

## **Oil-Related Activities and Environmental Concerns in the Gulf**

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### **Abstract**

Gulf is located within the richest oil province in the world which hosts more than 67% of the world oil reserve. The challenge to the Gulf States is to meet world energy demands and the conventional solution for this challenge is to increase the production. One issue associated with the increased production is the extremely damaging effects due to the activities related to exploration, production and distribution of oil on the environment. The arid physical setting, being shallow and enclosed with a low rate of water exchange (upto 5 years) complements the severity of any additional stress imposed by man. Nevertheless, the oil-related activities have not always been without some ecological side effects. Oil spills, damaged land, accidents and fires, and incidents of air and water pollution have all been recorded at various times and places. Intentional 1991 Gulf Oil Spill, the largest oil spill in history with an estimated release of 6–8 million barrels of Kuwait Crude oil, caused large-scale devastation to the marine environment of Kuwait and Saudi Arabia. In the last decades, Gulf States have paid much attention in minimizing adverse impact on the environment by conforming to current best practice and by setting and enforcing regulations. In this paper, we discuss the various marine environmental issues that Gulf faces with the oil-related activities and the management measures being taken up to avoid, minimize or mitigate the environmental effects.

**Keywords:** oil wells, offshore platforms, dredging, corals, seagrass, biodiversity.



# Oil-related activities and environmental concerns in the Gulf

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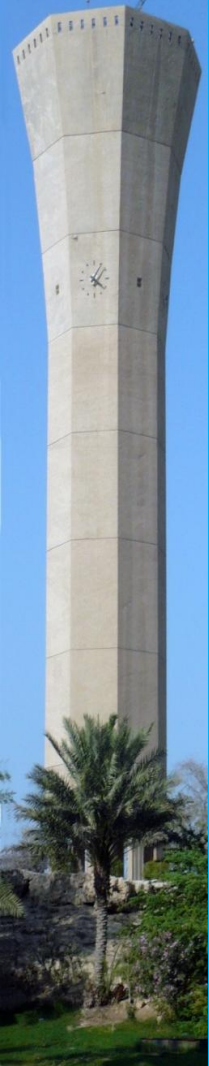
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# Presentation Outline

- Introduction
- Objectives
- Sources of oil related activities
- Impacts of oil related activities
- Environmental management measures
- Conclusion



# Introduction

- The Arabian Gulf is the major source of seafood, as well as two of the most precious and coveted resources—fresh water and oil.
- Within the Gulf, there are different types of sensitive habitats in which plants and animals live such as:



**Mangroves**



**Seagrasses**



**Coral reefs**



**Salt Marshes**

- These rich and diverse ecosystems are experiencing physical and chemical stresses mainly due to man-made activities such as industrial development and oil exploration.

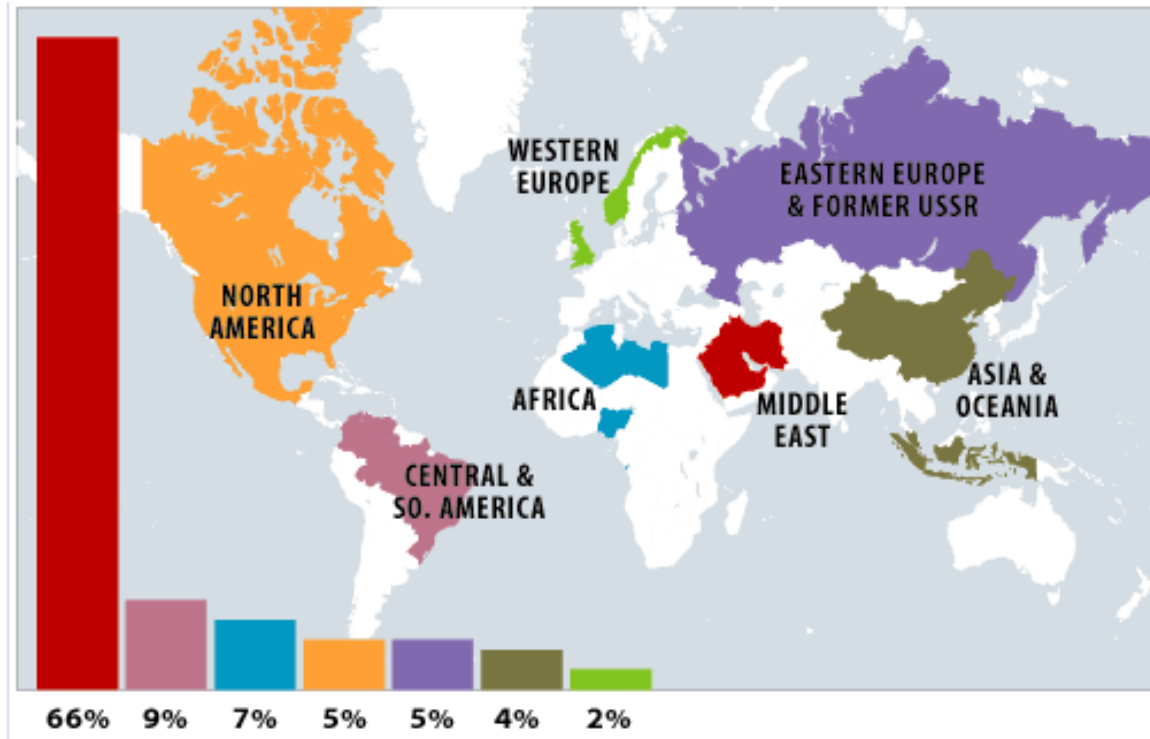




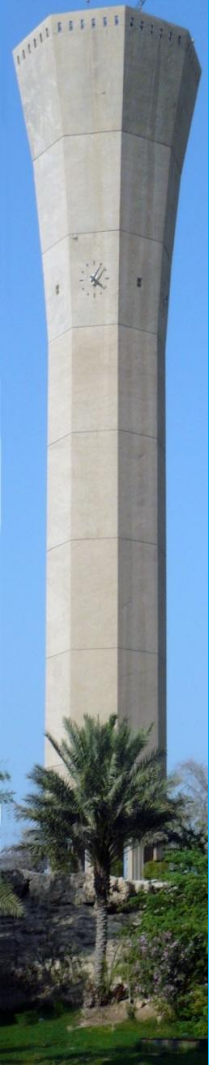
# Introduction

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- Approximately 66% (~ 76 million metric tons) of the global oil reserves are located in the Arabian Gulf.



- Gas reserves of the Gulf that amount to 190.1 trillion cubic meters, equivalent to 35% of the global reserves.

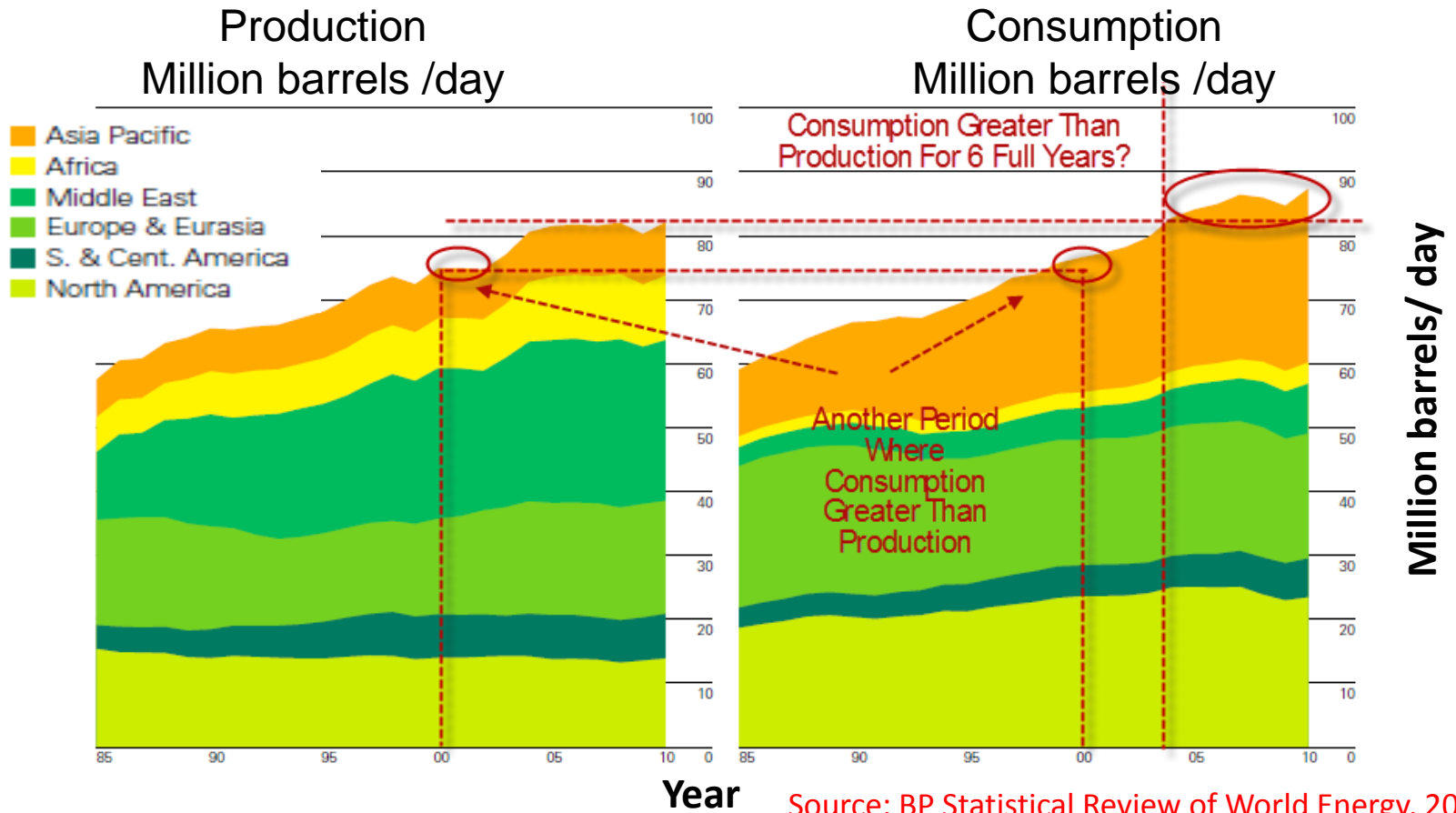




# Introduction

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- Consumption is higher than the production in the recent years
- In order to meet the demands, Gulf states have to increase the oil production.



Source: BP Statistical Review of World Energy, 2011

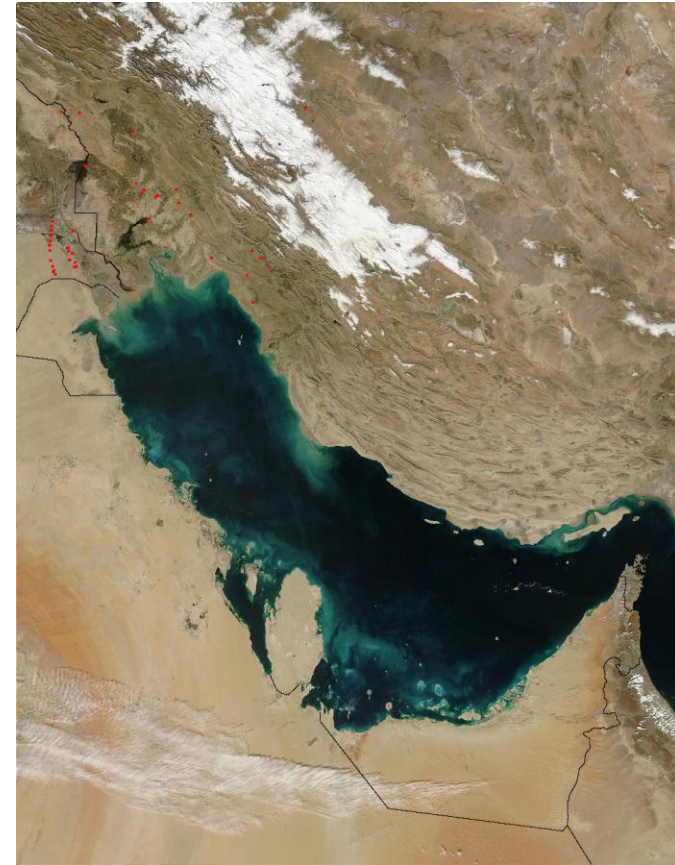
## Major Stressors in the Arabian Gulf

### *Natural*

- Arid physical setting
- Extreme environmental conditions
- shallow and enclosed water body
- Low rate of water exchange (upto 5 years)

### *Manmade*

- Oil-related activities (Exploration, production and distribution)
- Urban development
- Industrial pollution



# Objectives

To review the impact of the oil-related activities to the Gulf Marine environment and its management as outlined below:

- Sources and impacts in the Marine Environment
  - Exploration and Production
  - Coastal and Offshore Installations
  - Accidental Spills and Leakages
  
- Environmental Management
  - Gulf States
  - Saudi Arabia
  - Role of Saudi Aramco

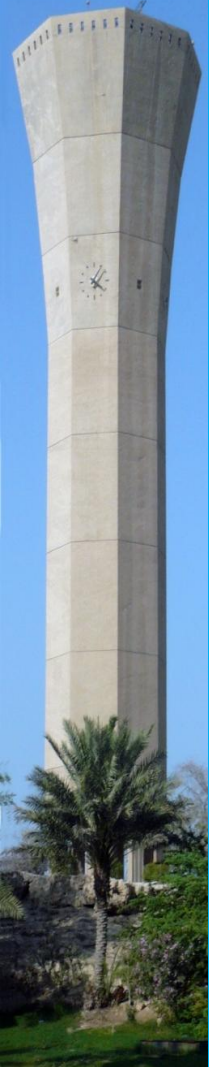




## Exploration and production

Sources of contaminants due to:

- Produced formation water (oil content of 30 to 40 ppm)
- Drilling fluid chemicals
- Oil- and water-based drilling muds and cuttings
- Oil spilled during extraction process
- Fuel oil from ships and equipment used in the production of oil and gas
- Flaring of associated natural gas, including methane and other light hydrocarbons



## Coastal and offshore installations/constructions

Redistribution of contaminants due to :

- Construction of Offshore Platforms
- Laying of submarine pipelines
- Laying of submarine cables
- Dredging
- Trenching
- Landfilling



## Spills and leakages

Deliberate incidents : For eg.,1991 Gulf oil spill

Accidental incidents due to:

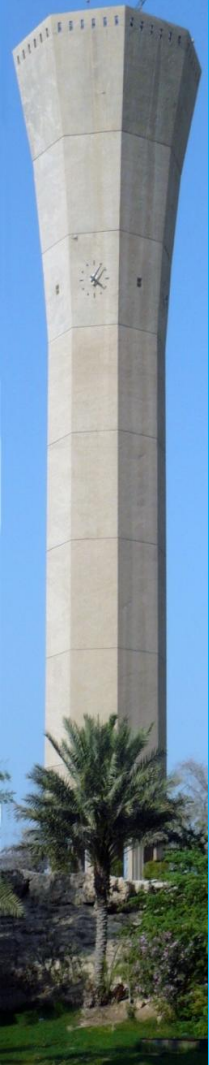
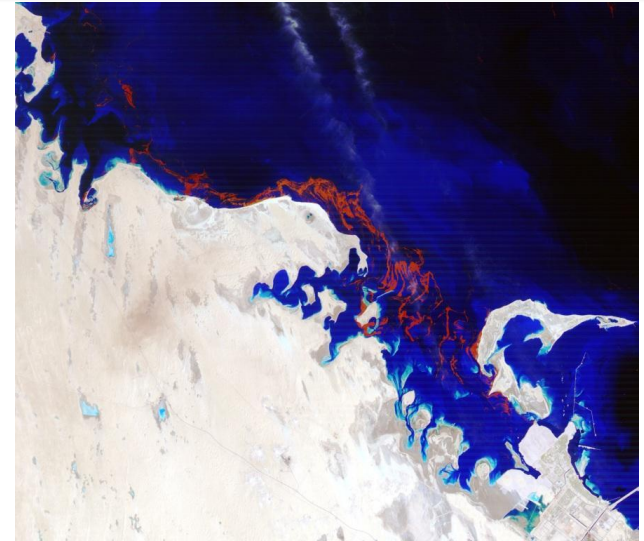
- Pipeline spills
- Tank vessel spills
- Operational discharges from cargo washings
- Coastal facilities spills and
- Gross atmospheric deposition of VOC releases from tankers



## Spills and leakages

1991 Gulf oil spill :

- Largest oil spill on record.
- The spill—in total, about 6-8 million barrels of oil
- Impacted 800 square miles of area (Between Kuwait and Abu Ali island of Saudi Arabia)
- Oil up to six inches thick coated 35 miles of coastline



# Major impacts

## Exploration and production

- Seismic surveys damages the hearing capacity of various marine fishes and mammals.
- Drill wastes alter the sediment granulometry and cause burial and mortality of seabed animals.
- Contaminants (Ba and TPH) in the drilling waste and produced water are toxic to marine organisms.
- Elevated concentration of contaminants in the tissue of marine organisms.



# Major impacts

*continued..*

## Coastal and offshore installations/constructions

- Smothering of benthic organisms due to dredging and dumping
- Organic enrichment of landfilling may lead to anoxic conditions leading to death of benthic organisms
- Offshore oil rigs attract seabirds at night due to their lighting and flaring and causes bird mortality
- Process of flaring involves the burning of fossil fuels which produces black carbon.



# Major impacts

*continued..*

## Spills and leakages

- As oil floats on top of water, less light penetrates limiting the photosynthesis of marine plants and phytoplankton
- Oil destroys the insulating ability of fur-bearing mammals such as sea otters and water-repelling abilities of bird's feathers – causing mortality
- Birds and marine mammals ingest oil when they clean themselves, causing them to be killed or injured.



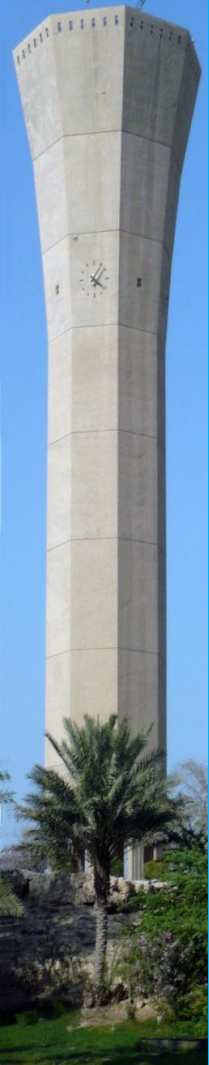
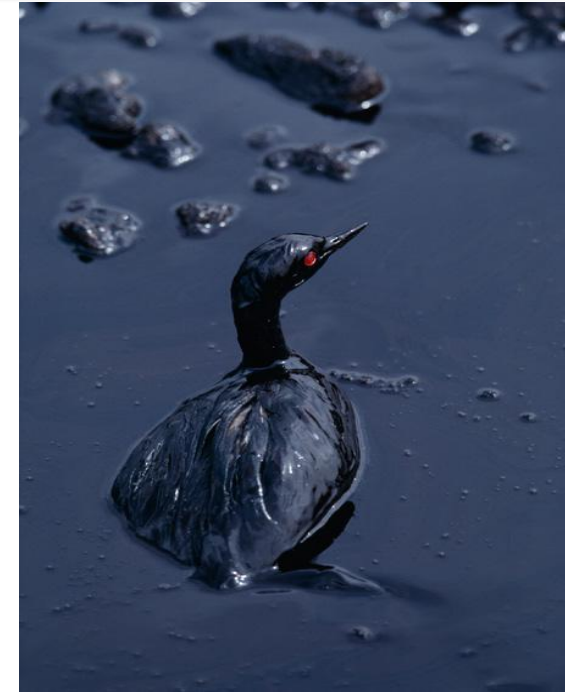
# Impacts

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## Spills and leakages

1991 Gulf oil spill :

- Almost all of the salt marshes along the Saudi coast were impacted.
- All benthic fauna as well as most halophytes were decimated along the shores.
- Around half of the mangrove trees were affected, and 30% died.
- Intertidal habitats and sheltered bays have shown long term impact
- Benthic fauna had not completely recolonized in the sheltered bays even 15 years after the spill event

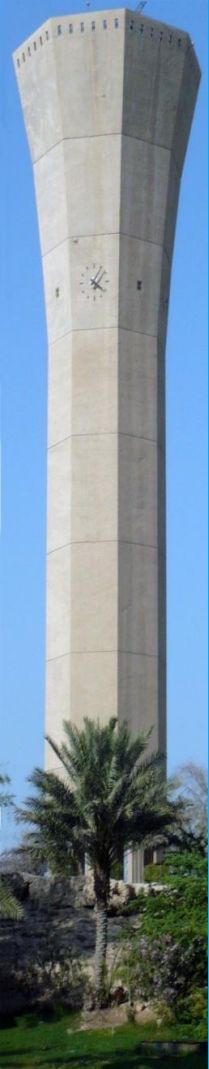






# Summary of impacts due to oil-related activities

Activity	Impacting agents	Environmental impact
<b>1. Exploration and production</b>	Drill cutting, drill fluids, produced water and other wastes	Water and sediment quality, burial of benthos, toxicity to flora and fauna and fish tainting
<b>2. Coastal and offshore installations/constructions</b>	Platforms, pipelines and cables, harbor, dredging, trenching, landfilling	Water and sediment quality and burial of benthos
<b>3. Accidental spills and leakages</b>	Oil and gas spill from wells, blow-out, platform and pipelines	Water and sediment quality, toxicity to flora and fauna and fish tainting





# Major oil spills in the Arabian Gulf

Rank	Year	Incident	Millions of Gallons
1	1991	1991 Gulf Oil spill, Kuwait	240.0
2	1983	Nowruz (Platform No. 3), Iran	80.0
3	1972	Tanker Sea Star; Oman; Gulf of Oman	37.9
4	1978	Pipeline No. 126 well and pipeline; Iran; Ahvazin	28.0
5	1985	Tanker Nova; Iran; 140 km south of Kharg Island	21.4
6	1983	Tanker Assimi; Oman; Gulf of Oman, Ras al Hadd, 93 km from Muscat	15.8
7	1983	Tanker Pericles GC; Qatar; 30 km east-northeast of Doha	14.0
8	1979	Ore/Bulk/Oil carrier Patianna; United Arab Emirates; 11 km off Dubai	11.2

(Source: Oil Spill Intelligence Report)



# Management – Gulf States



- The only multi-national organization in the Gulf is Regional organization for the protection of marine environment (ROPME)
- The objective of which is to coordinate the Member States (Bahrain, I.R. Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and UAE) efforts towards:
  - to protect the water quality in ROPME Sea Area
  - to protect the environment systems and
  - to abate the pollution caused by the development activities the member States.



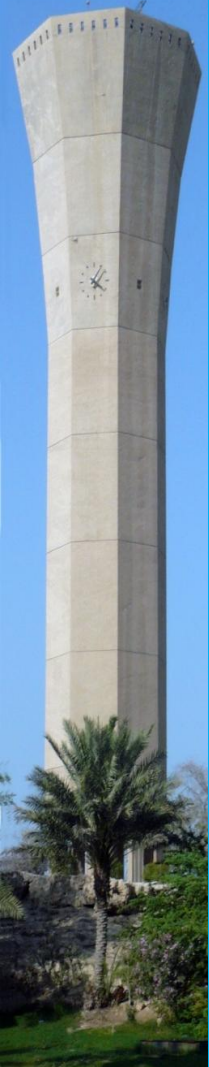


# Management – Gulf states

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The following are some examples of the existing framework laws in the Gulf (UNEP, 1997):

- The Decree for the establishment of the Environmental protection Committee in Bahrain
- The law protecting the Environment in Kuwait (1980)
- Iraq's Environment protection and improvement Act (1986)
- Act for Environment protection and pollution control in Oman (amended 1985)
- Saudi Arabia's Environmental protection standards (PME) and
- The Decree concerning the establishment of the supreme committee for Environment and its mandate in the United Arab Emirates





# Management – Gulf states

*continued..*

## Governmental Environment Institutions and Agencies in the Gulf (UNEP, 1997)

State	Policy Institutions	Executive Agency
Bahrain	Environmental Protection Commission	Ministry of Housing, Municipalities and Environment
Iraq	National Council for the Protection and Improvement of Environment	Ministry of Health
Kuwait	Environmental Protection Council	Various Ministries
Oman	Council of Ministers	Ministry of Provisional Municipalities and Environment
Qatar	Council of Ministers (Permanent Commission for Environmental Protection)	Ministry of Municipalities and Agriculture
Saudi Arabia	Ministerial Committee on Environment	Presidency of Meteorology and Environment
United Arab Emirates	Council of the Federation	Federal Environmental Agency





# Management – Saudi Arabia

*continued..*

## International and regional conventions signed by Saudi Arabia

- Basel Convention on Trans boundary Movement of Hazardous Waste
- Kuwait Regional Agreement for Cooperation on Protection of Marine Environment from Pollution
- The Regional Agreement for Protection of the Red Sea and Gulf of Aden
- The Protocol on Marine Pollution due to Exploration and Exploitation of the Continental Shelf in the Arabian Gulf sea area
- Protocol on Protection of Marine Environment from Land-based Sources (Arabian Gulf)
- Agreement on Conservation of Immigratory Wildlife and
- Vienna Convention (and its protocol) on Protection of Ozone Layer



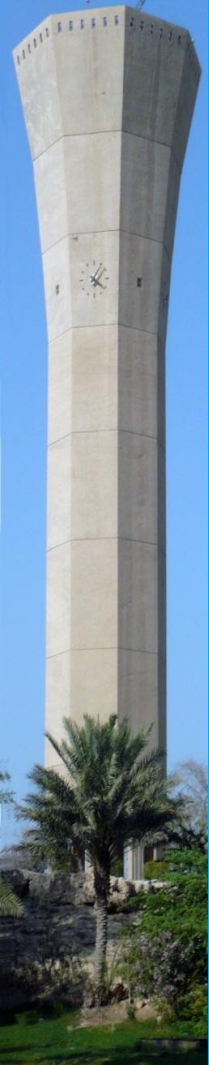
- Saudi Arabia strictly follows PME guideline values for the receiving waters
- PME categorizes the developmental projects into
  - Projects with limited environmental impacts (Category 1)
  - Projects with significant environmental impacts (Category 2)
  - Projects with serious environmental impacts (Category 3)
- Categories 2 & 3 requires EIA by a competent environmental organization



# Management – Role of Saudi Aramco

*continued..*

- Saudi Aramco is the state-owned oil company of the Kingdom of Saudi Arabia and ranks first among oil companies worldwide
- The Company has developed a set of contingency measures to prevent and/or control marine oil spills.
- The company has a
  - Oil Spill Response Team (ORST) to combat the spill
  - Dedicated vessels for oil spill recovery
  - Dedicated aircraft for dispersant spraying
  - Advanced equipment like booms, recovery skimmers etc. with 1000 trained employees





# Management – Role of Saudi Aramco

*continued..*

- Ensure environmental protection through Saudi Aramco's Environmental Protection (SAEP) policies.
- The Company has strict port regulations which includes financial punitive actions against substandard tankers
- All substandard tankers involved in pollution incidents or serious safety deficiencies are effectively controlled by stopping future calls.



# Conclusion

- Environmental consequences are unavoidable in any oil-related activity
- The growing demand for oil and the subsequent increase in production may impose additional stress to the Gulf ecosystem
- The stressors are so marked that a recent assessment (Sheppard et al., 2010) categorizes the Gulf as a young sea in decline.
- Gulf states have independent regulatory bodies to monitor and minimize the impacts due to oil-related activities
- An ecosystem based multi-national common framework is required for the effective environmental management in the Gulf





*Thank You*

