SUSTAINBLE WATER SECURITY AND WASTEWATER REUSE IN SAUDI ARABIA

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Presentation at
WEP MEETING, KAUST
20th January, 2014

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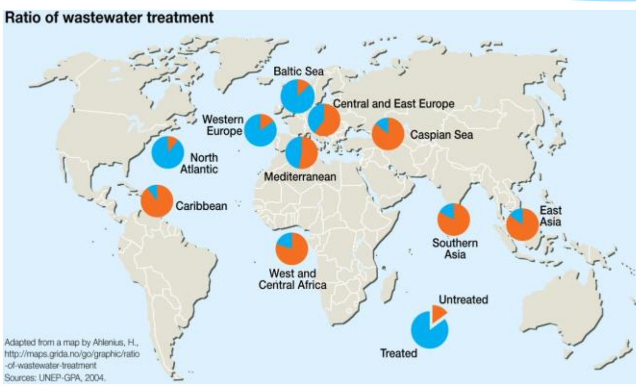
Global Wastewater Reuse

There is a global trend in increasing dependence on the reuse of wastewater as sustainable non-conventional water resource for solving the rising global water stress especially in arid countries.

Global Wastewater Reuse



Ratio of wastewater treatment.
The ratio of treated to untreated wastewater reaching water bodies for 10 regions. An estimated 90 per cent of all wastewater in developing countries is discharged untreated directly into rivers, lakes or the oceans (UN Water, 2008).

Global Wastewater Reuse

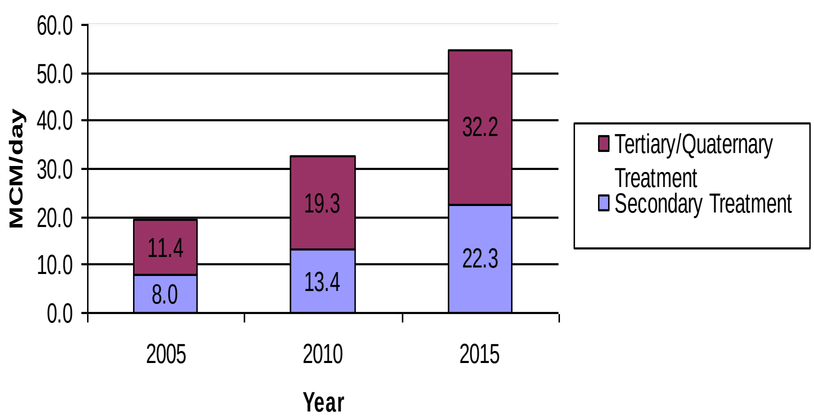
	Not available	Secondary	Tertiary	Quaternary
Americas				
USA	60%	14%	12%	14%
Rest of Americas	14%	83%	0%	3%
Americas total	**49%**	**30%**	**10%**	**11%**
Asia Pacific				
Japan	7%	39%	30%	24%
China	99%	0%	0%	1%
Singapore	0%	0%	0%	100%
Australia	17%	55%	6%	22%
Rest of Asia Pacific	88%	0%	0%	12%
Asia Pacific total	**66%**	**13%**	**6%**	**15%**
Europe, Middle East, Africa				
Western Europe	27%	12%	40%	20%
Eastern Europe/CIS	72%	0%	24%	4%
GCC	23%	0%	58%	19%
Israel	0%	0%	100%	0%
Rest of Middle East and North Africa	62%	35%	3%	1%
Namibia	0%	0%	100%	0%
South Africa	0%	67%	27%	7%
Rest of Africa	100%	0%	0%	0%
EMA total	**42%**	**19%**	**31%**	**7%**
World total	**51%**	**21%**	**20%**	**11%**

Water reuse volume by level of treatment by country/region

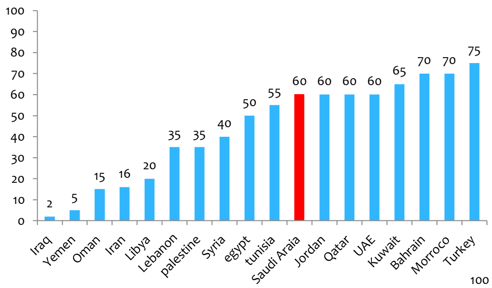
	Agriculture	Urban	Industry	Mixed	Not available
Americas					
USA	27.8%	46.9%	3.6%	10.8%	10.8%
Rest of Americas	78.6%	0.0%	7.1%	0.0%	14.3%
Americas total	**39.8%**	**21.2%**	**22.9%**	**21.2%**	**24.6%**
Asia Pacific					
Japan	5.0%	40.9%	9.0%	45.1%	0.0%
China	10.0%	40.0%	50.0%	0.0%	0.0%
Singapore	0.0%	100.0%	0.0%	0.0%	0.0%
Australia	42.4%	27.1%	4.9%	19.3%	6.2%
Rest of Asia Pacific	0.0%	0.0%	0.0%	0.0%	100.0%
Asia Pacific total	**8.2%**	**21.3%**	**12.7%**	**10.0%**	**47.8%**
Europe, Middle East, Africa					
Western Europe	24.9%	43.0%	18.5%	9.2%	4.3%
Eastern Europe/CIS	0.0%	0.0%	25.0%	0.0%	75.0%
GCC	13.6%	22.4%	2.1%	14.3%	47.6%
Israel	60.0%	0.0%	0.0%	40.0%	0.0%
Rest of Middle East and North Africa	39.0%	5.4%	2.8%	0.0%	52.9%
Namibia	0.0%	0.0%	0.0%	100.0%	0.0%
South Africa	5.3%	0.0%	15.8%	52.6%	26.3%
Rest of Africa	0.0%	0.0%	0.0%	0.0%	100.0%
EMEA total	**24.1%**	**10.5%**	**9.3%**	**11.6%**	**44.5%**
World total	**25.1%**	**16.5%**	**14.1%**	**14.2%**	**41.3%**

Global water reuse volume by field of application by country/region

Summary Of Global Trend In Wastewater Reuse



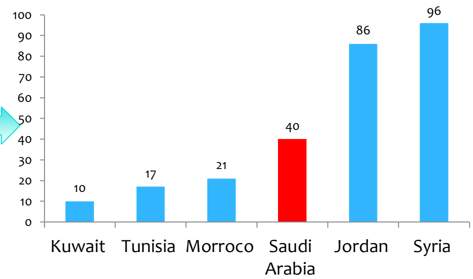
Wastewater Reuse in Arab and MENA Regions



Sewerage coverage - MENA Region

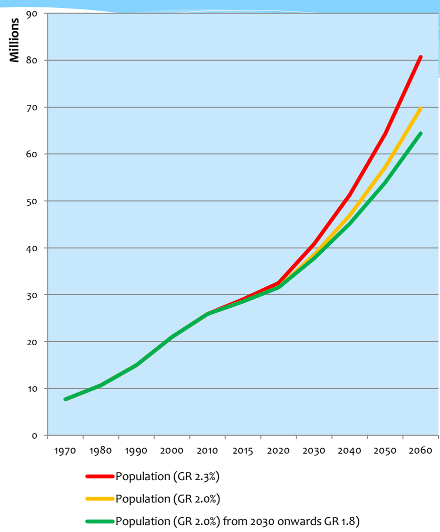
Source : GWI -2013 and personal contacts

Treated Effluent Reuse (% of treated volume)



POPULATION GROWTH , WATER RESOURCES AND DEMANDS KSA

GROWTH IN POPULATION AND DOMESTIC WATER DEMANDS

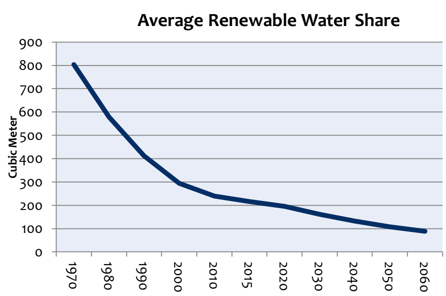


Population Growth in the Kingdom

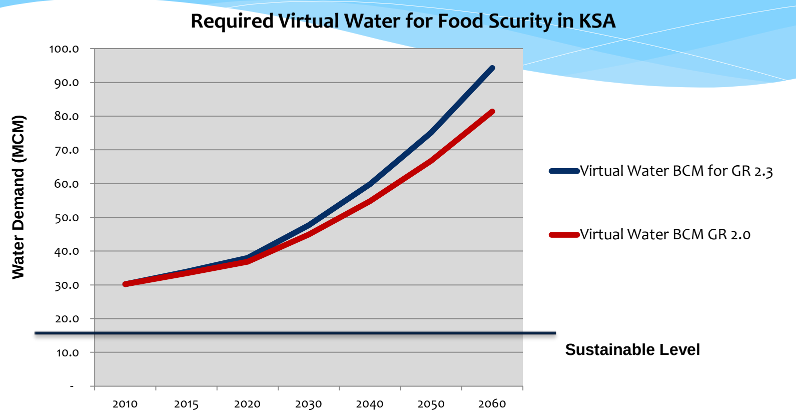
RENEWABLE WATER RESOURCES

- **Approximate volumes of renewable water resources (available for use) are about 5,000 MCM**
- **The average water share from renewable resources is about 220 cubic meters per person in 2013. According to the scarcity index the country is under extreme water scarcity**

The average renewable water share

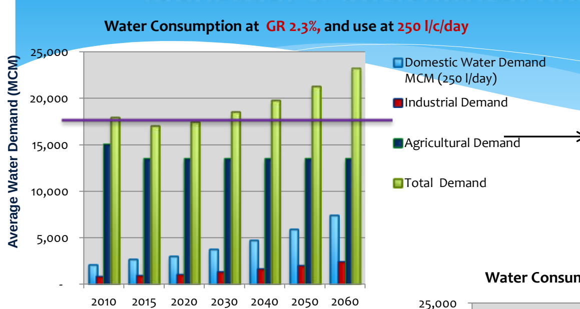


REQUIRED VIRTUAL WATER FOR FOOD SECURITY IN KSA



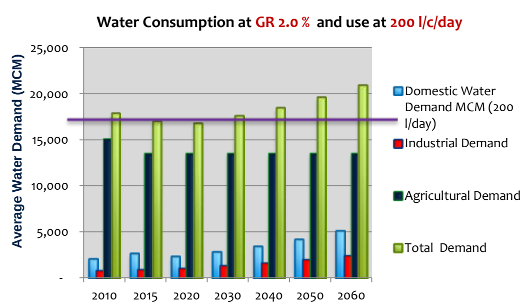
Assumption: Per capita food requirement is about 3200 cal/day or 3200 l/c/day

Projected Water Demands for Domestic, Industrial & Agricultural Purposes

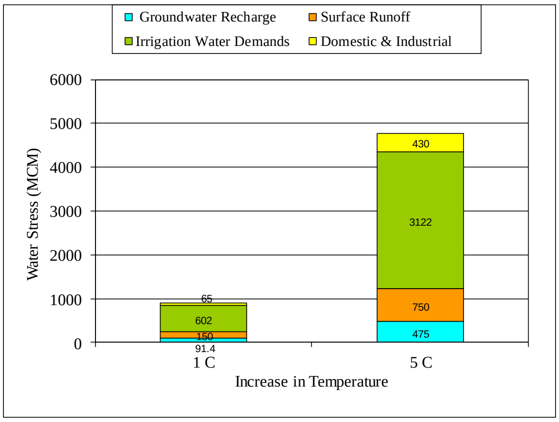


Agricultural demand is assumed to be constant at 13,000 MCM after

- **Phasing out wheat crop by year 2015**
- **Keeping The Same Ratio of Self-sufficiency in Vegetables and Dates as 2010**
- **Utilizing Drip System Irrigation for Dates and Green House for vegetables**
- **Phasing out 50% of fodder crops by 2015 and 100% by 2040**

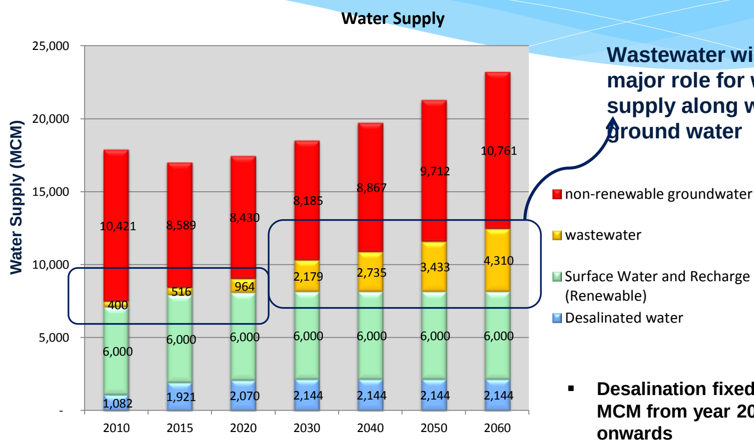


Added Stress On Water Resources Due To Climate Change



Water supply scenarios

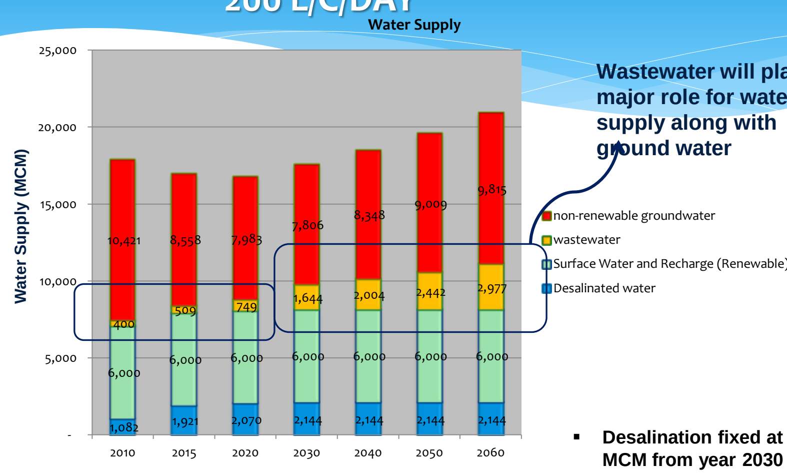
WATER SUPPLY FOR ALL DEMAND TYPES BASED ON POPULATION G.R. OF 2.3% AT 250 L/C/DAY



Wastewater will play a major role for water supply along with ground water

- **Desalination fixed at 2144 MCM from year 2030 onwards**
- **Calculated after phasing out wheat by 2015**

WATER SUPPLY FOR ALL DEMAND TYPES BASED ON POPULATION G.R. OF 2.0% AT 200 L/C/DAY



Wastewater will play a major role for water supply along with ground water

- **Desalination fixed at 2144 MCM from year 2030 onwards**
- **Calculated after phasing out wheat by 2015**

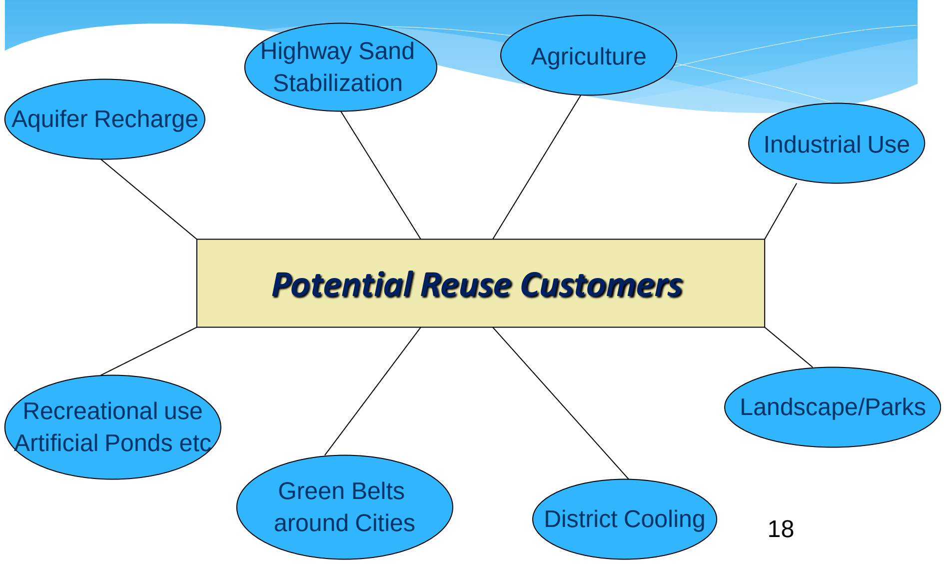
WASTEWATER REUSE AS STRATEGIC OPTION

- Wastewater reuse, in a scarce water country such as Saudi Arabia, has become a an inevitable mean, and an integral part of integrated water resource management to achieve sustainable water and food security in KSA.

- Wastewater reuse is one of the most cost and energy efficient alternative water resources compared to desalination and long distance water transportation. Energy-efficient advanced water recycling plants are producing recycled water of drinking water quality with a relatively low energy footprint .

- Reuse of water can contribute to the saving of valuable freshwater resources. At the same time, water reuse contributes in saving electric power, in particular, when freshwater has to be transported over long distances or further water treatment is required, for example production of potable water from desalination of brackish or seawater. The generation of recycled water only requires a fraction of the energy needed for the desalination of seawater.

Potential Reuse Customers



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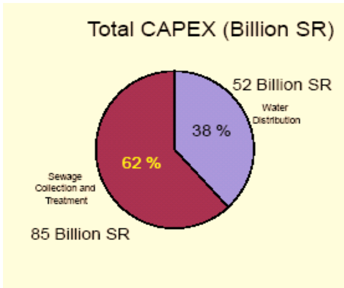
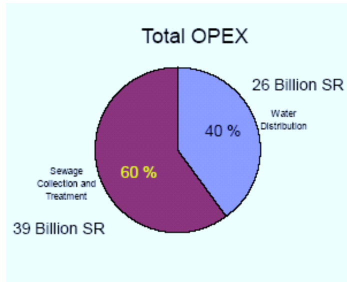
Wastewater Reuse in KSA

CAPEX AND OPEX EXPENDITURE ON WASTEWATER COLLECTION AND TREATMENT IN SAUDI ARABIA FOR NEXT 20 YEARS





Source: National Water Company, KSA

Framework for Wastewater Reuse

Pillars of wastewater reuse market

- Quantitative requirements for establishing demands for various industries.
- Qualitative requirements for various industries.
- Capex/Opex requirements for infrastructure development.
- Institutional requirements for establishing reuse market.
- Legislation Framework to regulate and maximize Wastewater reuse Such as introduction of reuse legislation - Ban on the use of fossil groundwater for fodder cultivation in Diary Farms nearby cities.
- Public-Private-Partnership model for reuse market.
- Assessing the customer's willingness to pay.
- Feasible tariff development for wastewater reuse.

Factors Controlling The Ability To Pay For Wastewater Reuse

- The first is the actual price that water consumers pay for water.

- The second is the maximum price that they are likely to pay for water. The maximum price is generally a function of the GDP per head.

Present Status of Wastewater Reuse in KSA

Wastewater Services After the Establishment of MOWE - KSA

MOWE -2001

Major Improvements

Expanding Wastewater Networks

WWTP
- Upgrade
- Expansion

Reuse
- Industrial
- Agriculture
- Municipal – Landscape

Irrigation

Involvement of Private Sector

National Water Company (2008)

Management Contract
- With private sector (National & International)
- Major cities: Riyadh, Jeddah, Makkah, Taif & Midinah

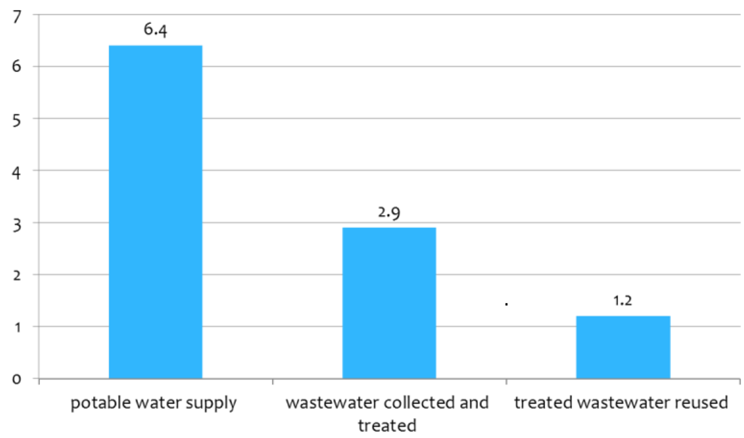
Creation of TSE Market in KSA
Included :
- Organizational
- Institutional
- Legal
- Finance

Executed more than 14 contacts selling TSE
For private sector in different cities for more than > 1.8 Billion SAR
- Landscape
- Industrial
- Municipal
- Mining

Formation of JV Between NWC and with Private sector (National & International)
To carry out O&M of: WWTP, Sewer Networks and TSE

Present Status of Wastewater Reuse in KSA

Wastewater Statistics in KSA (Million M^3/day)



Specific Challenges for boosting the Wastewater Reuse Market in Saudi Arabia

- The present coverage of Kingdom's sewage collection is only 60%.
- The wastewater reuse in the Kingdom is about 15% of total water supply.
- Huge capital investments are required for the collection systems and treatment of wastewater, and reuse infrastructure development in the kingdom. According to NWC about SR 125 billion is required in the next 20 years.

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Specific Challenges for boosting the Wastewater Reuse Market in Saudi Arabia-Contd

- Requirement for water and wastewater regulator.
- Although wastewater reuse legal act is announced, but additional frameworks are required to regulate and to enforce the implementation of the act.
- Additional legislation are required to enhance the wastewater reuse demands such as banning the use fossil non-renewable ground water for diary farms, forage crop production and industry within and around cities.

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Commercial Issues of Wastewater Reuse

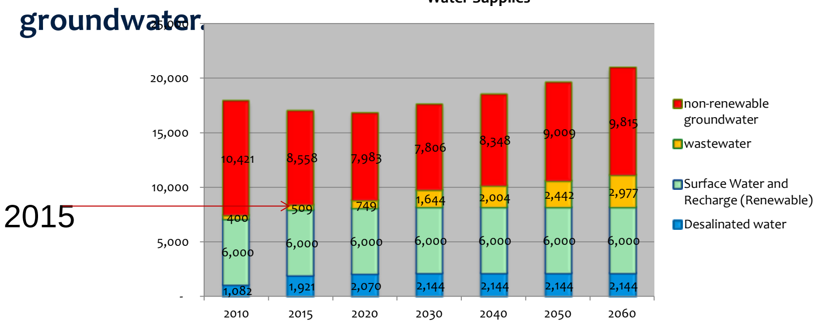
- **If the average cost of water from a wastewater reuse project is greater than the maximum affordable price, the project will only go ahead if there is an industrial off - taker.**
- **Water reuse may be required from a demand point of view and affordable, but not locally practical due to several factors such as:**
  - **mismatch between the supply of wastewater and the demand for reclaimed water due to various causes,**
  - **lack of wastewater collection and treatment facilities to supply a water reuse facility, lack of an economic distribution system to get the reclaimed water to where it is required.**
- **Distribution is the major bottleneck for the water reuse market. This is particularly true of large scale urban projects. If an urban wastewater treatment plant is not located conveniently for industry, and there are no local leisure facilities requiring irrigation then heavy investment in distribution infrastructure is required.**

QUANTITATIVE IMPACTS OF WASTEWATER REUSE ON WATER AND ENERGY SAVINGS IN KSA

* Wastewater reuse of 509 million m3 in 2015 will result in:

1)Reduction in production of 254.5 million m3/yr of Sea water desalination, and about 254.5 million m3/yr of fossil groundwater.

2) Saving about 3.5 million MWh to produce and transport 509 million m3 from sea water desalination and groundwater.

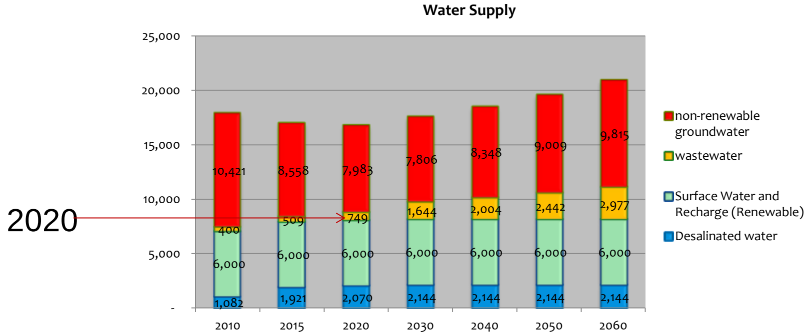


QUANTITATIVE IMPACTS (Continue)

- **Wastewater reuse of 749 million m3 in 2020 will result in:**

1)Reduction in production of 374.5million m3/yr of Sea water desalination, and about 347.5 million m3/yr of fossil groundwater.

2) Saving about 5.19 million MWh to produce and transport 749 million m3 from sea water desalination and groundwate.

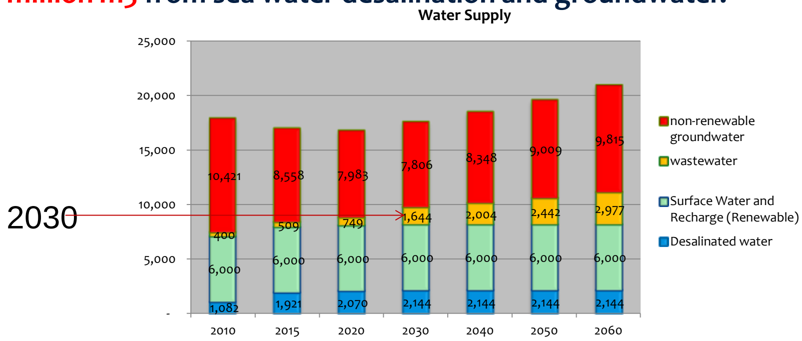


Quantitative Impacts (CONT.)

* **Wastewater reuse of 1644 million m3 in 2030 will result in:**

1)Reduction in production of 822 million m3/yr of Sea water desalination, and about 822 million m3/yr of fossil groundwater.

2) Saving about 10 million MWh to produce and transport 1644 million m3 from sea water desalination and groundwater.

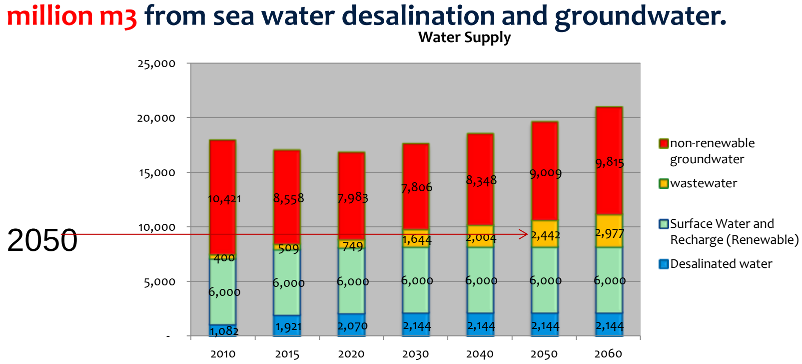


Quantitative Impacts (CONT.)

* **Wastewater reuse of 2442 million m3 in 2050 will result in:**

1)Reduction in production of 1221 million m3/yr of Sea water desalination, and about 1221 million m3/yr of fossil groundwater.

2) Saving about 14.8 million MWh to produce and transport 1221 million m3 from sea water desalination and groundwater.



Conclusions and recommendations

CONCLUSIONS AND RECOMMENDATIONS

- **There is a global trend in increasing dependence on the reuse of wastewater as sustainable non conventional water resource for solving the rising global water stress especially in arid countries. The maximum utilization of the wastewater effluents for different purposes is inevitable through proper levels of treatment.**

- **Wastewater reuse, in a scarce water country such as Saudi Arabia, has become a an inevitable mean, and an integral part of integrated water resource management to achieve sustainable water and food security in KSA.**

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CONCLUSION AND RECOMMENDATIONS (CONT.)

- **Adoption of comprehensive water and wastewater governance frameworks (organizational, legal, financial frameworks, water sector regulator, and new water tariff) are essential for successful and sustainable wastewater reuse.**
- **More financing and support to localizing the water technologies, R&D and specialized research centers, capacity building and training.**
- **PPP can play a major role in investment, development and O&M of wastewater reuse markets such as KSA.**

CONCLUSIONS AND RECOMMENDATIONS (CONT.)

- **optimal water allocation among sectors and more support for use of renewable energy for water production.**
- **The introduction of Aquifer Recharge Management for wastewater storage near major cities to maximize wastewater reuse.**

THANK YOU