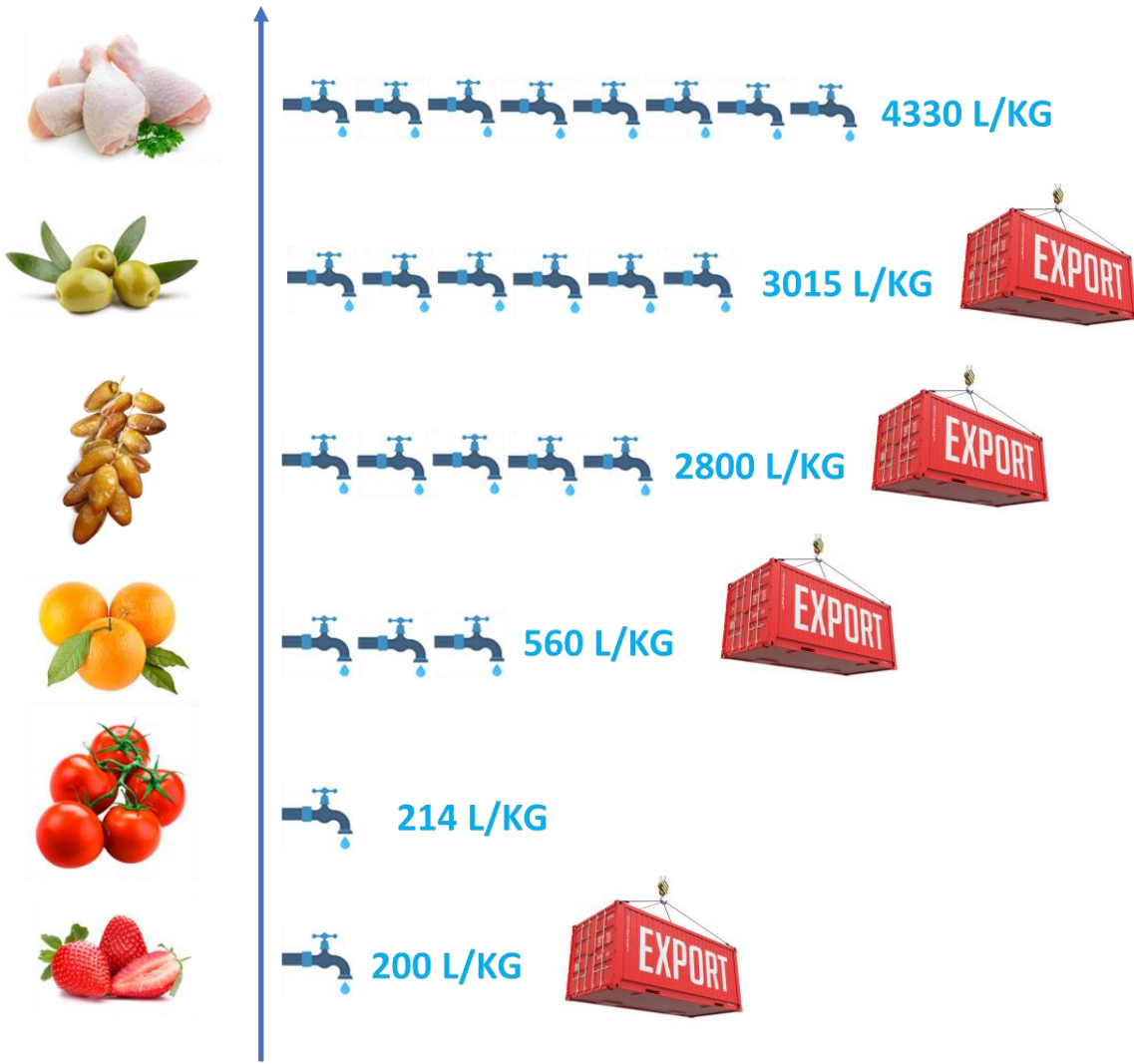
# Renewable Energy Powered Desalination for the UAE and the GCC



- Grid-connected PV plant produces 100% of desalination electricity demand.
- The program has demonstrated that producing drinking water with RO plants powered with renewable energy sources is cost-effective, providing Abu Dhabi with the valuable option to reduce the dependence on natural gas for the production of water.
- The calculated cost of drinking water produced by a grid-connected PV-RO plant with the technologies demonstrated in Ghantoot is around 0.90 USD/m<sup>3</sup>.



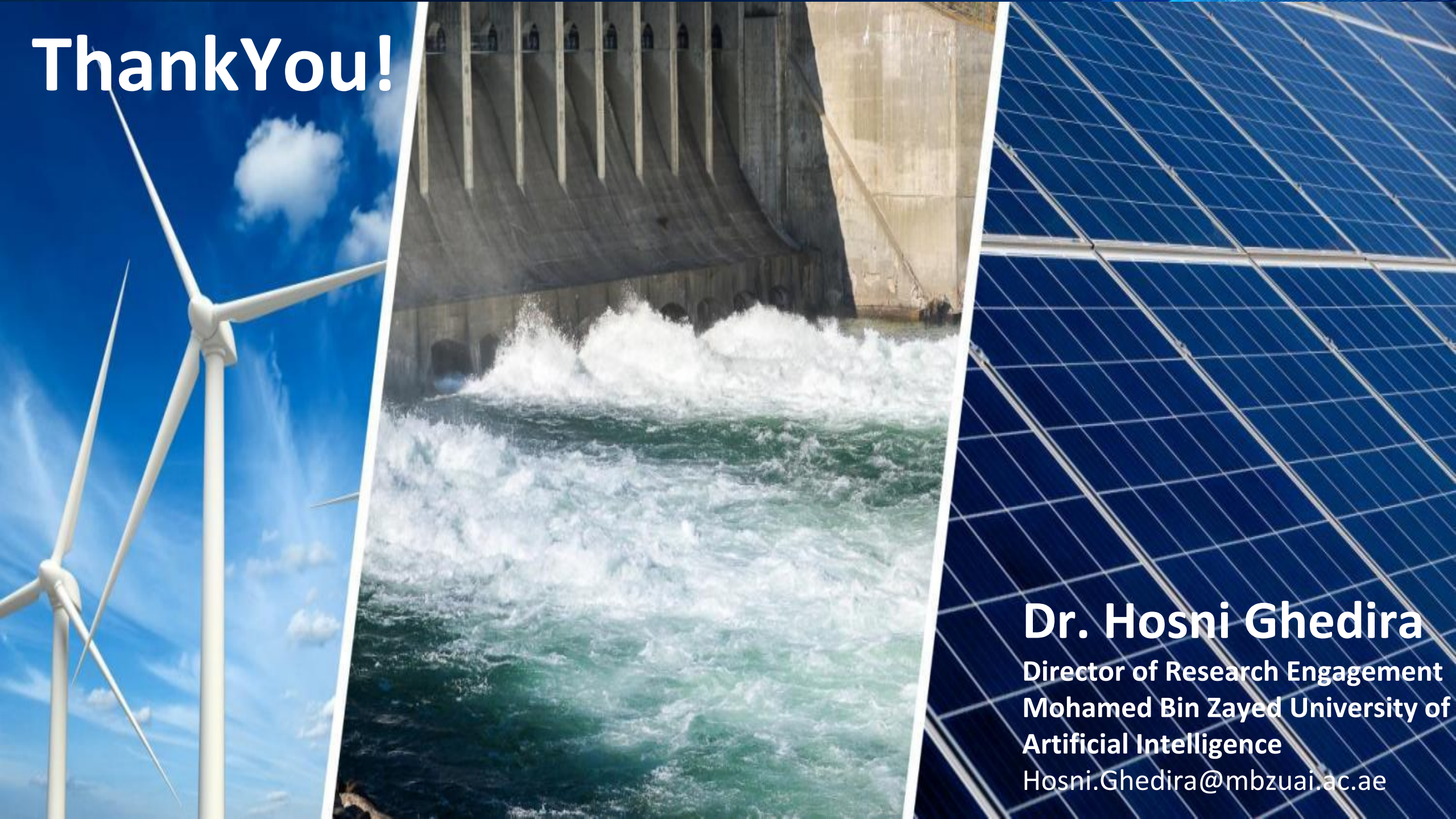
# Water Footprint of Agriculture in Tunisia



- Water footprint should be taken into consideration in agriculture/export planning
- Intensive investment on RE-based desalination is urgently needed
- Integration of smart agriculture technologies (AI, IoT, ...).
- Implementation of smart water metering in agriculture fields for accountability and responsible farming.
- Encourage non-irrigated agriculture, especially for olives and cereals.
- Encourage and support R&D in agriculture science and engineering (Tunisia is the birthplace of the Carthaginian **Magon**, “The Father of Farming”).



**Thank You!**



**Dr. Hosni Ghedira**

Director of Research Engagement  
Mohamed Bin Zayed University of  
Artificial Intelligence

[Hosni.Ghedira@mbzuai.ac.ae](mailto:Hosni.Ghedira@mbzuai.ac.ae)