

Saudi Aramco Wastewater Reuse Efforts

EnviroArabia 2007

*Thamer S. Al-Mutairi
David G. Evans*

April 2007

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Saudi Aramco

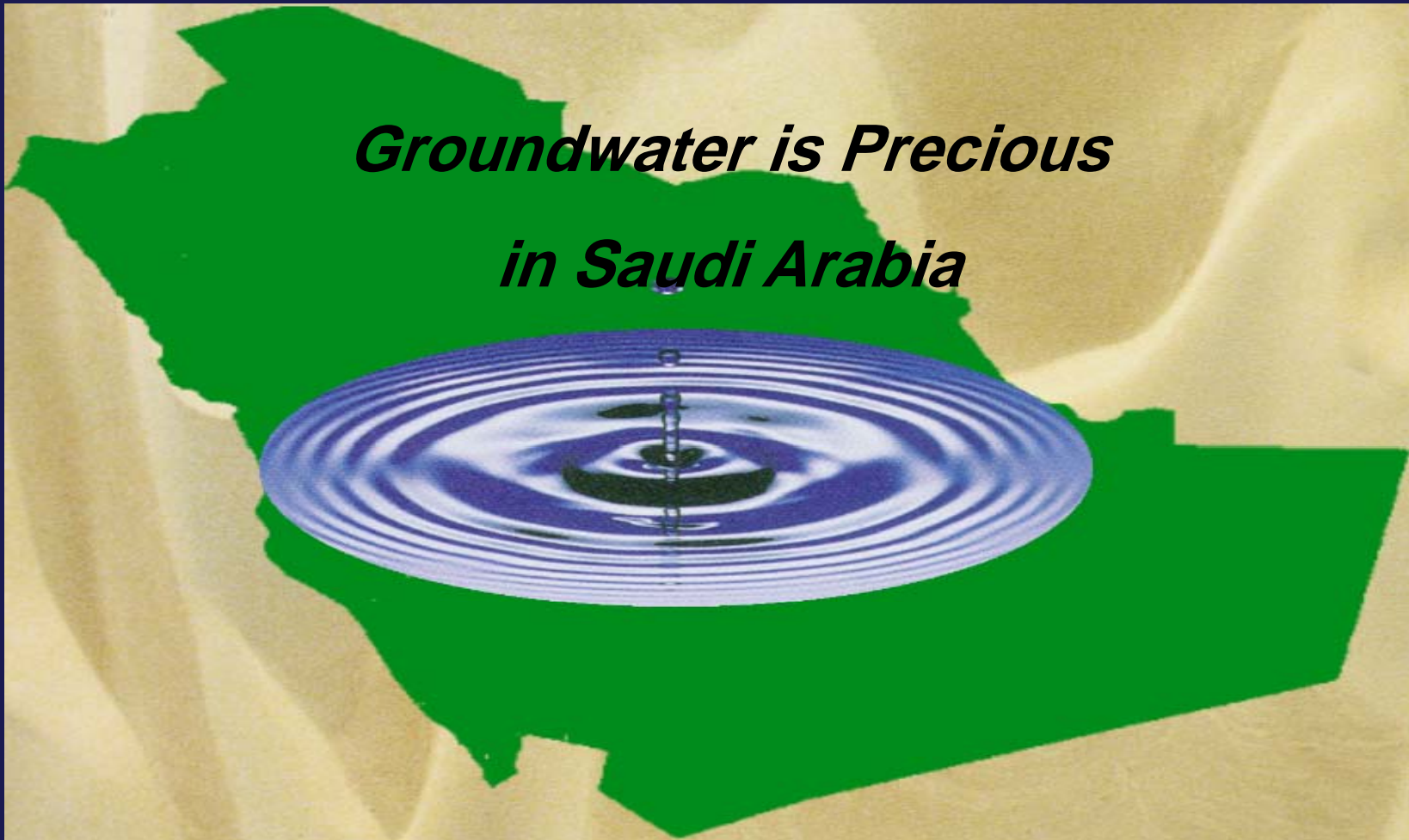


Outline

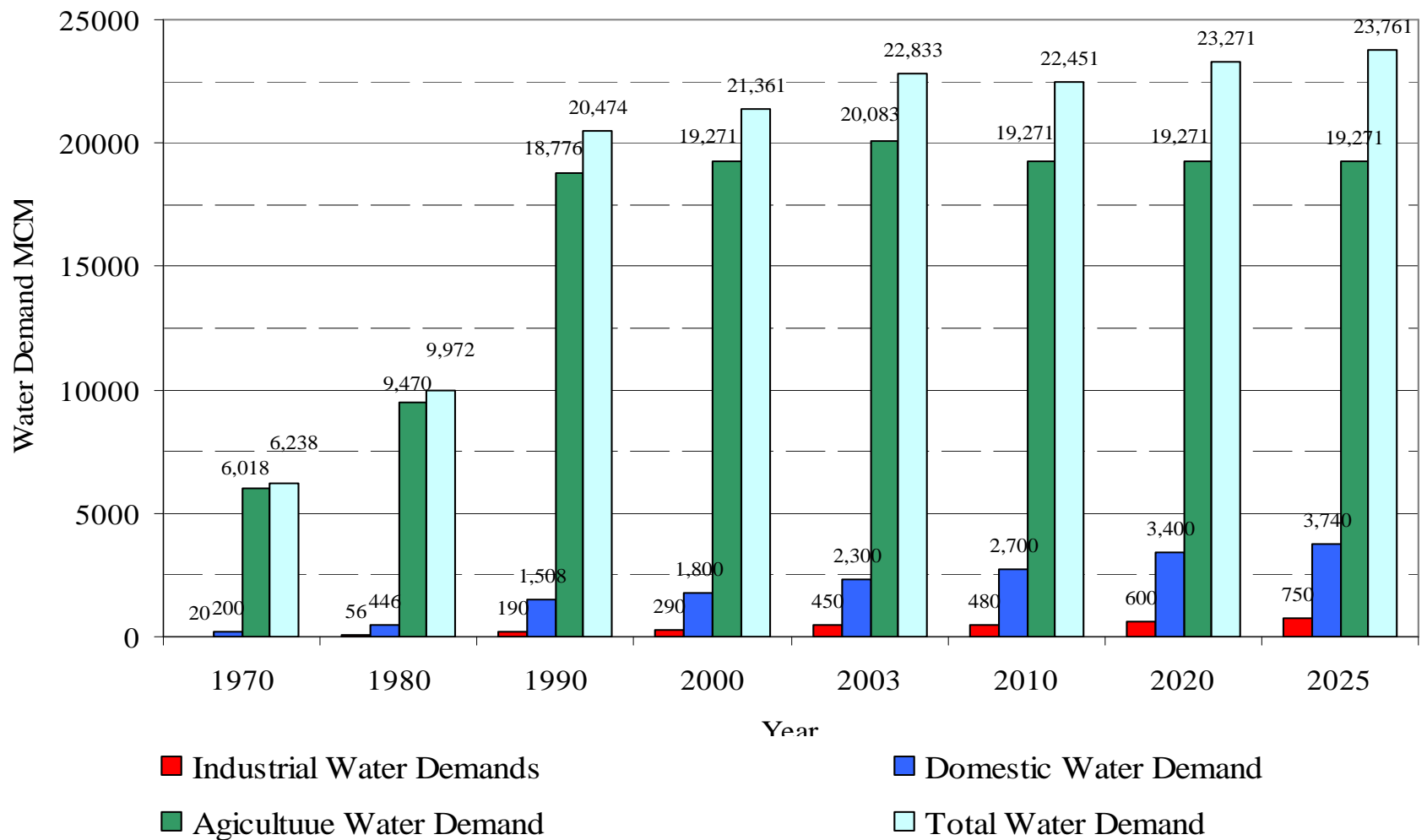
- *General Background in Water Resources*
- *Saudi Aramco Wastewater Generation*
- *Saudi Aramco standard*
- *Treatment Methods of Wastewater Re-use*
- *Re-use Applications*
- *Wastewater Reuse in the plant*
 - *Riyadh Refinery project*
 - *Juaymah Gas Plant study*
- *Saudi Aramco Wastewater Re-use Plans*
- *Conclusions*

Water Resources in Saudi Arabia

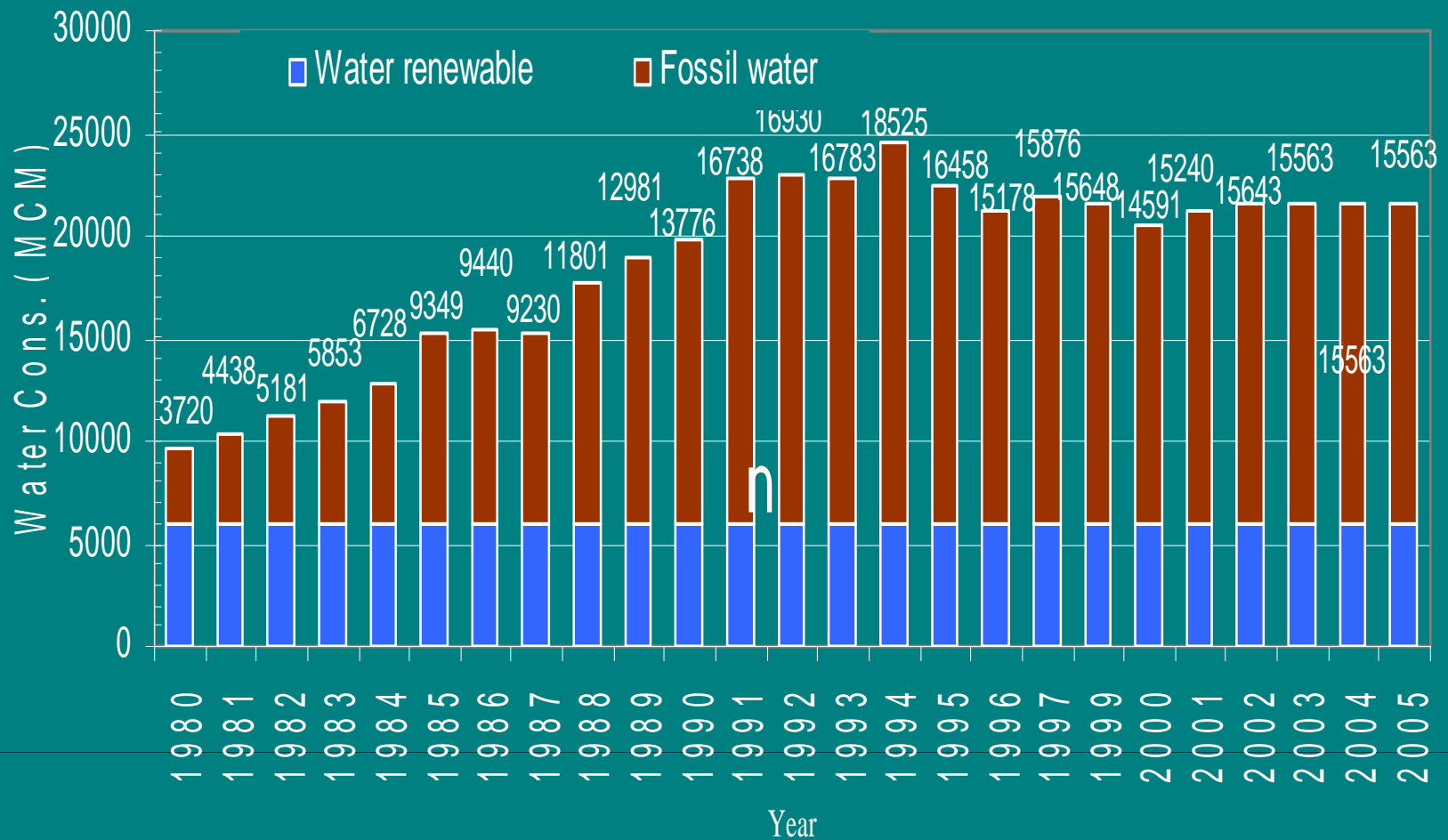
***Groundwater is Precious
in Saudi Arabia***



Growth in water demands in the Kingdom



Groundwater in Saudi Arabia



Saudi Aramco is generating Wastewater

SA is generating over **24** million gallons of **Industrial** wastewater each day.

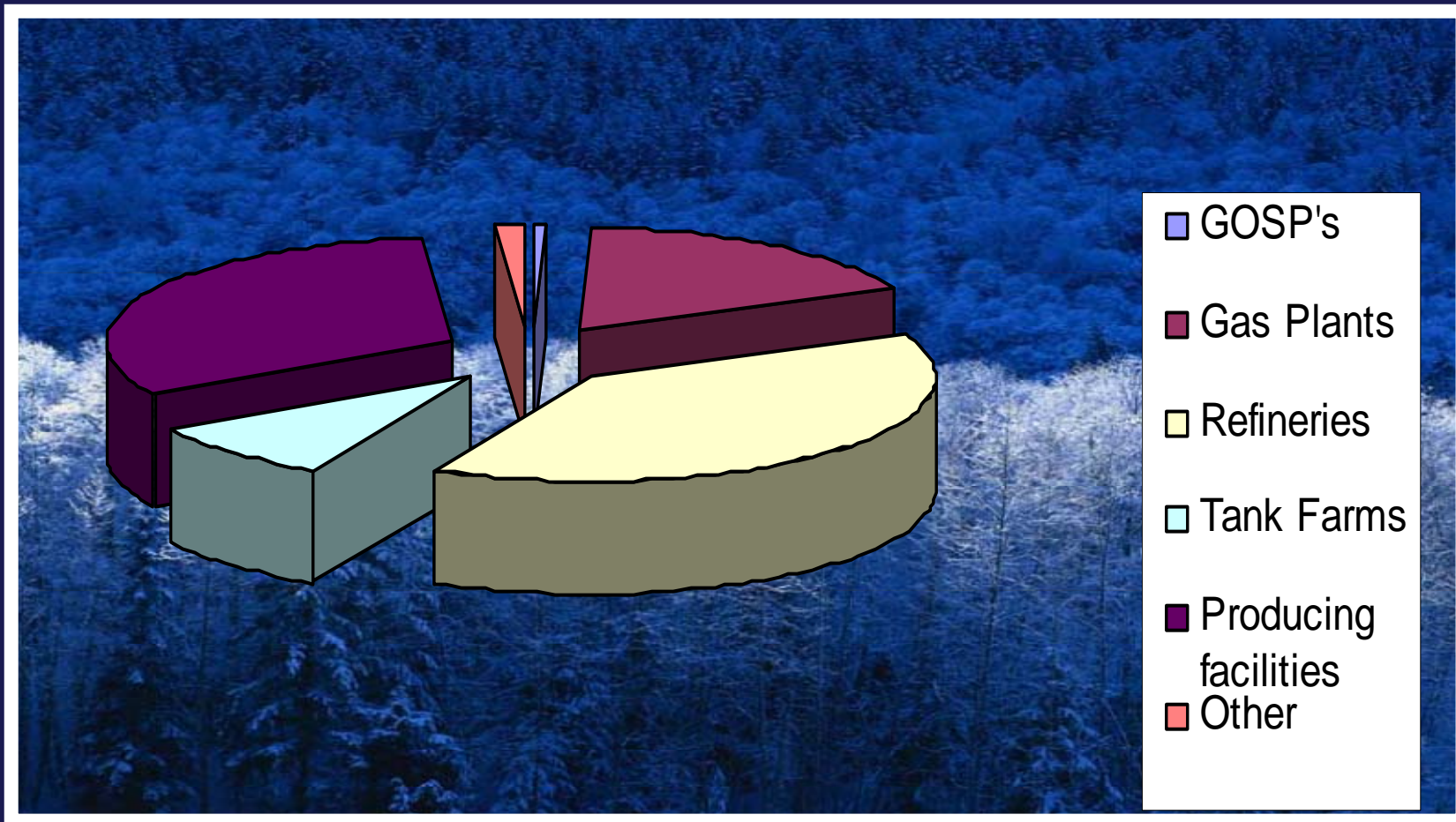
SA is generating over **21** million gallons of **sanitary** wastewater each day



Saudi Aramco Waste Minimization

- Waste Minimization Audits
- Water Conservation Audits
- New Reuse Facilities

Major Industrial Wastewater Generators



Saudi Aramco Strict Reuse Standards

Parameter	Saudi Arabian Government Maximum	Saudi Aramco Maximum
Total Suspended Solids (mg/L)	10	5
BOD ₅ (mg/l)	10	10
Total Coliform (MPN/100 ml)	2.2	2.2

Reuse Treatment Methods

TREATMENT METHOD	Number Of Plants
Complete Mix Extended Aeration Activated Sludge	12
Oxidation Ditch Extended Aeration	2
Rotating Bio. Contactors (RBC)	1
Flocculation	15

TREATMENT METHOD	Number Of Plants
Slow Sand Filters	1
Rapid Sand Filters	12
Continuous Backwash Filters	2
Reverse Osmosis	1

Reuse Treatment Methods

Membrane Bio Reactor MBR

<i>Projects Stage</i>	<i>No. Of MBR's</i>
<i>Construction</i>	<i>9</i>
<i>Design</i>	<i>2</i>
<i>Planned</i>	<i>5</i>

Reclaimed Water Applications

REUSE	Irrigation	Golf Course	Sod Farm	Perc. Ponds	Tree Farm	Farming Canal Water	Cooling Tower Water	Boiler Feed Water
FLOW (mgd)	10.5	1.5	2.0	0.5	0.5	1.4	1.4	2.2

REUSE APPLICATIONS



Baseball Fields

REUSE APPLICATIONS

Soccer Fields



REUSE APPLICATIONS

Golf Courses



REUSE APPLICATIONS

PASPALUM GRASS

- Salt-water tolerant
- Resistant to insect and disease damage
- Can handle weather extremes
- Need few nutrients to thrive

Golf Courses

REUSE APPLICATIONS

Golf Courses



REUSE APPLICATIONS



Golf Courses

REUSE APPLICATIONS

Parks



REUSE APPLICATIONS



Parks

REUSE APPLICATIONS



Sod Farming

REUSE APPLICATIONS



Percolation Pond

REUSE APPLICATIONS



Redshanks (*Tringa totanus*) and flamingos (*Phoenicopterus ruber*) feed at depths that suit their length of leg



An Isabelline strike (*Lanius isabellinus*) perches on one of the tall reeds that form dense stands in Lake Lanhardt



A moorhen (*Gallinula chloropus*) feeds afloat among the reeds; little crakes (*Porzana parva*) prefer shallower water



Percolation Pond

REUSE APPLICATIONS



Abqaiq Tree Farm

REUSE APPLICATIONS

Irrigation Canal



An aerial photograph showing a vast, dense forest of date palm trees. In the background, a city with various buildings and structures is visible under a hazy sky. The foreground shows a sandy, light-colored area, possibly a dune or a cleared area. The text "REUSE APPLICATIONS" is overlaid in yellow, bold, uppercase letters in the upper middle part of the image.

REUSE APPLICATIONS

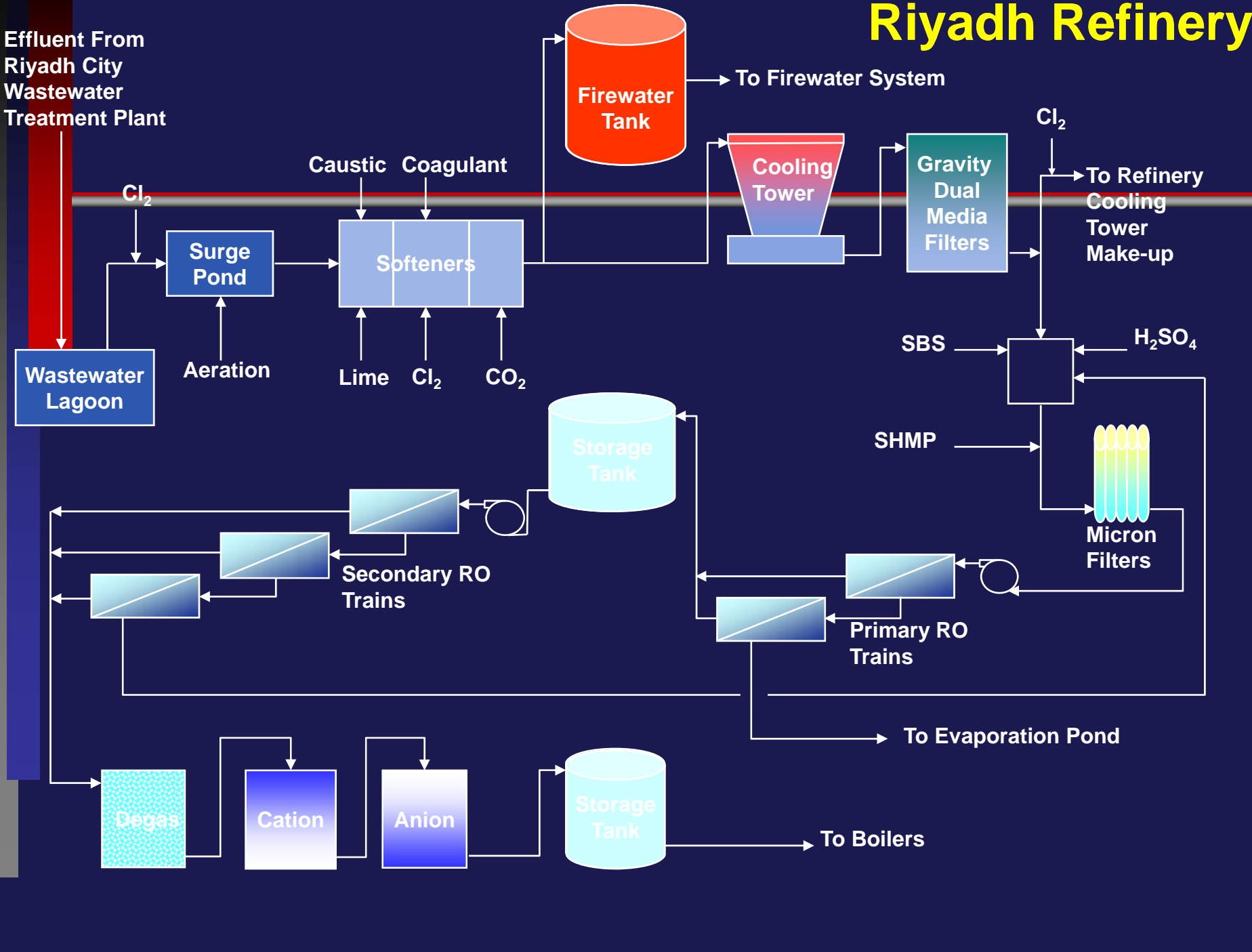
Date Trees

RIYADH REFINERY



Riyadh Refinery

Effluent From Riyadh City Wastewater Treatment Plant



Saudi Aramco Water Conservation

**Case study
JGP Industrial WW Reuse Technology**

Wastewater

Treatment

Water Uses

Sanitary WW

MBR

Irrigation

RO Reject

Raw Water

Boiler
Blowdown

Blending

Cooling Tower
Make-up

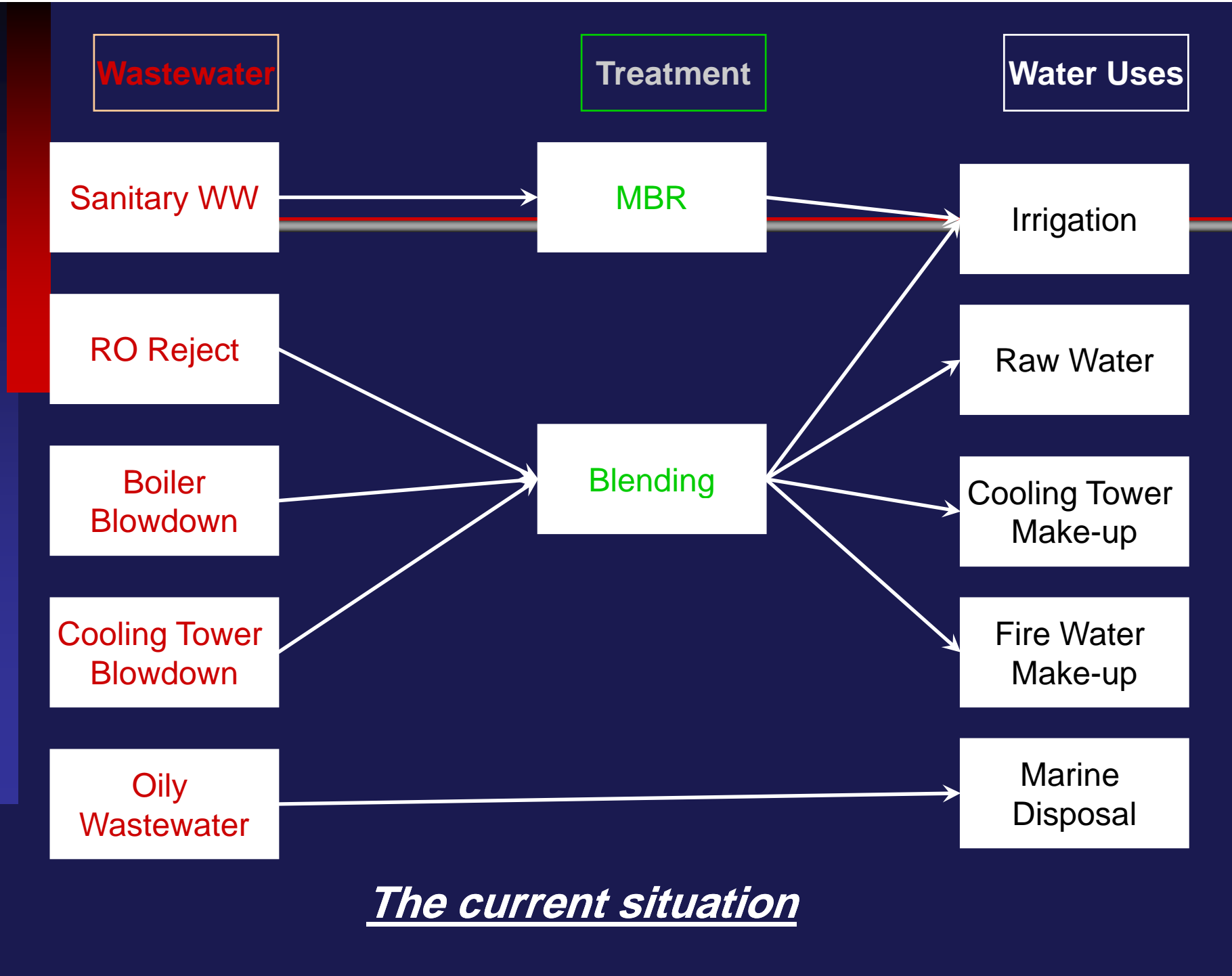
Cooling Tower
Blowdown

Fire Water
Make-up

Oily
Wastewater

Marine
Disposal

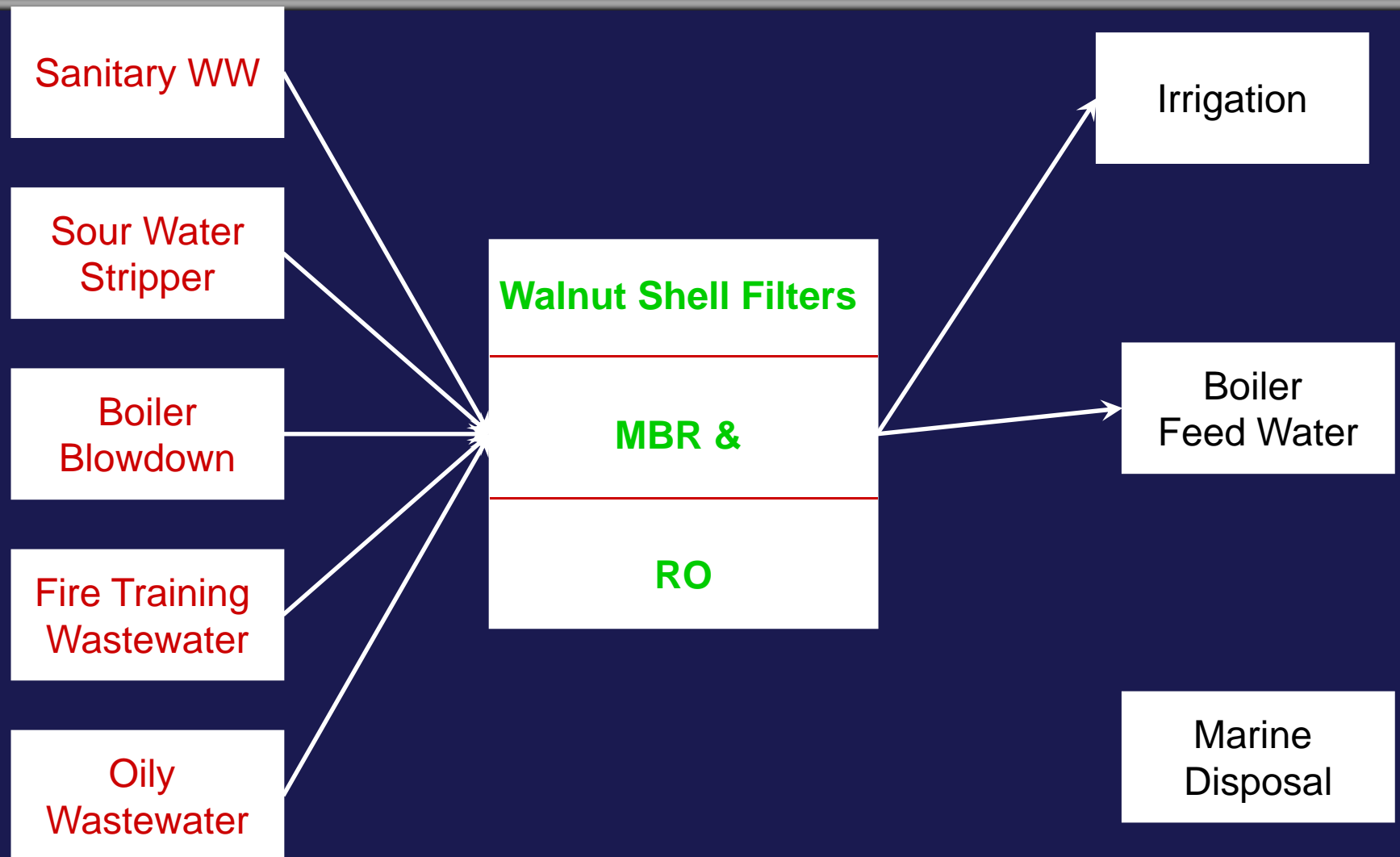
The current situation



WW Reuse – New High Tech Options

- JGP Industrial WW Reuse
 - Combine Sanitary & Oily Wastewater
 - API & Walnut Shell Filters
 - MBR Treatment (carbon assisted)
 - RO to Provide Boiler Feed Water
 - Annual Cost Savings > \$1 MM

JGP – Carbon Assisted MBR & RO



Saudi Aramco

Wastewater Reuse Plans

- Sanitary Wastewater
 - Currently 72% Reused
 - Current projects will increase reuse to over 94%
- Oily Wastewater
 - Currently Mostly Discharged to Evaporation Ponds (15% Reused)
 - Beneficial Reuse Plan (Up to 90% Reuse)
 - Oil Field Pressure Maintenance
 - Walnut Shell Oil Removal & MBR

CONCLUSION

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- *Water Reuse Saves Precious Groundwater*
- *Wastewater Can be Reused Many Ways*
- *Plans for More Water Conservation*



*Thank You
For Your
Time*