



# Water and Wastewater R&D

## King Fahd University of Petroleum & Minerals

### Water Arabia 2015

Le Meridien, Al-Khobar, Saudi Arabia  
February 17-19, 2015

Dr. Alaa A. Bukhari

Director

Center for Environment & Water  
Research Institute





# Water and Wastewater R&D King Fahd University of Petroleum & Minerals

## KFUPM – At a Glance

1963

College of Petroleum and Minerals



- A College
- 2-Year Technical Program
- 76 Students
- 14 Faculty Members

Today

King Fahd University of Petroleum & Minerals



- 7 Colleges
- BS, MS, and PhD Programs
- 10,000 Students
- 1,500 Faculty Members
- Research Institute
- Centers of Research Excellences
- State-of-the-art facilities
- A science Park
- Network of Global Experts



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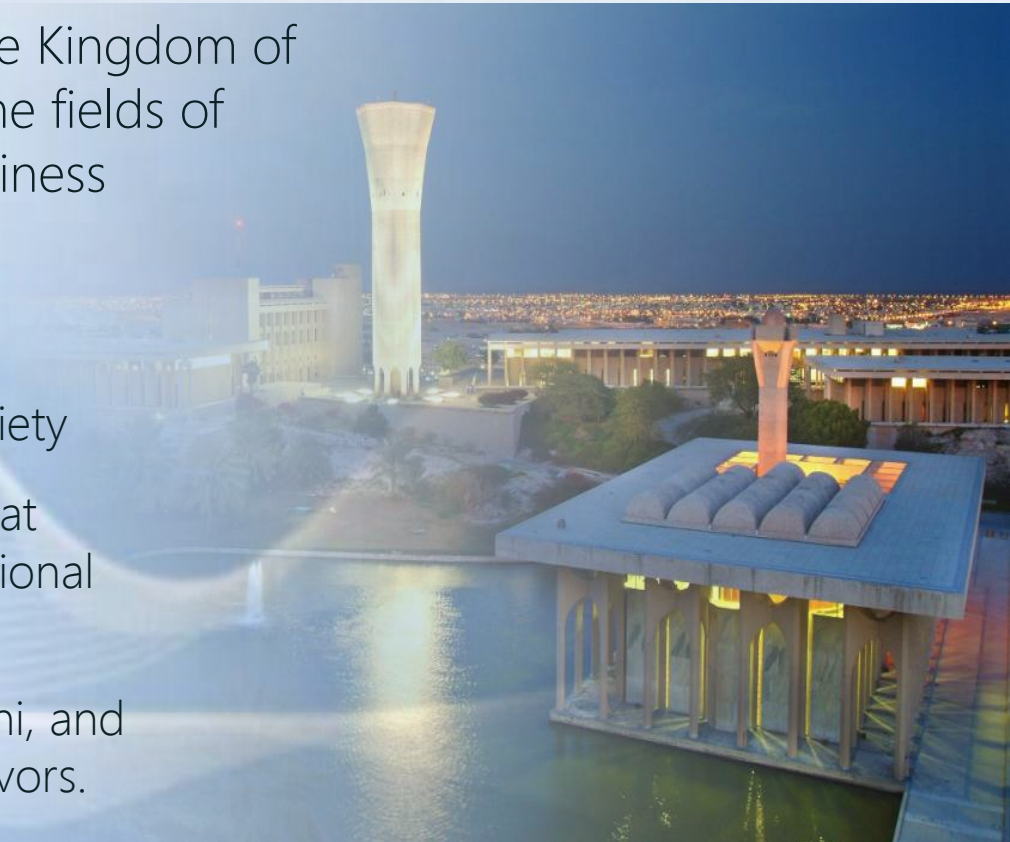
## KFUPM – At a Glance

### Mission

To make a difference within the Kingdom of Saudi Arabia and beyond in the fields of sciences, engineering and business

### Commitments

- ✓ Producing leaders who are productive members of society
- ✓ Creating new knowledge that would contribute to the national economy
- ✓ Engaging our society, alumni, and partners, in valuable endeavors.





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## KFUPM Academic Programs

### Engineering

### Sciences

### Industrial Management

### Environmental Design

### Computer Sciences & Engineering

### Applied & Supporting Studies

- ✓ Aerospace
- ✓ Civil
- ✓ Chemical
- ✓ Electrical
- ✓ Mechanical
- ✓ Petroleum

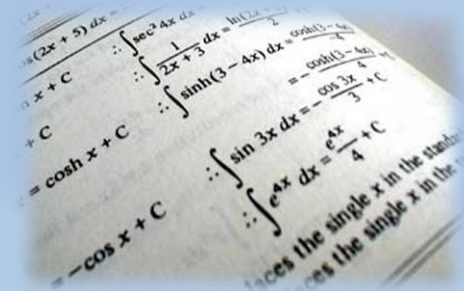
- ✓ Chemistry
- ✓ Physics
- ✓ Mathematics & Statistics
- ✓ Earth Sciences
- ✓ Biology

- ✓ Accounting
- ✓ Management & Information Systems
- ✓ Finance & Economics
- ✓ Management
- ✓ Marketing

- ✓ Architecture
- ✓ Architectural Engineering
- ✓ Construction Engineering & Management
- ✓ City & Regional Planning

- ✓ Computer Sciences
- ✓ Computer Engineering
- ✓ Systems Engineering
- ✓ Software Engineering

- ✓ Preparatory Year
- ✓ Skills Development
- ✓ Islamic & Arabic Studies
- ✓ Physical Education
- ✓ English Language
- ✓ General Studies







# Water and Wastewater R&D King Fahd University of Petroleum & Minerals

## KFUPM Academic Programs in Water and Wastewater





# Water and Wastewater R&D King Fahd University of Petroleum & Minerals

## KFUPM R&D Paradigm

Internal Programs

Deanship of Research

University R&D Fund

Fast Track R&D Fund

Sponsored Programs

Centers of Research Excellence

National Science, Technology and  
Innovation Program

KACST Annual Grants

SABIC Grant

Client-Funded Research

Research Institute

Academic Departments

Dhahran Techno-Valley Ecosystem

DTV Science Park

Business Incubator

Innovation Center

Liaison Office

Consultancy Services Center





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**Research Institute** – the Cornerstone of R&D Activities

8 Research Centers

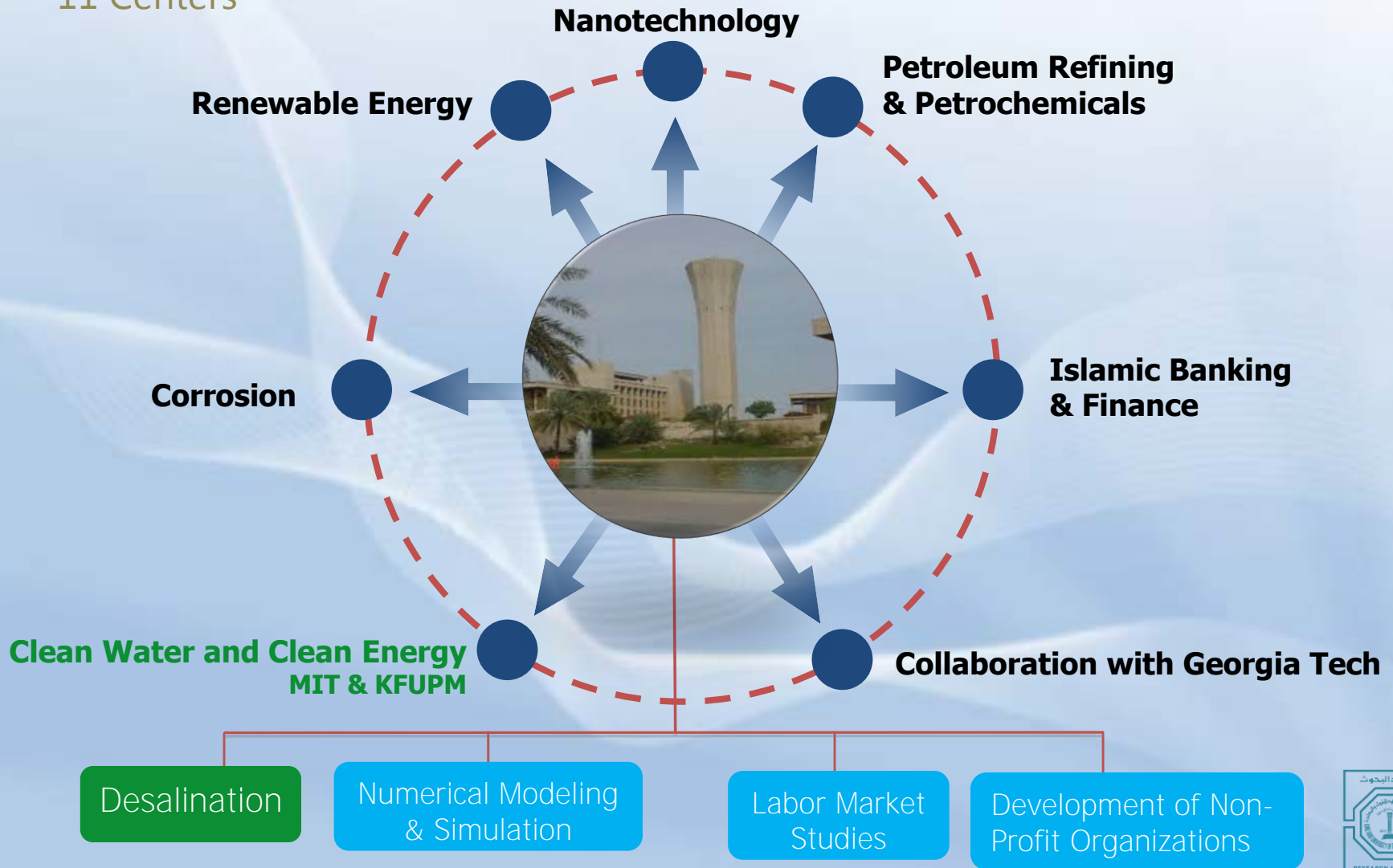




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**Center of Research Excellence – Towards Innovation**

11 Centers







# Water and Wastewater R&D King Fahd University of Petroleum & Minerals

## Center for Environment & Water

### Major Research Areas





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## Center for Environment & Water - Facilities

### Marine Studies

- Oceanography
- Water and Sediment Quality
- Fisheries
- Marine Ecology
- Marine Ecotoxicology
- Marine Museum



Inverted and Phase contrast Microscopes



Remotely operated vehicles



Survey boats



Current meters



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## Center for Environment & Water - Facilities

### Environmental Chemistry

- Organic
- Inorganic
- Environmental Engineering



Sedimentation study



LC ICP MS



GC



HPLC



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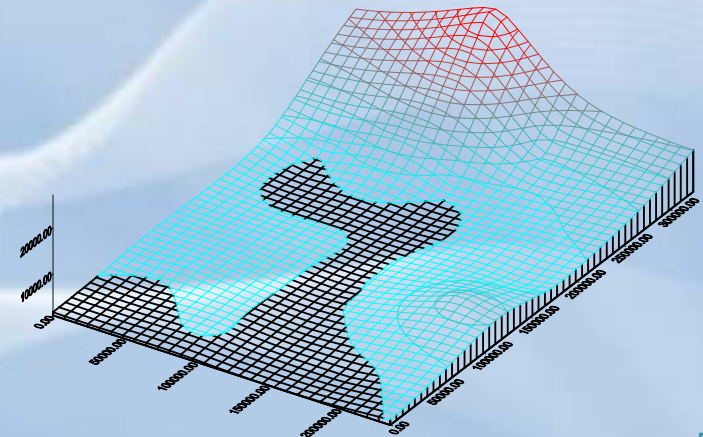
## Center for Environment & Water - Highlights

### Accomplishments

#### Water Resources Planning, Development, and Conservation

##### Focus Areas

- Irrigation water saving and conservation with the use of specific polymers
- Computerized Irrigation Water Management System (CIWMS)
- Development of Numerical Simulation Model for shallow groundwater level rise in coastal areas







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## Center for Environment & Water - Highlights

### Accomplishments

Towards Securing Wheat Demand Under Water Scarcity Conditions of KSA  
A Comprehensive Study (2012 -2013)

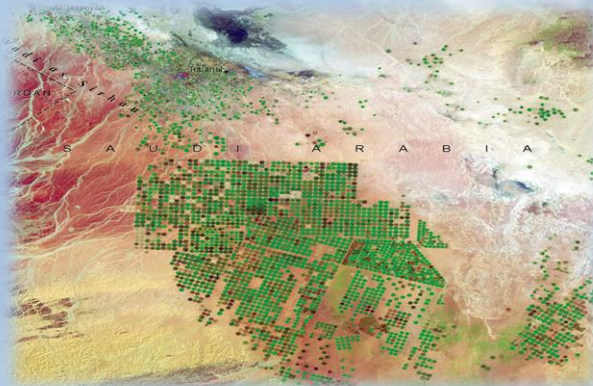
Client

Ministry of Interior, Kingdom of Saudi Arabia



Project Brief

- Development of an effective strategy for satisfying wheat needs of the Kingdom for the next 25 years either via local production, importing or by investment in external wheat cultivation







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## Center for Environment & Water - Highlights

### Accomplishments

Fisheries Investigations for Sustainable Harvest and Enhancement of Resource Integrity and Ecosystem Status in Saudi Arabian Waters (from 2013)



#### Clients

Ministry of Agriculture  
Kingdom of Saudi Arabia



ارامكو السعودية  
Saudi Aramco



#### Program Brief

- Population dynamics and stock assessment
- Assessment and management of essential fish habitats
- Environmental impact of fishing methods
- Management strategy framework





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## Center for Clean Water and Clean Energy at MIT & KFUPM

An innovation and entrepreneurship stride in research and education since 2008

### Objectives

- Transfer know-how in research
- Technology transfer and product development
- Develop education
- Attract high caliber faculty, student and researchers

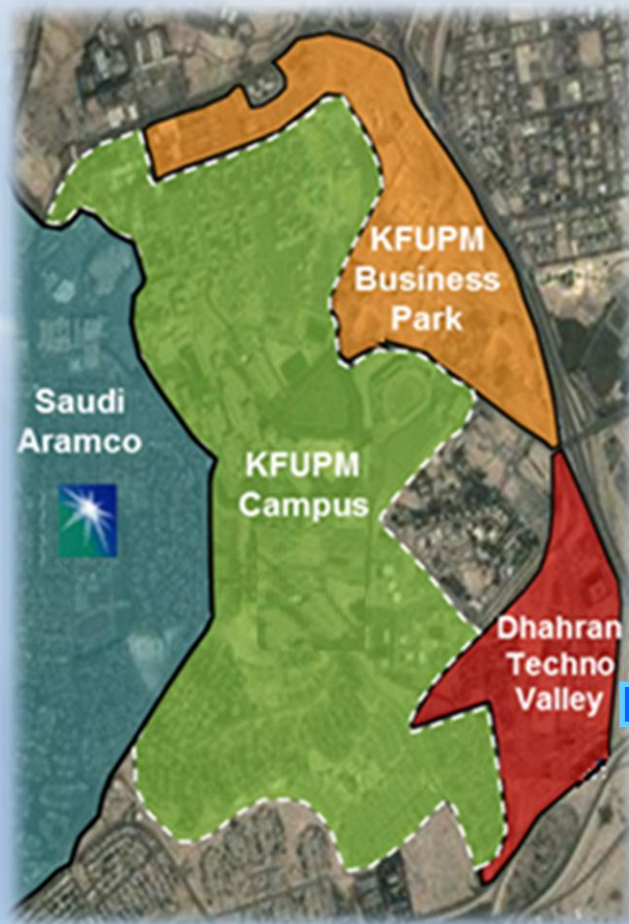




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## Dhahran Techno-Valley

### Dhahran Techno-Valley Ecosystem



- An integrated ecosystem established at KFUPM in 2006 to drive the knowledge economy in KSA
- Hosts R&D Centers of national and multinational companies







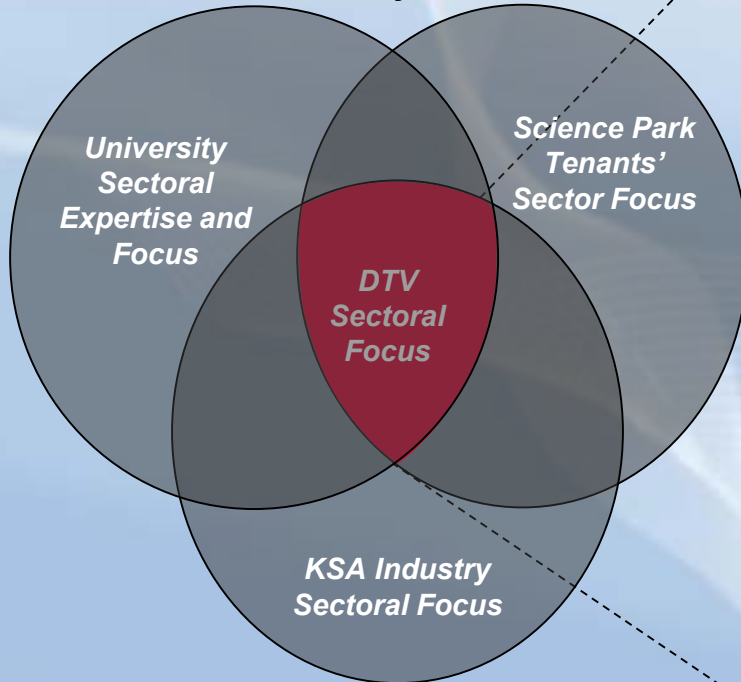
# Water and Wastewater R&D King Fahd University of Petroleum & Minerals

## Dhahran Techno-Valley

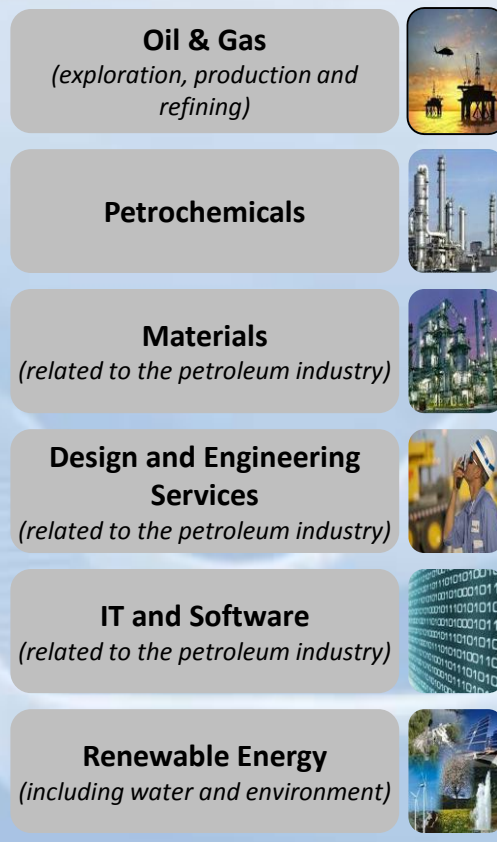
Six Technology Themes

### DTV Sectoral Focus Framework

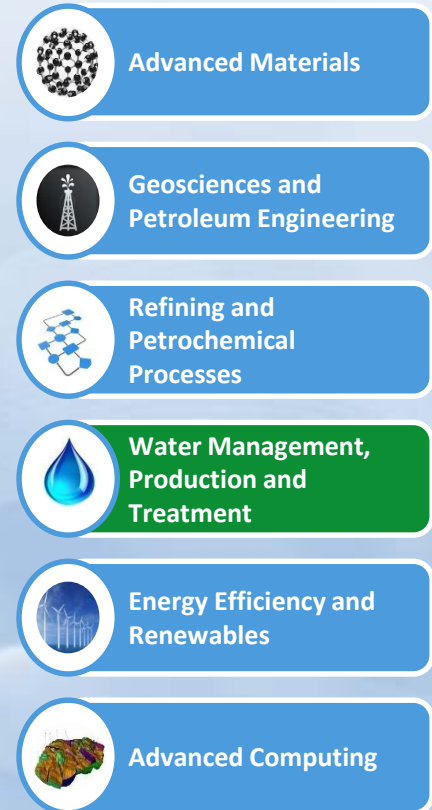
#### Technology Transfer Ecosystem



### DTV Sectoral Focus



### Technology Themes

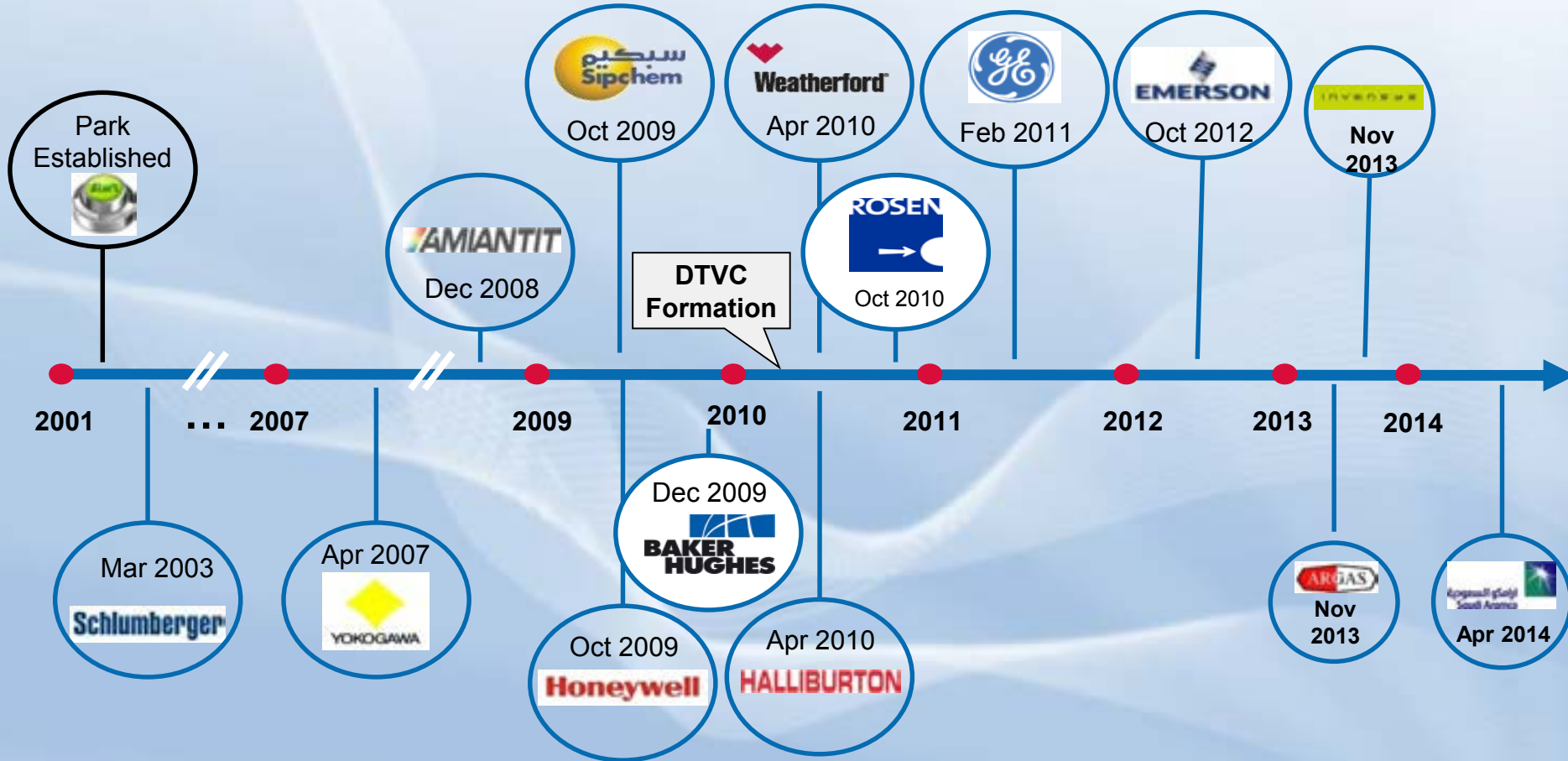




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## Dhahran Techno-Valley - Regional and International Partners

### Science Park Timeline







# Water and Wastewater R&D King Fahd University of Petroleum & Minerals

## KFUPM Water Technology Portfolio - Highlights

- ✓ KFUPM research portfolio in water related technologies started developing in 2008 mainly due to:
  - Establishing the “Center for Clean Water and Clean Energy at MIT and at KFUPM-CCWCE”
  - National focus through the NSTIP grants on areas of strategic importance to KSA. The water-related technologies were at the top of the list of priorities.
- ✓ KFUPM has more than 50 patents (issued/filed) that is related to the water technology field
- ✓ About 20 researchers are involved to different levels in water-related research activities.



# Water and Wastewater R&D King Fahd University of Petroleum & Minerals

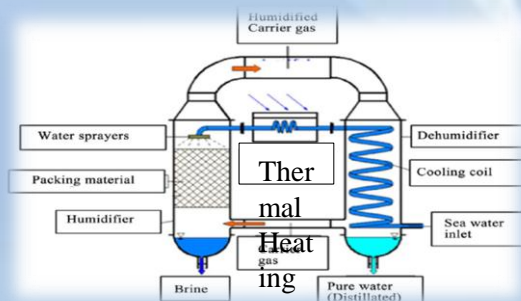
## KFUPM Water Technology Portfolio - Accomplishments Carrier Gas Extraction Technology

### Technology

- Invented at KFUPM & MIT laboratories
- Employs a continuous, atmospheric pressure, ambient temperature desalination technique that uses a carrier gas to extract fresh water (< 100 ppm salinity) from high salinity brines. Mechanisms of pressure/temperature gradients are extensively used

### Applications

- Currently used for purifying returned fracked waters from unconventional oil wells
- Could be customized for purifying other types of severely contaminated waters.





## KFUPM Water Technology Portfolio - Accomplishments

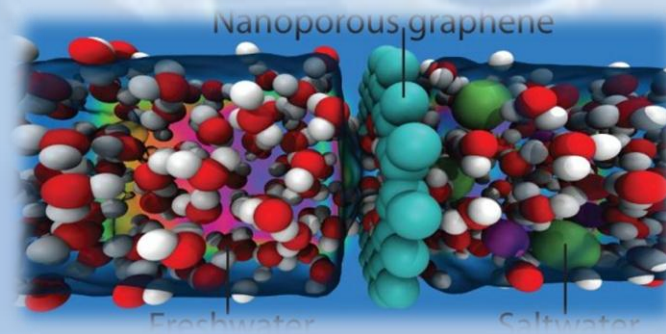
### Nano-Porous Graphene Membrane Technology

#### Technology

- A filtration membrane, comprising one or more active layers of Graphene
- The method of producing the membranes & the material composition has the potential to significantly improve performance and decrease costs over state-of-the-art technology.

#### Applications

- Water desalination, Residential water filtration, Bio-chemical filtration, Fine chemicals processing, metal refining, industrial waste processing, ultrapure water, water recycling, agricultural wastewater treatment



Credit: Grossman and Cohen-Tanugi (2012)



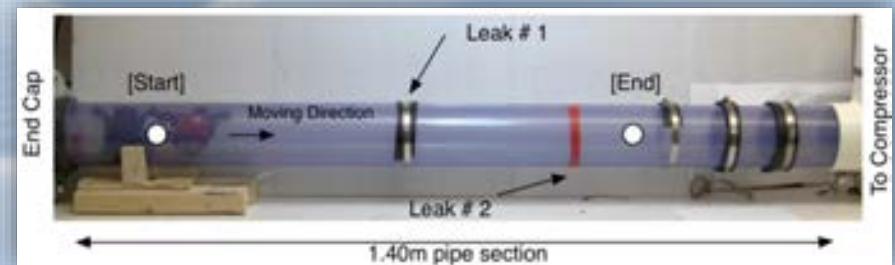
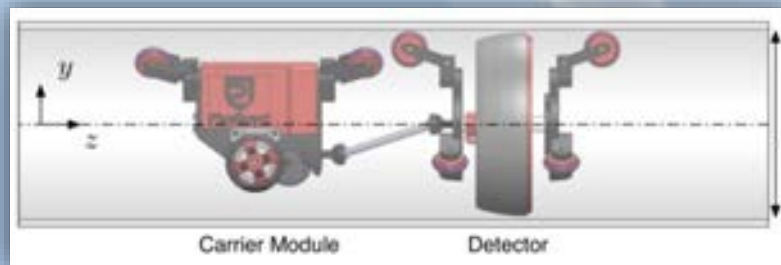
## KFUPM Water Technology Portfolio - Accomplishments In-Pipe Leak Detection Technology (Water/Oil/Gas)

### Technology

- The technology is an in-pipe leak detection system for gas, water and oil pipelines. The leak is sensed by the system using the large pressure gradient in the vicinity of the leak. The leak location is communicated to user through wireless communication system

### Applications

- In-pipe leak detection in underground gas, water and oil pipelines





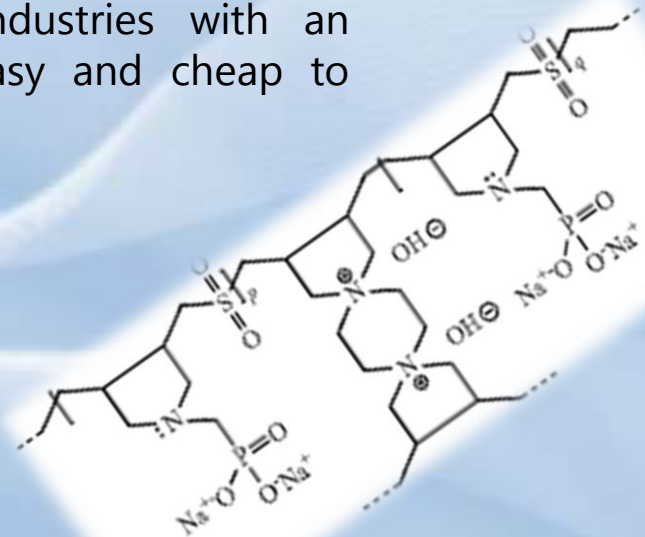
## KFUPM Water Technology Portfolio - Accomplishments Wastewater Treatment Using Polymer Resin

### Technology

- Compositions and methods of making polymer resin to treat wastewater for removing toxic non-biodegradable metal ions such as lead and copper. Material was synthesized in lab and method tested on synthetic water

### Applications

- Treating wastewater from Chemical industries with an effective material which is relatively easy and cheap to synthesize







## KFUPM Water Technology Portfolio - Accomplishments Wastewater Treatment Using Electrochemical Process

### Technology

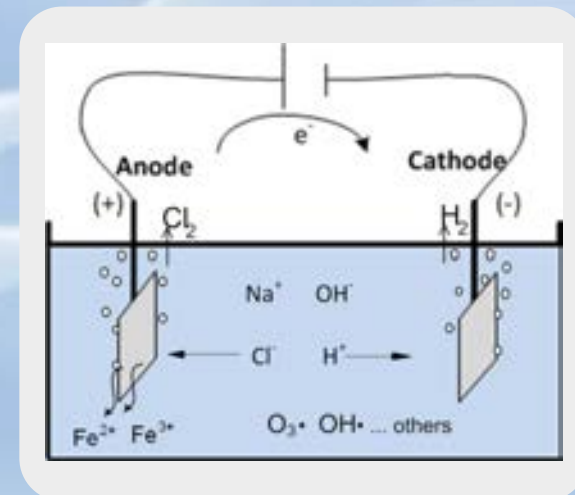
- The main idea is to pass an electrical current through the wastewater. The passage of current triggers a complex process involving chemical and physical mechanisms operating simultaneously which results in remove of pollutants from wastewater

### Applications

- Treating municipal and industrial wastewater
- At KFUPM, the technology tested for municipal, dairy, paint, and for targeted contaminants

#### A Promising Technology for Wastewater Treatment

- High removal efficiency of COD, TSS, Turbidity, etc.
- Simple operation and small footprint
- Economically competitive





# Water and Wastewater R&D King Fahd University of Petroleum & Minerals

## R&D Business Lines

R&D Studies

Consulting  
Works

Laboratory  
Services

Educational  
& Training  
Services



# Water and Wastewater R&D

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*Thank you*