

Under the Patronage of His Excellency **Eng. Abdulrahman bin Abdulmohsen AlFadley**  
Minister of Environment, Water & Agriculture

# منتدى المياه السعودي

saudi water forum **SWF 2024**



## ZERO COST WATER SOLUTIONS

Dr. Sarper Sarp – Senior Expert  
WTIIRA / SWCC



29 April – 01 May 2024



Hilton Riyadh Hotel & Residences  
Riyadh, Saudi Arabia

Organized by

وزارة البيئة والمياه والزراعة  
Ministry of Environment Water & Agriculture



المؤسسة العامة لتحلية المياه المالحة  
Saline Water Conversion Corporation (SWCC)



شركة المياه الوطنية  
National Water Company



الشركة السعودية لشراكات المياه  
Saudi Water Partnership Company



المؤسسة العامة للمياه  
Saudi Water Partnership Company



منظم المياه  
Water Regulator



المركز الوطني لكفاءة وترشيد المياه  
NATIONAL WATER EFFICIENCY AND CONSERVATION CENTER  
MAEE



Organizing Partners

## HOW TO EVALUATE THE COST OF WATER?

- Importance of Water
- Value of Water
- Cost of Water Production
- Recent Efforts to Reduce the Cost
- Zero Cost Water?

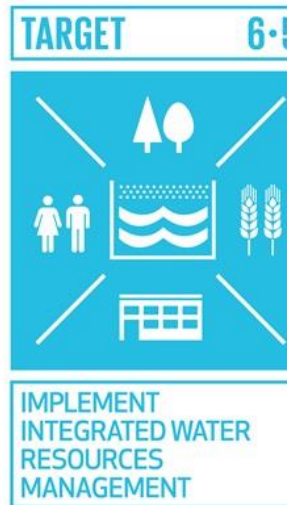


**To Preserve the Essence  
of Life**

# IMPORTANCE OF WATER



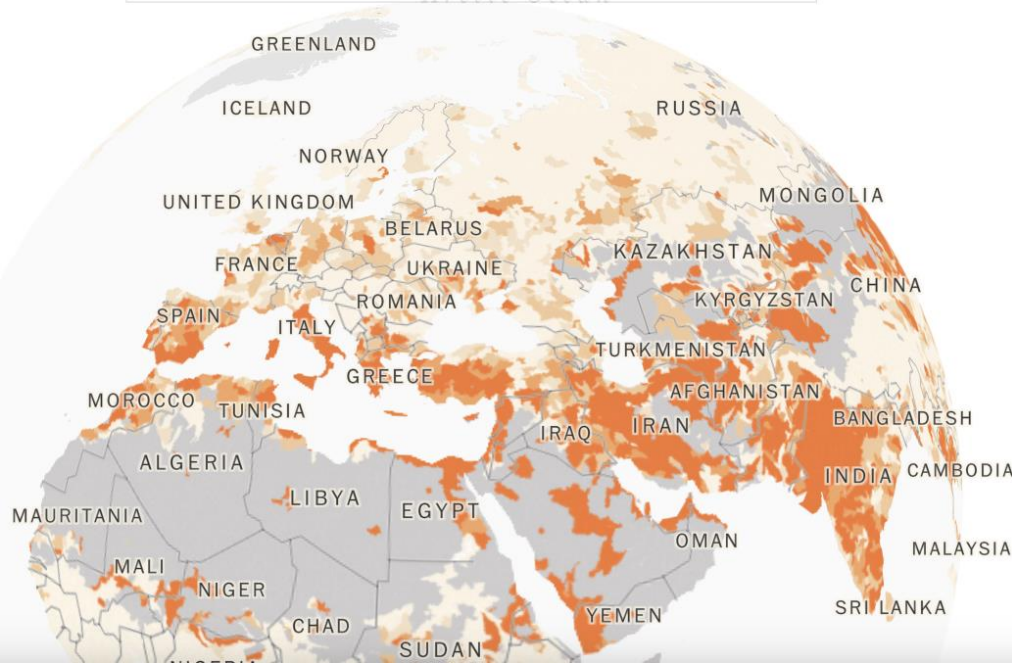
## Sustainable Development Goals





## VALUE OF WATER

“Value has a subjective connotation that **depends on personal, climatic, and social factors**. Water is not worth the same to a farmer as to someone living in a city, nor is it worth the same to **someone living in Scandinavia as to a nomad in the Sahel**.”



“Five of the six most water-stressed countries are in the **Middle East and North Africa**”

*The Washington Post*

## VALUE OF WATER - KSA

“The absolute water scarcity level is 500 cubic meters per capita, per year. Saudi Arabia has only 89.5 cubic meters per capita, per year.”



الهيئة العامة للإحصاء  
General Authority for Statistics

Per Capita Water Consumption In Saudi Regions  
During The Period 2009-2017

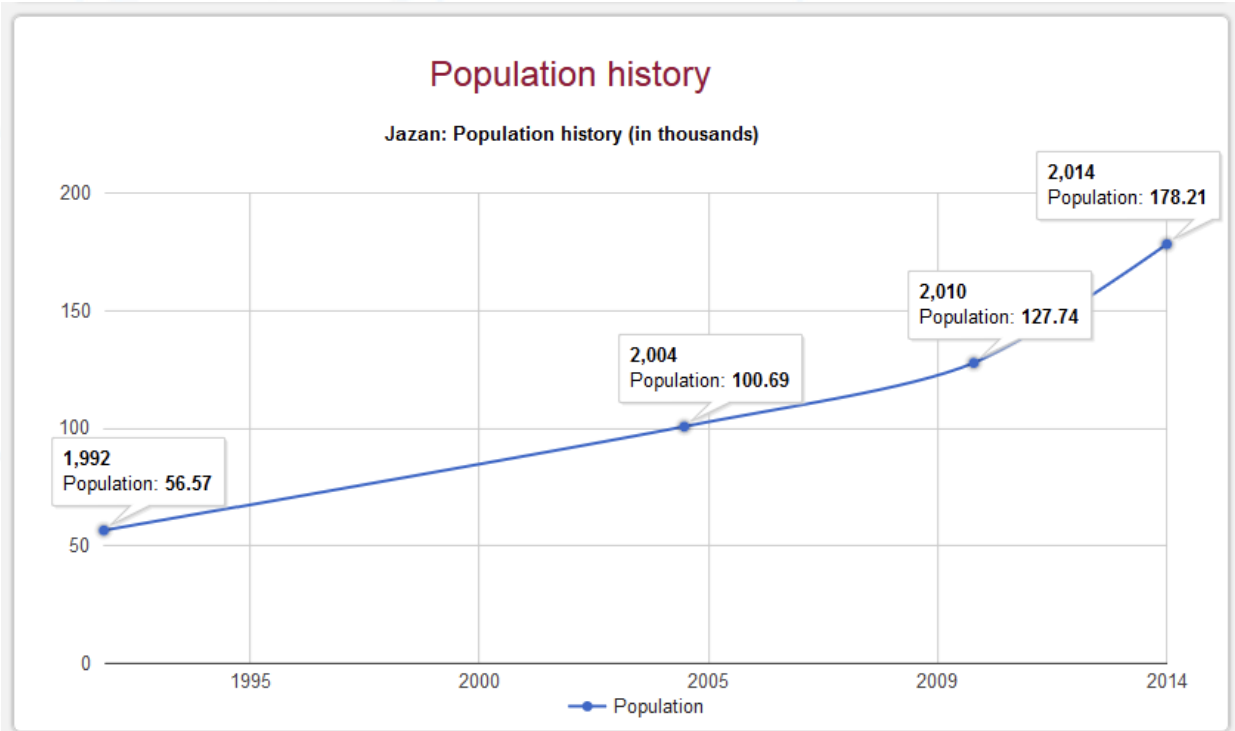
Region	Year								
	2009	2010	2011	2012	2013	2014	2015	2016	2017
Riyadh	289	292	292	285	293	304	337	353	357
Makkah	189	214	237	241	246	248	237	233	240
Madinah	229	232	219	220	235	231	231	242	258
Al-Qassim	295	263	252	245	243	241	258	244	124
Eastern Region	380	344	370	374	377	374	364	378	381
Asir	78	83	85	89	98	99	104	127	125
Tabuk	192	199	174	168	283	299	211	220	158
Hail	137	136	110	105	130	170	220	224	228
Northern Borders	108	143	136	202	170	162	164	181	224
Jazan	36	35	31	57	66	76	136	108	102
Najran	56	54	47	45	114	88	108	116	105
Al-Bahah	57	60	61	80	102	153	232	254	189
Al-Jouf	225	239	240	246	228	225	222	242	149
Kingdom-wide average	227	231	235	238	249	253	263	270	265

# VALUE OF WATER – KSA – Jazan

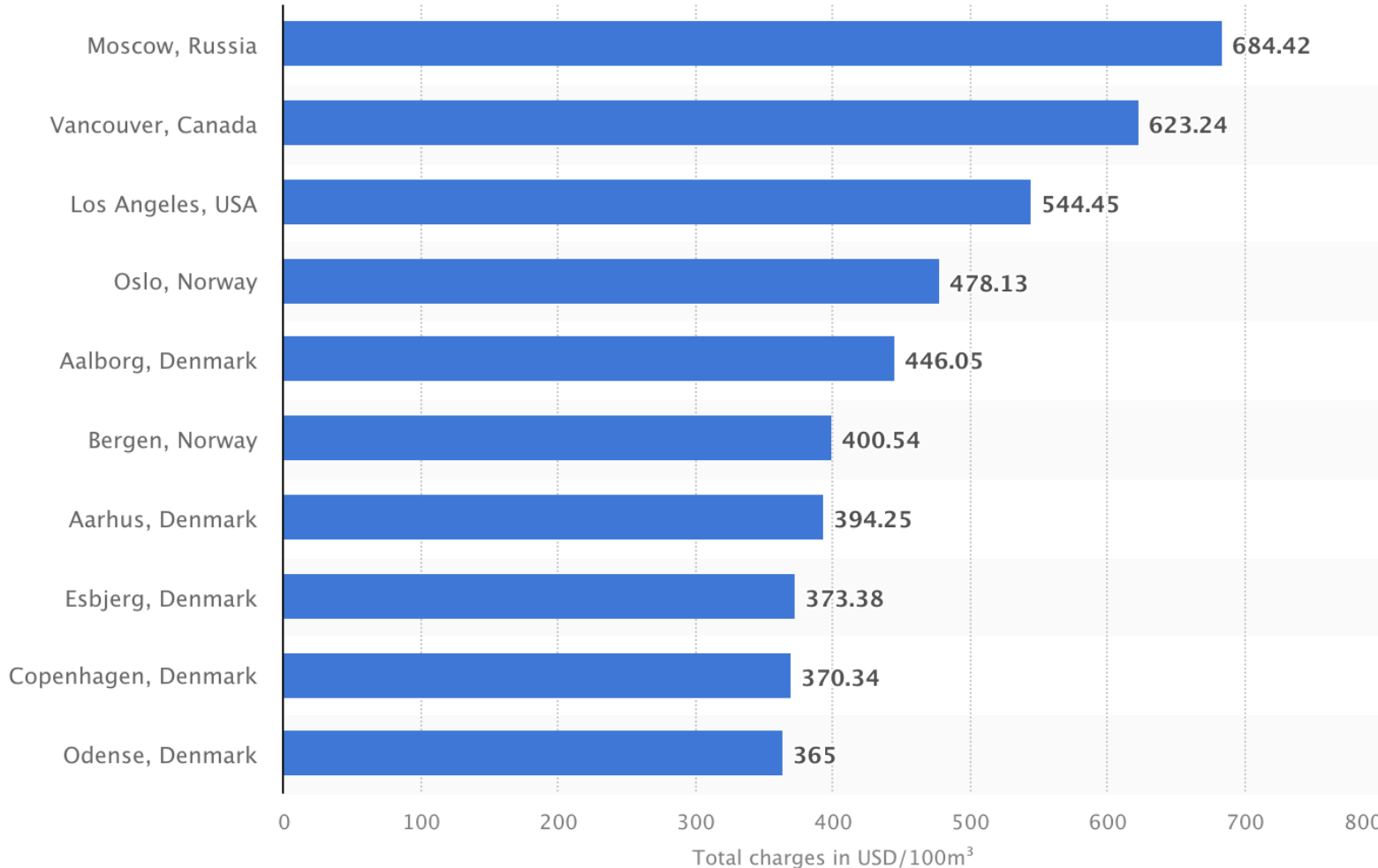
## ARAB NEWS

Home / Jazan region attracts over \$266m in two years

### Jazan region attracts over \$266m in two years



## VALUE OF WATER – Water Tariffs



### Potable Water & Sanitary Wastewater Tariff Residential and Commercial

Monthly Consumption Slabs (SAR/m <sup>3</sup> /Month)	Water Consumption Rate (SAR/m <sup>3</sup> /Month)	Sanitary Wastewater Rate (SAR/m <sup>3</sup> /Month)	Total Consumption (SAR/m <sup>3</sup> /Month)
LESS THAN 16	0.1	0.05	0.15
FROM 16 TO 30	1.0	0.5	1.5
FROM 31 TO 45	3.0	1.5	4.5
FROM 46 TO 60	4.0	2.0	6.0
MORE THAN 60	6.0	3.0	9.0

مرافق  
MARAFIQ

Heavily Subsidized and Losing Money?

Or Investment for Sustainable Development?

## VALUE OF WATER

# Financing water

Investing in sustainable growth



Benefit-cost ratios for **investments in water sanitation services** have been reported to be as high as **7 to 1** in developing countries.



OECD (2011)



# COST OF WATER PRODUCTION

- Quality of Raw Water
- Treatment Technologies
- Legal Regulations
- Used Energy Sources
- The Amount of Treated Water



	Cost (2010\$/m <sup>3</sup> of potable water)
Ground water (Global)	\$0.01- \$0.20
Brackish water (SoCal)	\$0.14
Conventional water treatment (USA)	\$0.34
Surface water (SoCal)	\$0.32 - \$0.65
Ground and surface water (USA)	\$0.40-\$0.75
Ground and surface water (Western Australia)	\$0.45-\$0.61
Treated municipal water (SoCal)	\$0.81
Ground water(SoCal)	\$0.30 - \$0.89
Desalinating brackish agricultural runoff water	\$0.45 - \$0.71

	Cost (2010\$/m <sup>3</sup> of potable water)
SWRO of water from the Mediterranean Sea	\$0.60
Water produced by implementing efficiency measures (SoCal)	\$0.12 - \$0.81
Tampa Bay SWRO	\$0.93
High level engineering estimate for SWRO (global)	\$1.00 - \$1.11
Recycled water (SoCal)	\$0.97 - \$1.46
Brackish water (SoCal)	\$1.20-\$1.39
Gold Coast (Australia) SWRO	\$1.63
Kurnell SWRO (Sydney, Australia)	\$2.00
Seawater Desalination (California)	\$1.54-\$2.43

# COST OF WATER PRODUCTION

## Safe Drinking Water Act

[CONTACT US](#)

[Safe Drinking Water Act Home](#)

[Overview of the Law](#)

[Regulations Under Development](#)

[Developing Regulations](#)

## Drinking Water Treatment Technology Unit Cost Models

### Drinking Water Treatment Technology Unit Cost Models

Small Scale Brackish Water RO

Total Cost:

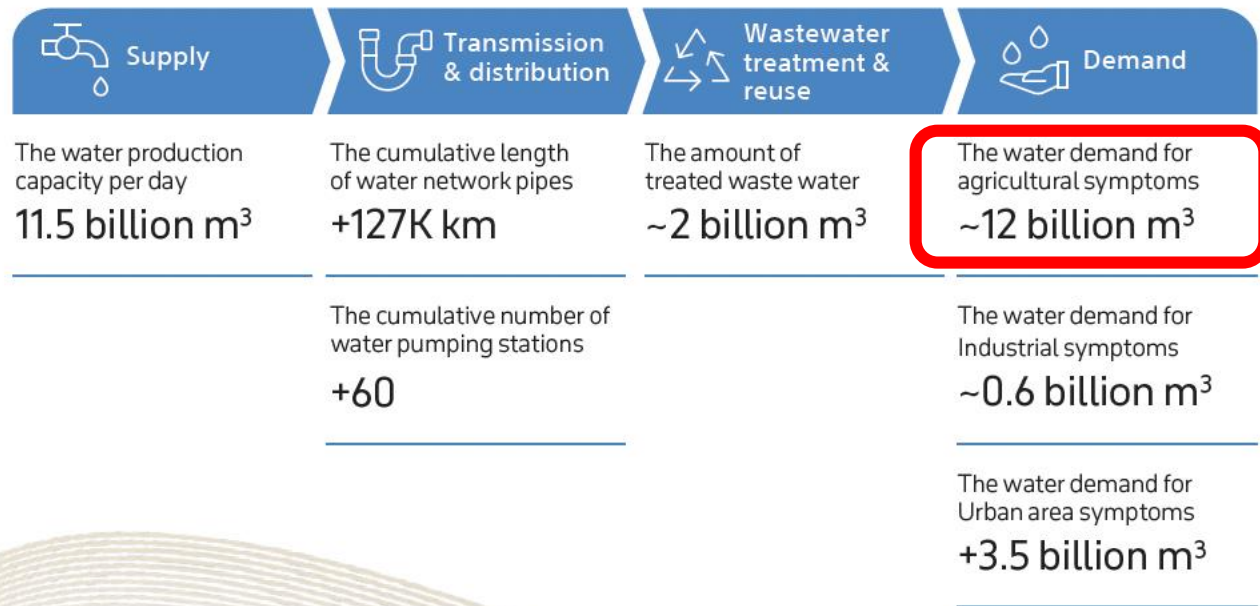
**\$1.36/m<sup>3</sup>**

#### OUTPUT SUMMARY

Parameter	Value	Units
Technology		RO
System Size Category		small
Design Flow	0.74	MGD
Average Flow	0.251	MGD
Design flux	16	gfd
Feed water		Low Qual GW
Total membrane area	48,000	ft <sup>2</sup>
Recovery	74.6%	
Train configuration	7:3	
Elements/vessel	6	
Feed pressure	263	psi
Feed/booster pump energy	324	MWh/yr
Salt rejection	99.1%	
Component level		high cost
System automation		fully automated
<b>Resulting Costs (in year 2021 dollars)</b>		
Direct Capital Cost	\$ 1,769,446	<a href="#">Details</a>
Add-on Cost	\$ 39,757	<a href="#">Details</a>
Indirect Capital Cost	\$ 1,221,745	<a href="#">Details</a>
<b>Total Capital Cost</b>	<b>\$ 3,030,948</b>	<a href="#">Details</a>
Annualized Capital Cost (per year over 28.7 years at 7%)	\$ 247,697	<a href="#">Details</a>
<b>Annual O&amp;M Cost (per year)</b>	<b>\$ 223,836</b>	<a href="#">Details</a>
<b>Total Annualized Cost (per year, 53% capital, 47% O&amp;M)</b>	<b>\$ 471,534</b>	<a href="#">Details</a>
Annualized cost per 1,000 gallons average flow	\$ 5.15	
Annualized cost per household per year	\$ 632	

# RECENT EFFORTS

Figure 1: An overview of the water sector in the Kingdom of Saudi Arabia



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Ministry of Environment Water & Agriculture

## Innovation in the Water sector in Saudi Arabia

Technology Adoption Roadmap



# RECENT EFFORTS



Supply



Transmission & distribution



Wastewater treatment & reuse



Demand

Desalination & alternative supply technologies

1. Advanced RO

2. New desal methods [excl. RO]

3. Brine mining

4. Renewable desalination

5. Alternative supply

20. Smart water control systems



WTIIRA

management

13. Wastewater treatment and reuse

14. Recovery technology

15. Innovative treatment

16. Innovative water testing

17. Innovative water consumption in homes

18. Innovative water consumption in industry

19. Innovative irrigation



## RECENT EFFORTS



### BRINE MINING

- Brine Concentration
- Minimum liquid discharge
- Mineral Harvesting

### CLEAN & RENEWABLE ENERGY

- Renewable Energy
- Carbon Capture
- E-Fuels
- Energy Storage
- Energy Balance

### PROCESS & PRODUCT INNOVATION

- RO process
- Pre-treatment
- Balance of Plant
- Process Innovation

### SUSTAINABILITY & ADVANCED MATERIAL

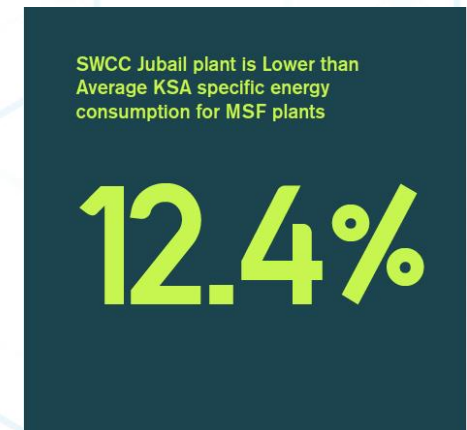
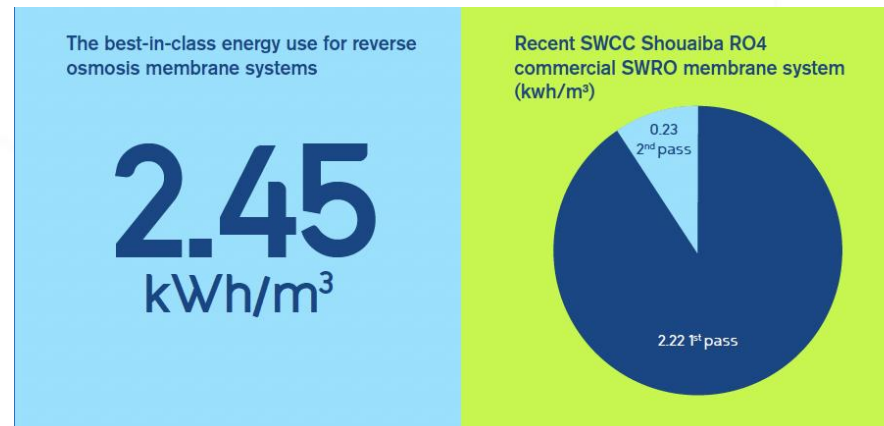
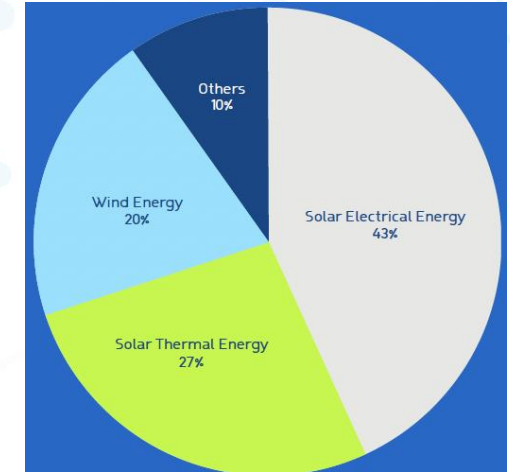
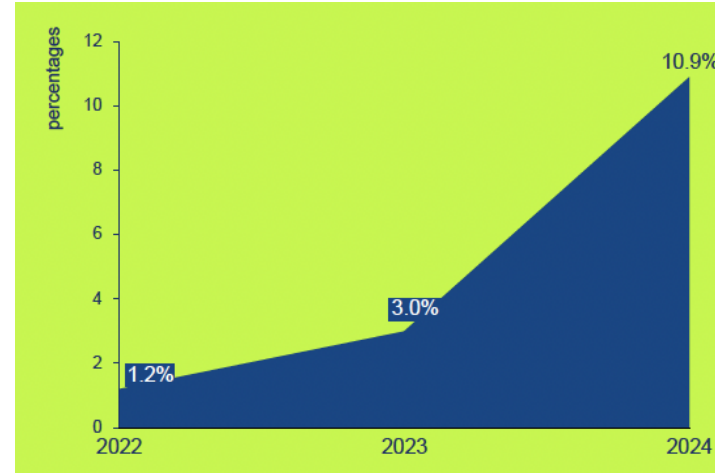
- Environment
- Biology
- Corrosion
- Material Selection
- Water Quality

- 50+ Active Projects with Industry and Academia
- Lab to Field Implementation
- Lowest SEC for SWRO Process in the World
- State of the Art Mg<sup>++</sup> Recovery Application



## Recent Efforts and Future Goals

- Novel Pre-treatment and RO membranes
  - Low Fouling
  - High Flux
  - High Selectivity
- Carbon Capture
- Valuable Resource Recovery
- Renewable Desalination
- Thermodynamic Process Optimization
- Salinity Gradient Process Implementation



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# THANK YOU!



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