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THE WATER CRISIS IN THE GULF AREA: SEAWATER DESALINATION A PATH TO A PARTIAL SOLUTION.

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- The Water Situation in The Gulf States
- Seawater Desalination in the Gulf States
- Seawater Desalination Potential
- Using An Effective IWRM
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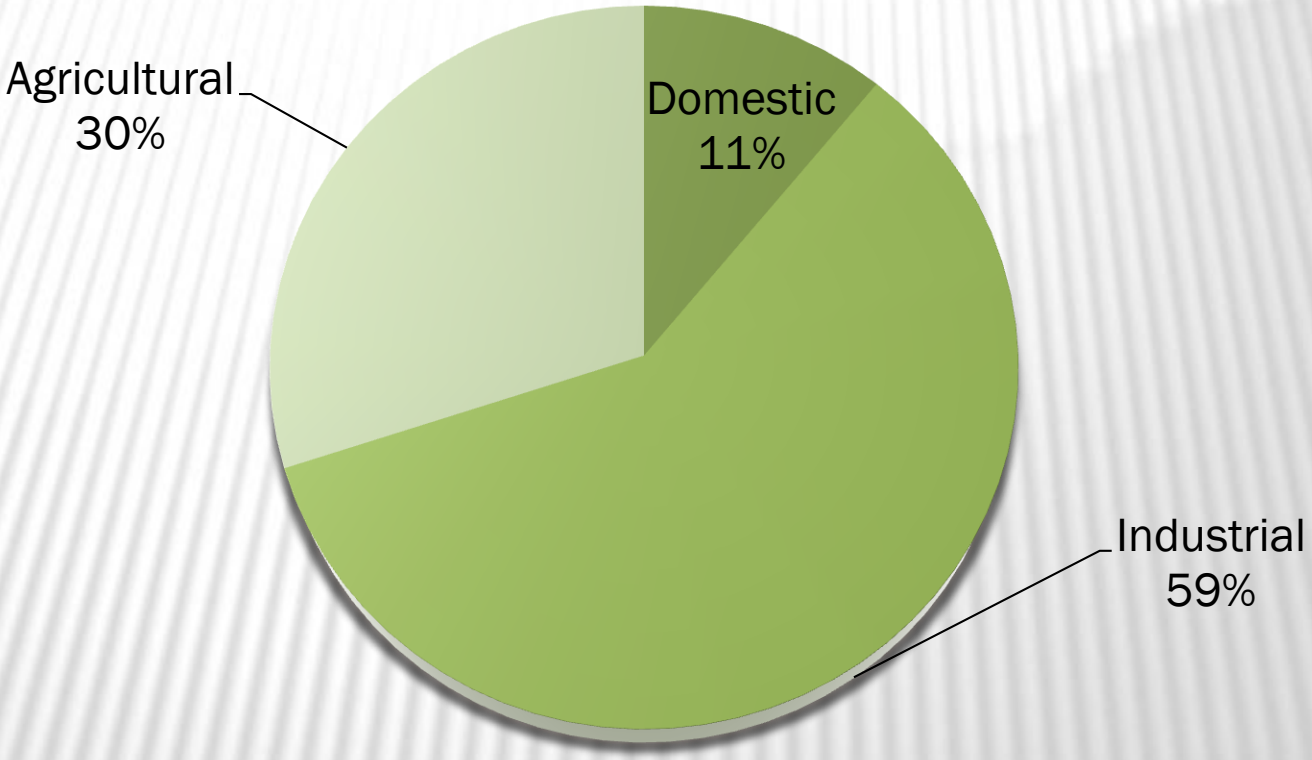
- Conclusion

INTRODUCTION

- It has been estimated that the annual worldwide freshwater supply per capita in the year 2025 will be 62% of what was available in the year 1990.
- The GCC countries have a renewable freshwater supply less than 400 m^3 per Capita
- if rainfall is used as a source of fresh water, the rainfall in the GCC is less than 250 mm/year which is considered to be very low
- The main source of freshwater available comes from the ground water wells, which is not considered to be a renewable water resource (Consumption values are high compared to the recharging values)
- All the Gulf States are considered to be high income countries

HIGH INCOME COUNTRIES WATER DISTRIBUTION



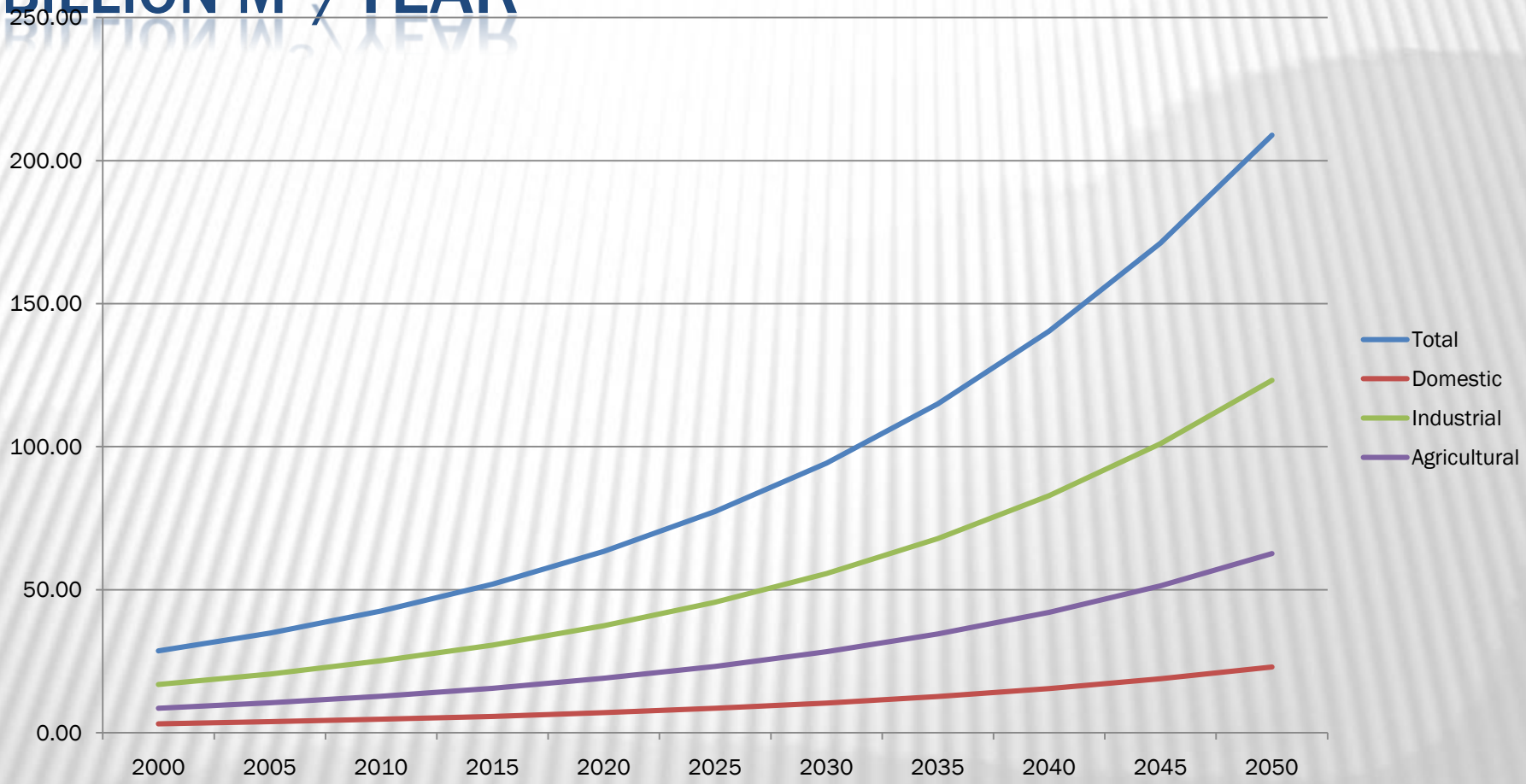
THE WATER SITUATION IN THE GULF STATES IN THE YEAR 2003

Ranking Out of 182	Country	Total Internal Renewable Water Resources (km3/year)	Ground Water Produced Internally (km3/year)	Surface Water Produced Internally (km3/year)	Overlap Surface And Groundwater km3/year	Water resources Total Renewable km3/year	Water resources Total Renewable Per Capita (m3/capita	Dependency Ratio (%)	Land Area (km2)	Population in 2000 (1000 inh)	Population Density in 2000 (inh/km2)
165	Oman	0.99	0.96	0.93	0.9	0.99	**388**	0	212460	**2538**	12
169	Bahrain	0.004	0	0.004	0	0.12	**181**	97	690	**640**	928
173	Saudi Arabia	2.4	2.2	2.2	2	2.4	**118**	0	2149690	**20346**	9
176	Qatar	0.05	0.05	0.001	0	0.05	**94**	4	11000	**565**	51
178	UAE	0.15	0.12	0.15	0.12	0.15	**58**	0	83600	**2606**	31
180	Kuwait	0	0	0	0	0.2	**10**	100	17820	**1914**	107

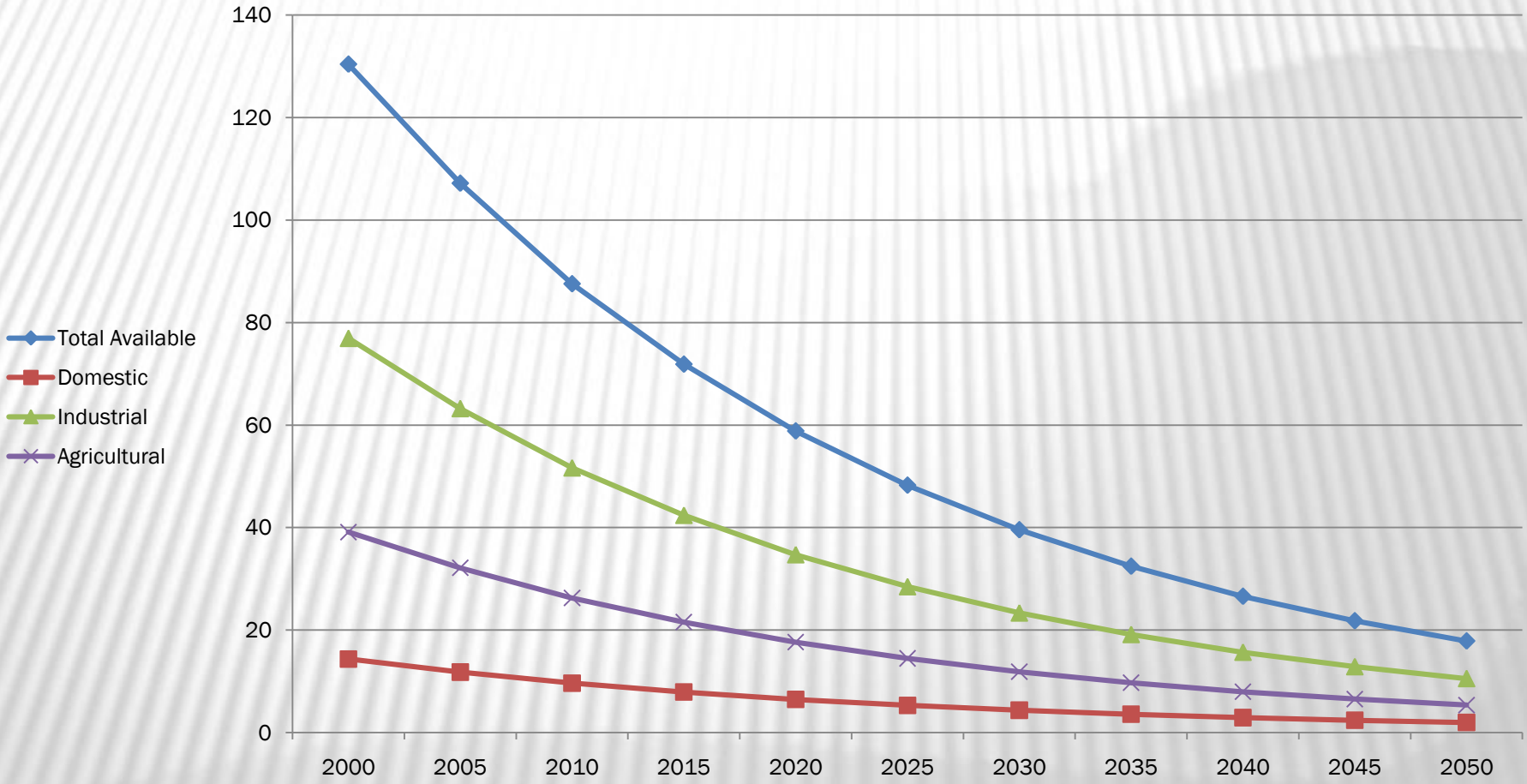
THE WATER SITUATION IN THE GULF SATES IN THE YEAR 2006

Country	Population (1,000,000s)	Precip Rate1 (mm/yr)	TARWR Per Capita 2000 (m3/yr)	TARWR Per Capita 2005 (m3/yr)	Surface water % TARWR*	Ground- water % TARWR*	Overlap2 % TARWR*	Incoming Waters % TARWR	Outgoing Waters % TARWR	Total use % TARWR
Bahrain	**.739**	100	**181**	**157**	3%	0%	0%	97%	0%	**258%**
Kuwait	**2.60**	100	**10**	**8**	0%	0%	0%	100%	0%	**2.227%**
Oman	**2.94**	100	**388**	**340**	94%	97%	91%	0%	0%	**137%**
Qatar	**.619**	100	**94**	**86**	2%	94%	0%	4%	0%	**554%**
Saudi Arabia	**24.9**	100	**118**	**96**	92%	92%	83%	0%	6%	**722%**
UAE	**3.05**	100	**58**	**49**	100%	80%	80%	0%	0%	**1.538%**

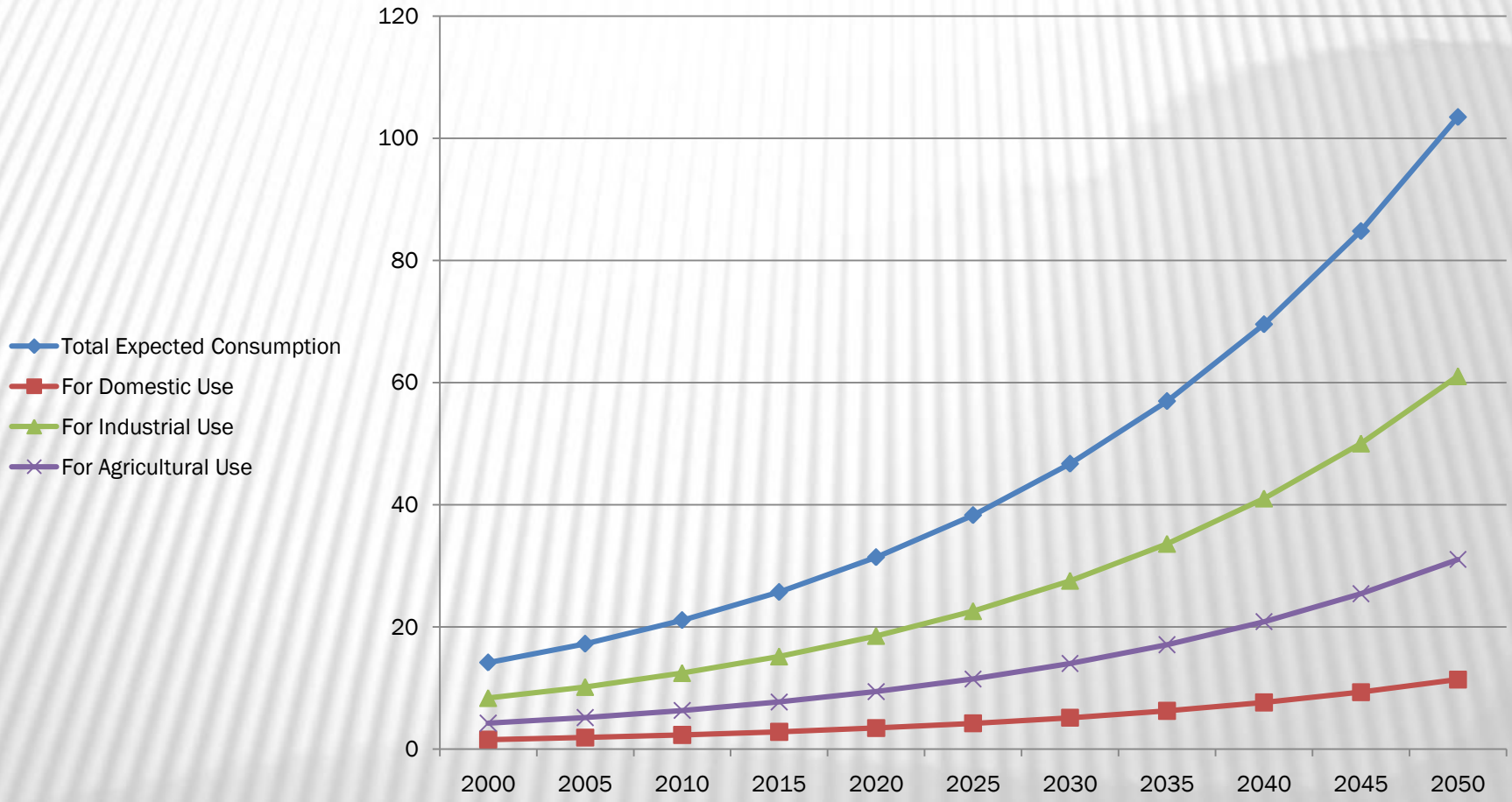
THE EXPECTED WATER DEMAND UNDER THE CONDITION OF 1000 M^3/CAPITA/YEAR FOR THE TOTAL POPULATION PREDICTED IN THE GULF STATES IN BILLION M^3/YEAR



THE AVERAGE FRESHWATER AVAILABLE M^3/CAPITA/YEAR FROM RENEWABLE RESOURCES IN THE GULF STATES UP TO THE YEAR 2050



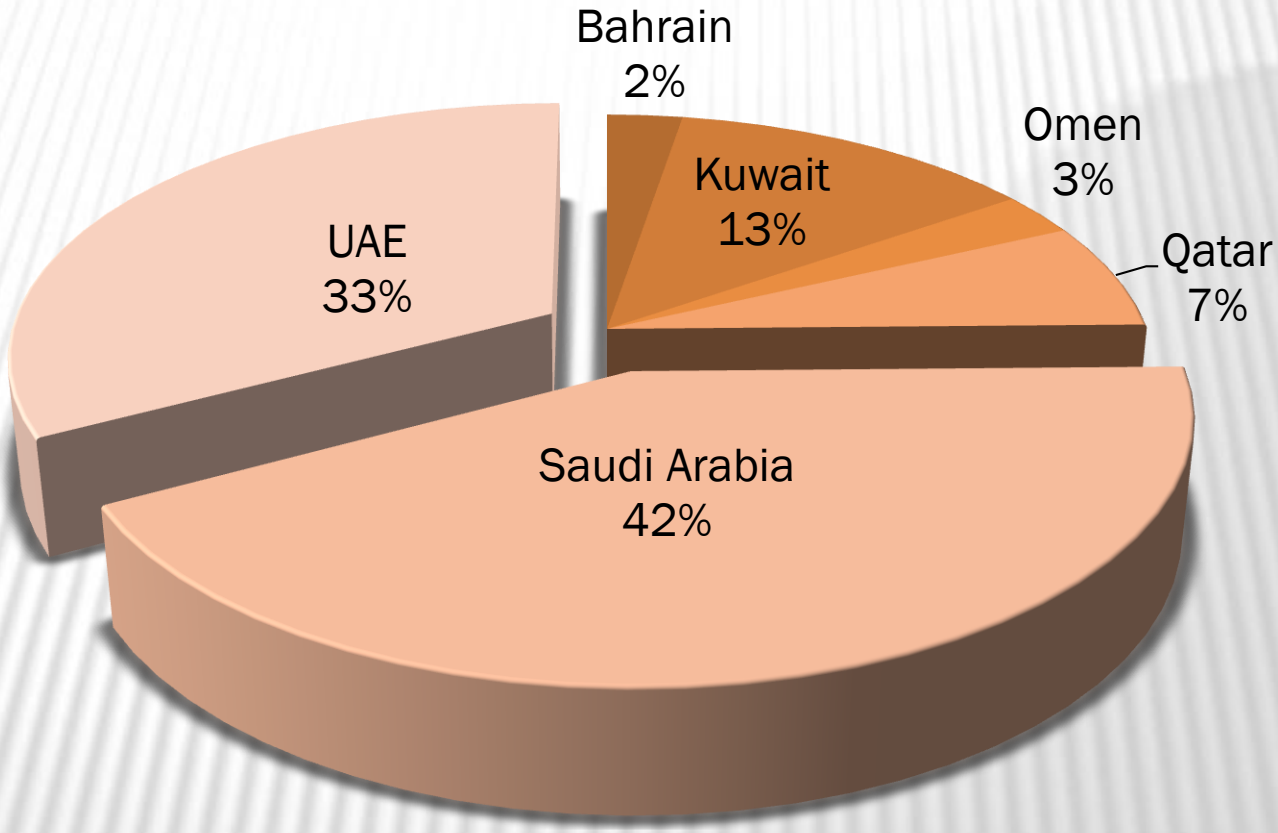
TO SUSTAIN PRESENT ACTUAL WATER SUPPLY PER CAPITA IN BILLIONS OF M^3/YEAR FOR THE GULF STATES WITH RESPECT ACTUAL FRESHWATER CONSUMPTION RATE IN THE YEAR 2005



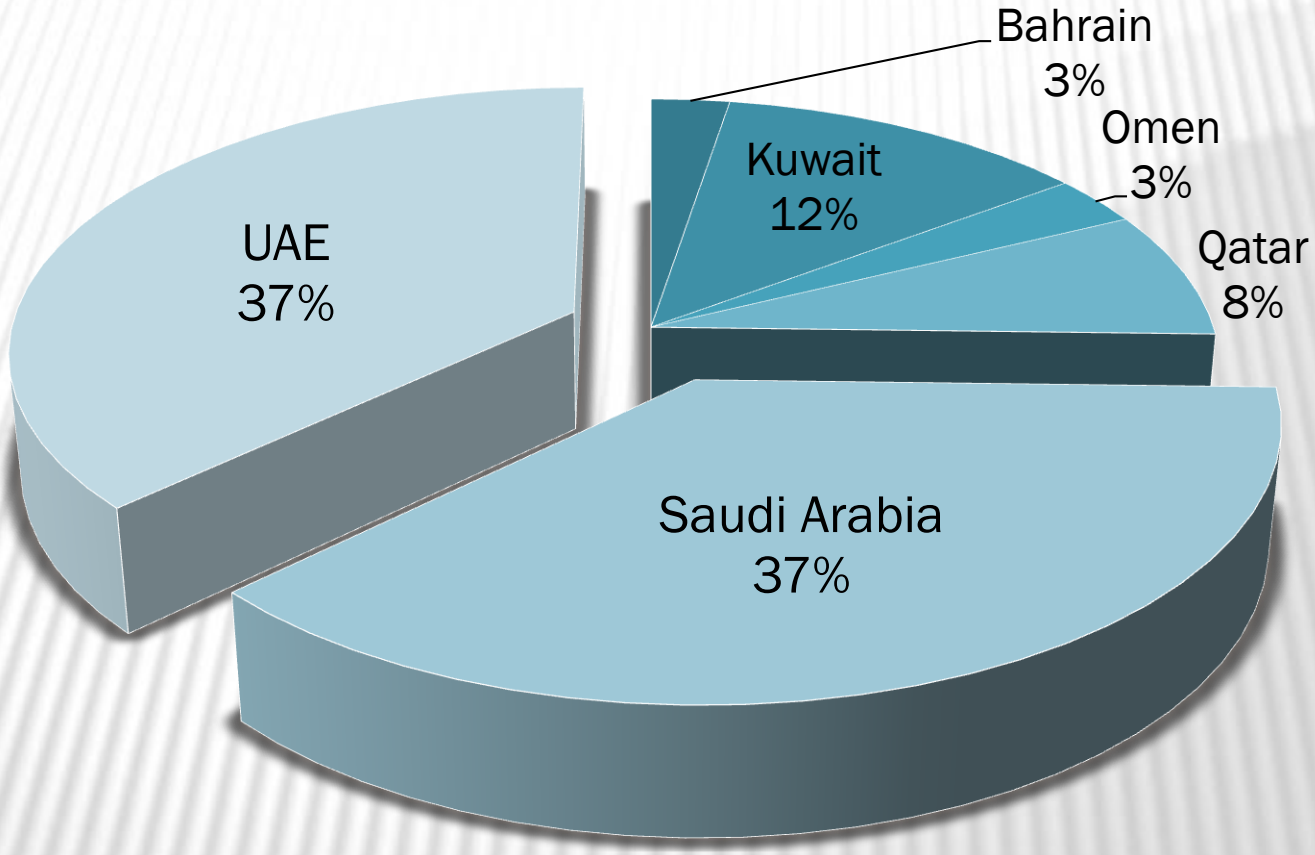
SEA DESALINATION IN THE GULF STATES

- The Gulf States are considered to be leaders in sea water Desalination
- The Yearly production of the gulf states is 37% of the total water desalinated freshwater produced in the world.
- More than 50% of freshwater produced from Seawater Desalination is been produced in the Gulf States
- Starting from the 1950's to date The installed capacity in the Gulf States is more than 17 Million M^3 /Day
- Seawater Desalination Can be assumed to be a nonconventional Renewable freshwater Resource

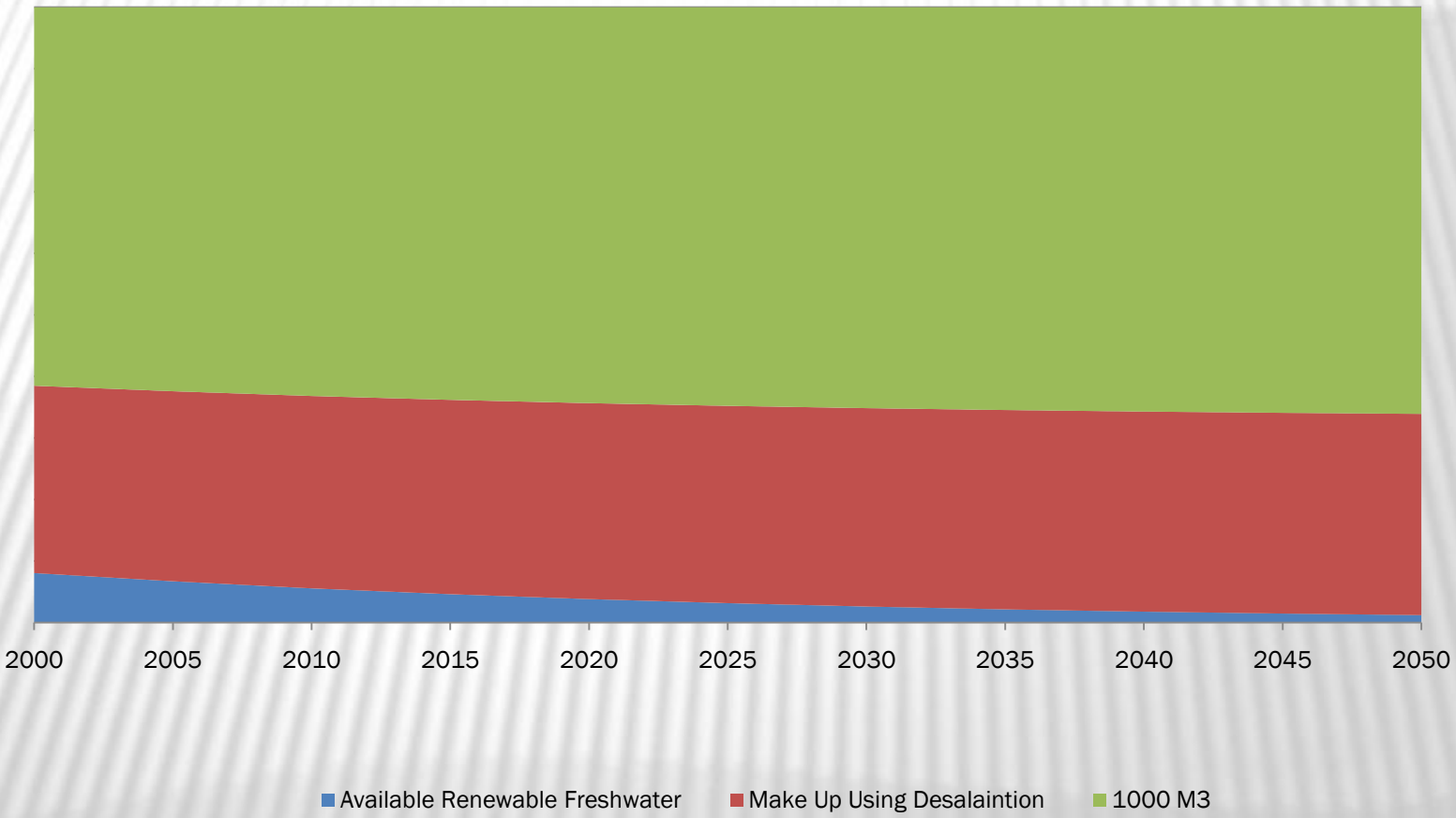
DESALINATION CAPACITY IN THE GULF STATES



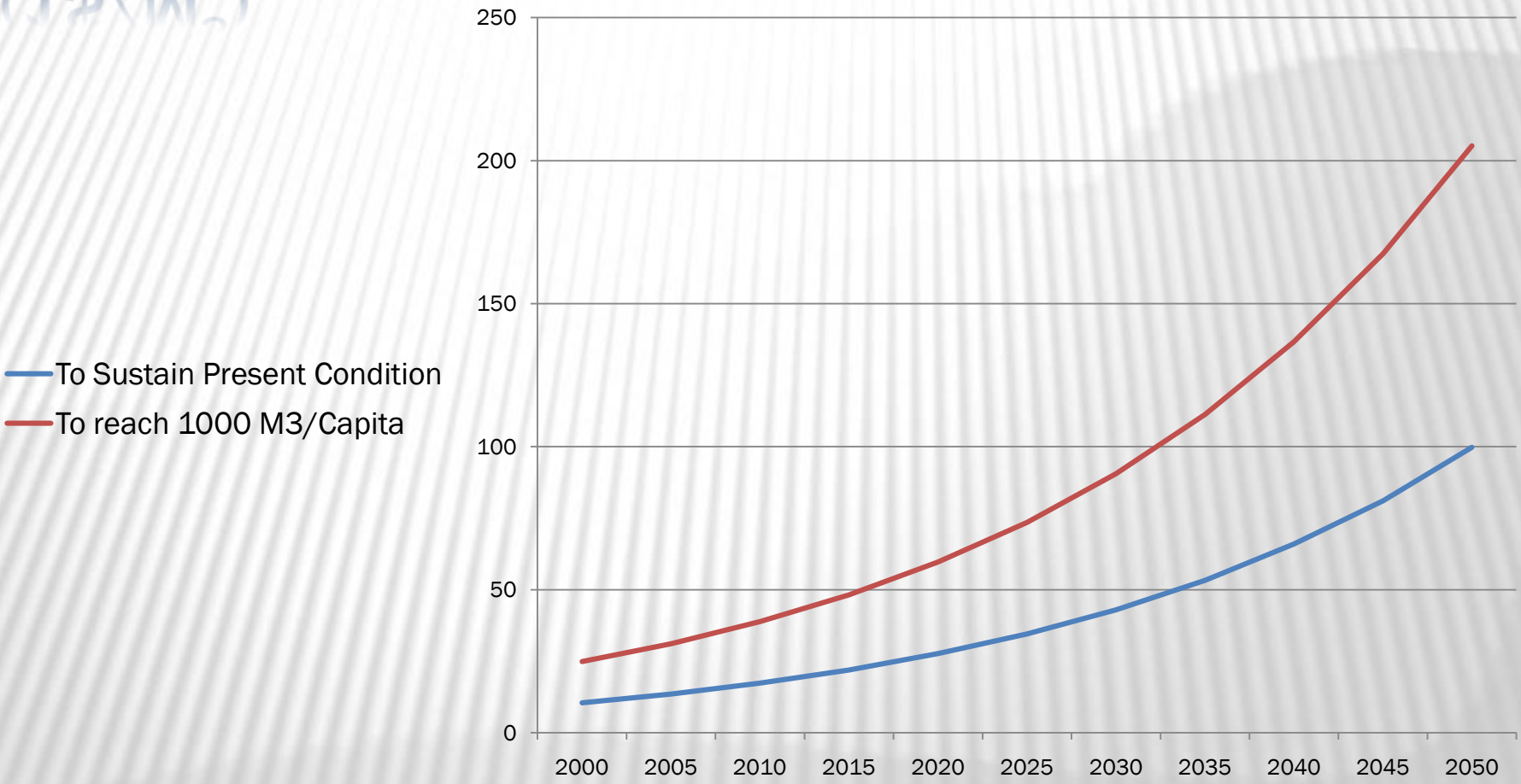
SEA WATER DESALINATION CAPACITY IN THE GULF STATES



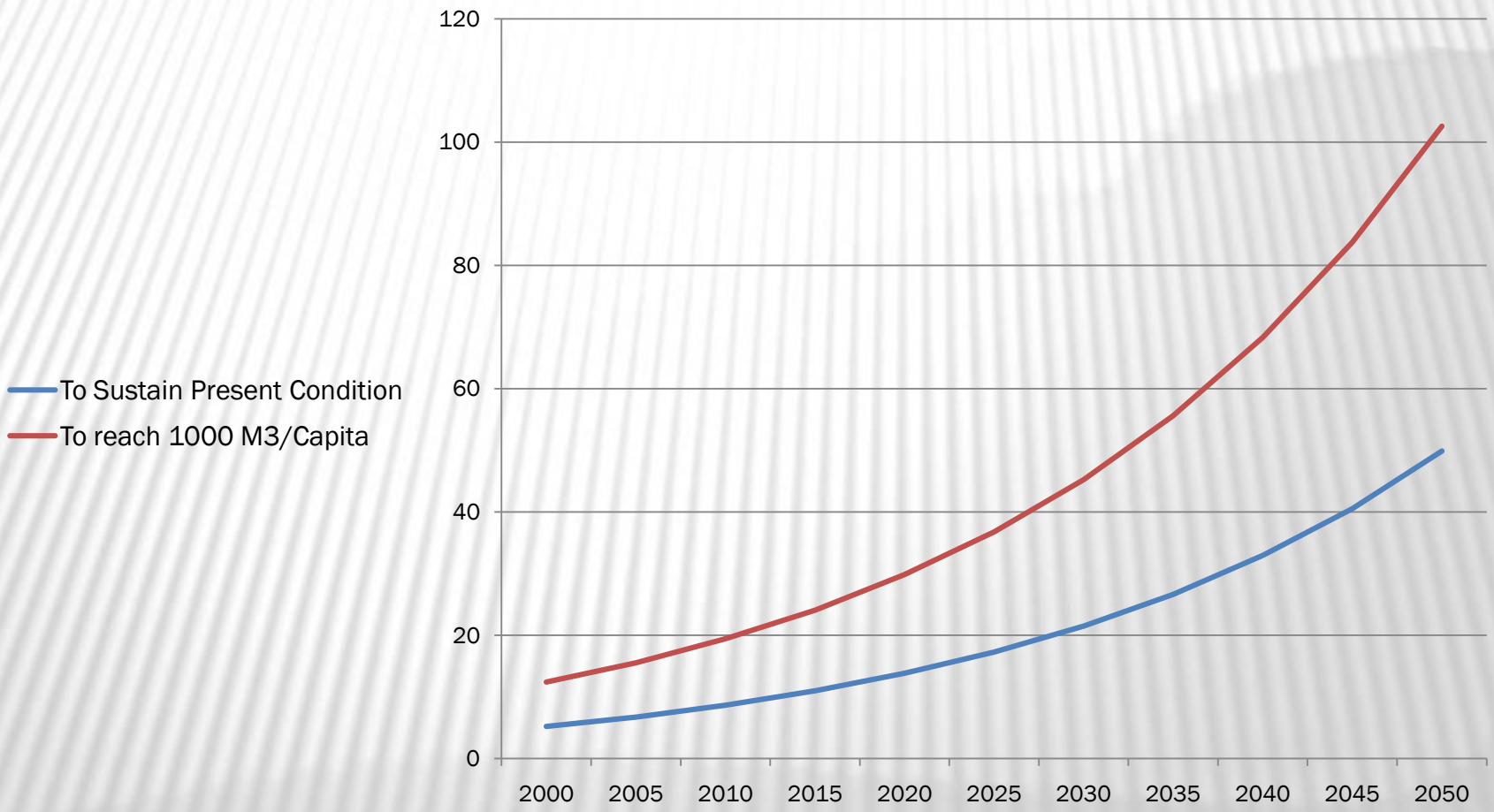
THE DESALINATION CAPACITY IN THE GULF STATES TO SUSTAIN PRESENT /CAPITA/YEAR SUPPLY



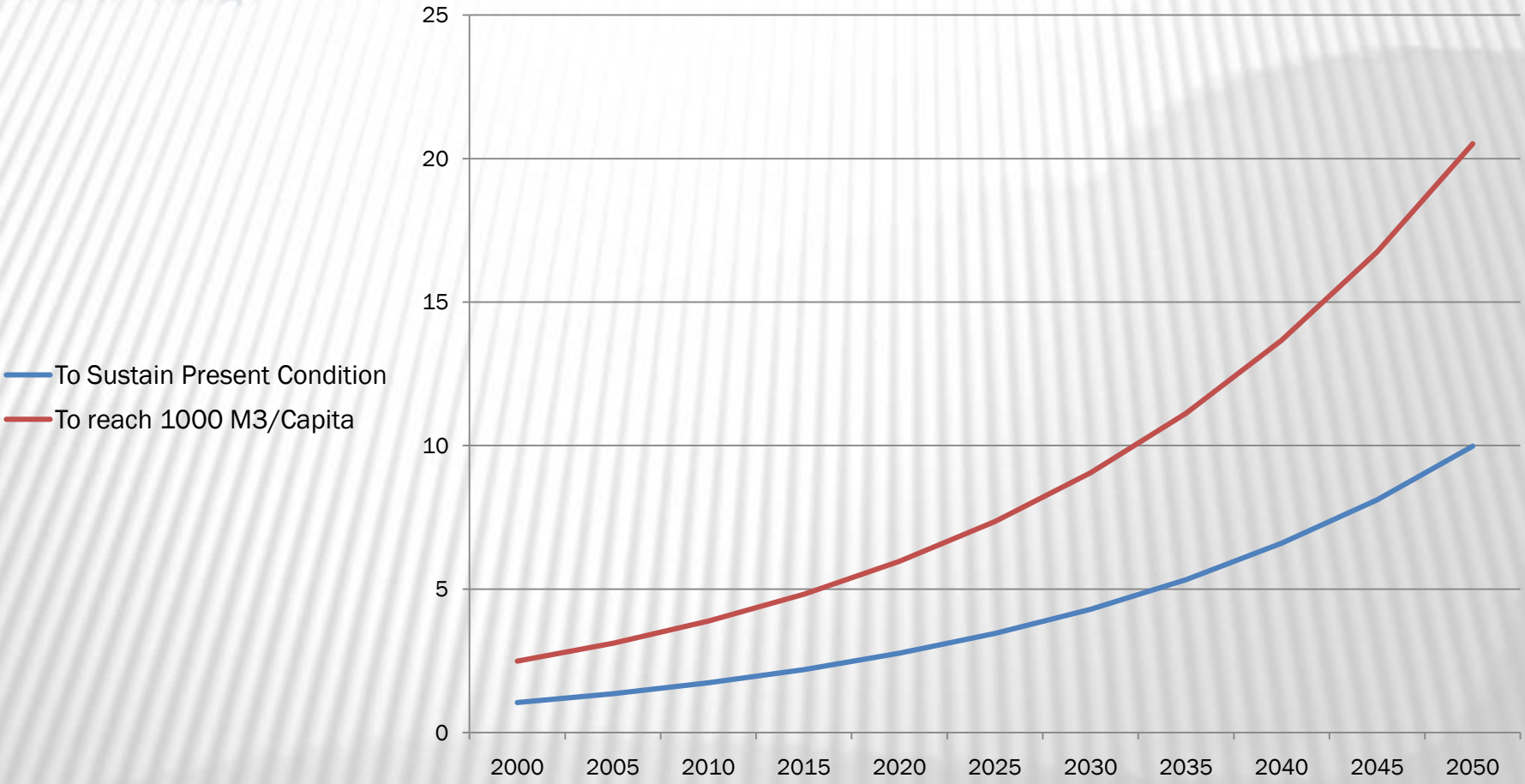
TOTAL DESALINATION COST (MSF MODEL) IN BILLION US$ NEEDED FOR SUPPLY MAKE UP ($1\$/M^3$)



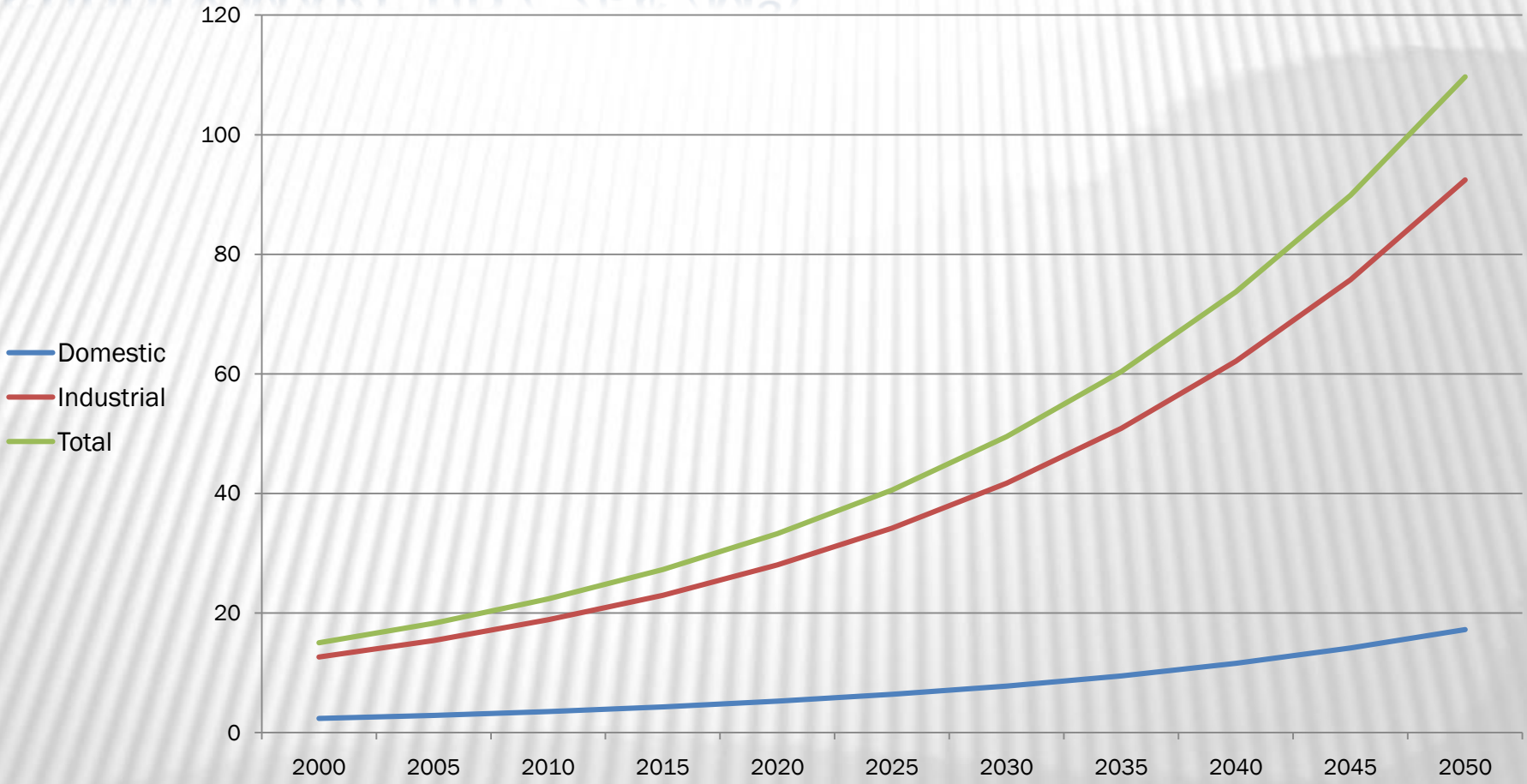
TOTAL DESALINATION COST (RO MODEL) IN BILLION US$ NEEDED FOR SUPPLY MAKE UP (.5$/M^3)



TOTAL DESALINATION COST (DREAM MODEL) IN BILLION US$ NEEDED FOR SUPPLY MAKE UP (.1$/M^3)



TOTAL DESALINATION COST (ONLY DOMESTIC, INDUSTRIAL USE) IN BILLION US$ NEEDED FOR SUPPLY MAKE UP (.75$/M^3)



USING AN EFFECTIVE IWRM

- The Demand Issue:

Domestic Use:

- Sydney of Australia has per Capita daily consumption rate of 123 liters/Capita/Day
- Along with The development of effect Awareness Campaigns The development of an effective a award/penalty legal System is of the up most importance
- A legal frame work on the usage of the freshwater supply is needed
- Reduction of Distribution Network Leaks (5%)
- Rational Use of water for (Car Wash, Landscaping, ..etc)
- Water Crisis Management techniques (Water Shortage Legislation, Water Emergency planning)

USING AN EFFECTIVE IWRM

The Demand Issue

Agricultural Use:

- Long term Planning For the Agricultural Sector Taking to consideration available water sources (renewable and non renewable)
- Food security Vs Self sufficiency (Cost/benefit analysis)
- Maintain the Balanced Dietary Energy Supply (DES) Threshold (2800 Kcal/person/day)
- Using high efficiency irrigation systems in place of traditional irrigation systems.
- Investment in the food processing industry
- Water requirements for the establishment and expansion of available farm land

USING AN EFFECTIVE IWRM

The Demand Issue

Industrial Use:

- Planning the industrial sector growth while taking in consideration water quality and freshwater requirements
- Environment protection of coastal area as the may be used in seawater desalination
- Minimizing the usage of freshwater in the industry
- Using freshwater recirculation methods as a part of the industrial plant specifications
- The construction of industrial plants may be associated with construction of desalination plants and electrical power plants

USING AN EFFECTIVE IWRM

The Supply issue:

- Usage of water aquifers while taking into consideration recharge rates
- Minimizing the overall cost of Seawater Desalination
- Investment in The Waste Water treatment plants
- Using water reuse methods
- The establishment of research centers on the Gulf States Level with the strategic goal of minimizing the production and construction of Seawater Desalination plants
- Rehabilitation of existing seawater Desalination plants
- The manufacturing of Desalination Plant equipment within the Gulf States
- The prospect in new Seawater Desalination technologies that may prove to be Cheaper than existing traditional methods
- The use of Solar energy and nuclear energy in Seawater desalination if proven to be more efficient and cheaper

IWRM AND THE ESTABLISHMENT OF RESEARCH CENTERS

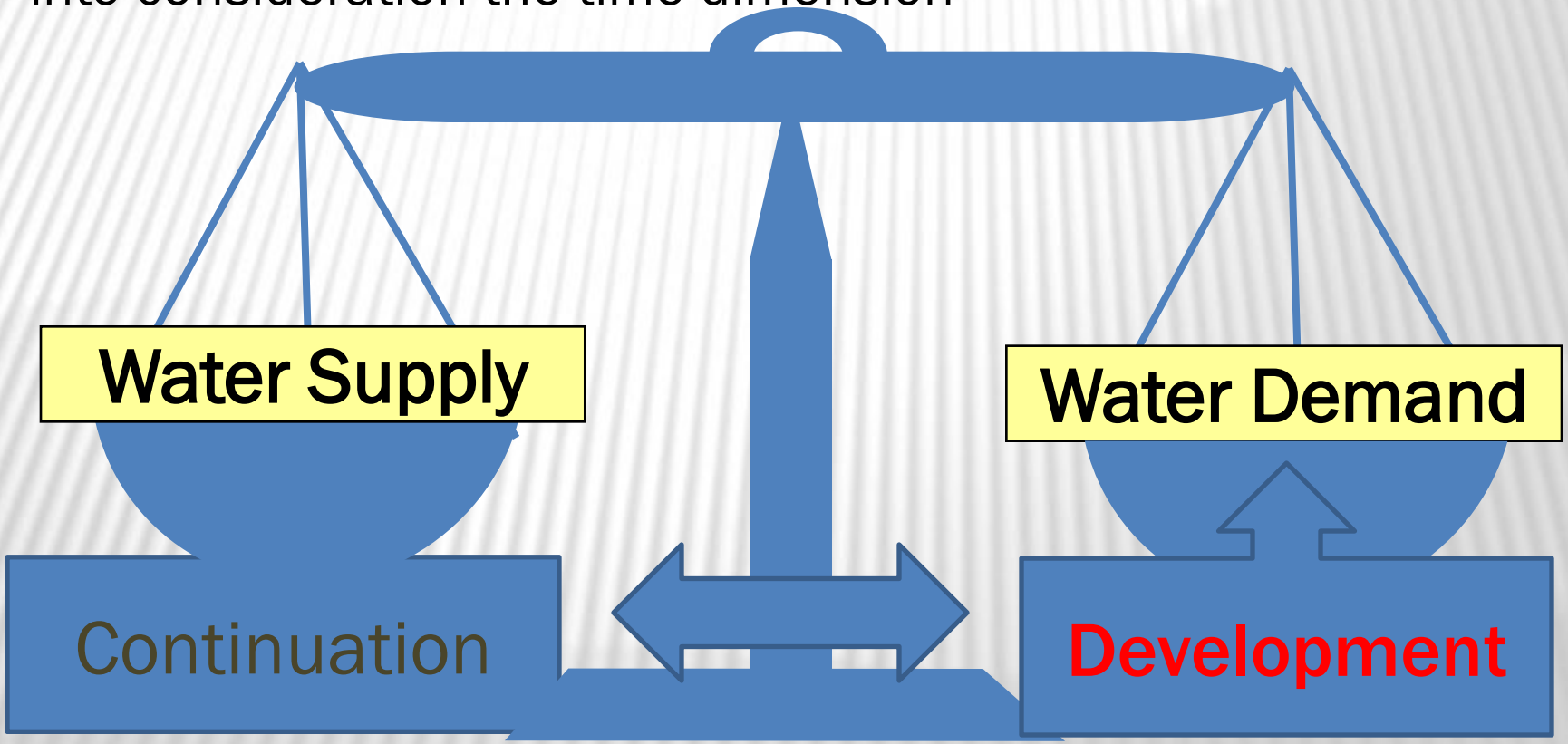
- As a part of the IWRM scheme it is important to introduce by lateral research centers that will address the water supply and demand issues throughout the Gulf states.
- In Seawater desalination these research centers have to address issues like:
  - The investment in new method of desalination
  - Increasing of the desalination Unit capacity
  - Reduction of Construction and production costs for Desalination (e.g. Chemicals costs, Lower material costs, better unit performance, Lower fuel costs....etc)
- Research in Wastewater treatment plants
- Research in Water reuse methods
- Research to increase the efficiency of Irrigation systems
- Research in water recirculation methods, also reduction of freshwater usage in the industrial sector

IWRM AND THE PRIVATE SECTOR

- Enforcing the Continuation of Production
- Using Balanced Legal frame work
- Using Balanced Billing systems that take into consideration rational freshwater supply
- The establishment of the IWRM controlling Organization
- The private sector research funding
- The role of the Private sector in the manufacturing of freshwater production equipment locally

ESTABLISHMENT OF THE TOTAL IWRM MODEL OR THE BALANCED IWRM MODEL

It is the balance between water supply and water demand taking into consideration the time dimension



FACTORS TO BE CONSIDERED IN THE MODELS

- Supply Side:
  - **Available Surface Water resources** (Dam water, evaporation control).
  - **Under Ground water** (Quality, Depth, Quantity, efficiency of consumption, Pollution, S/W intrusion, Charging rate).
  - **Desalination Plants** (IWPP, Technology, Lowering costs, R&D, Energy Co-Generation, Seasonal Fluctuation, Blending, Subsidization of the Industry, Local intensity)
  - **WWT Plants** (Reclamation, Aquifer Re-Charging, Livestock, Agriculture Irrigation)
  - **Rain** (Collection Systems, Clouds Harvesting)
  - **Water Storage** (Quality, Underground storage, Seepage).
  - **Imported Water** (Pipe Lines, Tankers….)

FACTORS TO BE CONSIDERED IN THE MODELS

- Demand Side:
  - **Awareness Campaigns** (Water Availability, Conservation Incentives, Population growth).
  - **Distribution Networks Control** (Design, Materials & construction Control, leak detection & repairs, Pressures, Control, Training, Trucking, Water Shedding).
  - **Emergency Plan**
  - **Legislations & Specifications** (Water Boxes, Piping, Washing Machines, Water Meters, Tariffs, Housing Dual Networks, Car Wash, Laundries, Hotels, Swimming Pools, Home Tanks, Dual Networks, Water Authorities Structure, Drilling Control).
  - **Conservation Implementation** (Facet Aerators, Leak Detection, Water Boxes)
  - **Agriculture Consumption** (Irrigation Optimization, Fining, Crops Type).
  - **Live Stock Consumption** (Review on Economics Basis).
  - **Industrial Uses** (Type of industry, Water Injection Control, efficiency monitoring).
  - **Water Chemistry Monitoring** (Control, Salinity,....)

CONCLUSION

- It is evident that the Gulf States have to adopt a number of controlling measures that will help the public and private sectors in the proper development of the water supply schemes, with respect to domestic, industrial, and agricultural uses of the supplied freshwater. The cost/benefit feasibility of different freshwater supply schemes will be influential on the overall development of the Gulf States.

- The strategic planning of the available conventional and nonconventional freshwater supply schemes is a mandatory requirement to sustain and improve the overall development of the Gulf States.

- Seawater desalination is considered to be one of the mean pillars in solving the water crisis in the Gulf area, but on its own it is not considered as a complete solution