GEMM

Gulf Environmental Monitoring and Management

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Local Context

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Marine Environment

The Gulf War has caused major environmental effects that have been felt well beyond the boundaries of the countries involved. Hostilities have resulted in an international environmental disaster affecting the land, sea and atmosphere. Throughout the Arabian Gulf region and specifically the three countries of Kuwait, Iraq and Saudi Arabia there are a total of more than 3,650 animal species. Of these, some 50 are recognized internationally as being threatened with extinction, these include 20 species of bird, 20 mammal species, three reptiles, two fishes, four mollusc and one insect. The Gulf itself constitutes an almost entirely closed body of shallow water, 1,000 km long by 300 km wide, with an average depth of just 35 m. It is one of the most productive plankton water bodies in the world, but it is also regarded as being one of the most fragile and vulnerable marine ecosystems. Its low tidal displacement means that it has little di charge of its water into the Indian Ocean and thus little opportunity to flush out pollutants. The inflow of nutrient-rich fresh water from the Euphrates and Tigris Rivers through the Shatt al Arab waterway deposits its silt load in the extensive mudflats and salt marshes at the head of the Gulf. The clear warm waters, good light penetration and shallow depth encourage the growth of coral reefs, the most productive marine habitat, which contribute to the production of plankton that in turn support the food chain of fish and birds. The Gulf is represented by at least four critical marine habitats-coastal marshes and mudflats, coral reefs, sea grass beds and mangroves.

The adjacent land area also supports a number of key terrestrial habitats, including riverine marshes and undisturbed desert biotopes. The spillage of large quantities of oil into this fertile but vulnerable marine environment is likely to create one of the worst marine ecological disasters to date. In size it dwarfs the Exxon Valdez spill in Alaska, and because of the biological richness of the Gulf waters it is likely to have much more serious ecological repercussions. But the extent of its impact will depend upon where the slick comes ashore. With the main slick currently at sea, its effect shave been slight - just a few coral islands in Kuwaiti waters have been affected. Where it comes ashore will depend upon the wind and current, but the 600 km length of Saudi coast from Kuwait to Bahrain is threatened -and this includes seve al ecologically and economically important sites and Qatar is immediately threatened -and this shoreline includes several ecologically and economically important sites. With the spill breaking up due to strong winds and waves, it is difficult to predict its future spread. Potentially at risk could be the vital sea grass beds and coral reefs off the coast of the United Arab Emirates, which are probably the richest sites in the Gulf for wildlife and commercial fisheries.

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Earth Environment and Biodiversity

Gulf Environmental Monitoring and Management

Along the seacoast, the land is made up of coastal deposits of a nature less dry and desert-like than the interior. These lands are punctuated with and even demarcated from the rest of Kuwait by medium-sized coastal hills, while the interior parts of Kuwait are essentially sandy.
Kuwait's wild plant-life is one of its unique natural heritages. Plants are adapted to survive in the harsh conditions and extreme temperatures. Unfortunately, they suffered under the intense pressure caused by grazing, collection of fuel, etc.
Kuwait is home to numerous species of insects, animals and birds. Among the diverse insects the most attractive group is that of butterflies. Several beautiful varieties are found here and the best time to see them is spring.
A sad by-product of Kuwaitís rapid growth and socio-economic developments, has been deterioration in the natural eco-systems.
Prior to the discovery of oil there were natural checks and balances which protected environment. Today things are no more the same.

The worst environmental devastation occurred with the Iraqi invasion of Kuwait. The Iraqis unleashed the worst kind of environmental terrorism the world had ever witnessed - the burning oil wells, creation of thousands of oil-lakes, oil slicks, million of land mines - all of which severely damaged the vegetation, marine life and other flora and fauna.
Even though, the war is over and substantial damage control has been done, the real magnitude of the impact of war is yet to be assessed, and its results will be borne by many generations to come.

Atmosphere

The issue of air quality conditions and atmospheric pollution in the Arab Region (or Middle East and North African countries) has been addressed through consideration of the energy production and energy consumption pattern. Global, regional and local sources of air pollution in the region have been considered. Emission scenarios of many countries of the region have been outlined.

Even though it has been long realized that air pollution constitutes one of the major sources of loss on GNP of many countries in the region weak institutional capabilities for air pollution management and control still exist in the region.

Major types of pollution sources in the region such as dust storms and sandstorms, greenhouse gas emissions and other gases from various industries are outlined. Local sources including urban growth, transportation systems, industrialization, and lack of awareness and shortage of institutional capabilities all contributed to the relatively low air quality and weak control. The risk of radioactive contamination of air and shortage of contingency plan has not taken into consideration. Examples of potential impacts of air pollution on the national gross product as well as potential impacts of climate change on various economic and health sectors have also been investigated.

An outline of the required ground-based monitoring networks and its needs as well as the most recent capabilities of satellite monitoring systems have been presented in the Report : 'Air quality and atmospheric pollution in the Arabian Regioní and needs for capacity building concerning new air pollution monitoring and control techniques have been addressed.

The need for change of fuel strategy shift with particular emphasis on transportation systems, industry and urban systems is emphasized.

Priorities for action on the global, regional and local scales have been addressed for improving consumption pattern, minimizing impacts of climate change and depletion of ozone layer, upgrading air quality and promoting better governance and Public Participation for Sustainable Development. Particular emphasis was also placed on building up and upgrading institutional capabilities in member countries through establishing of monitoring and assessment networks.

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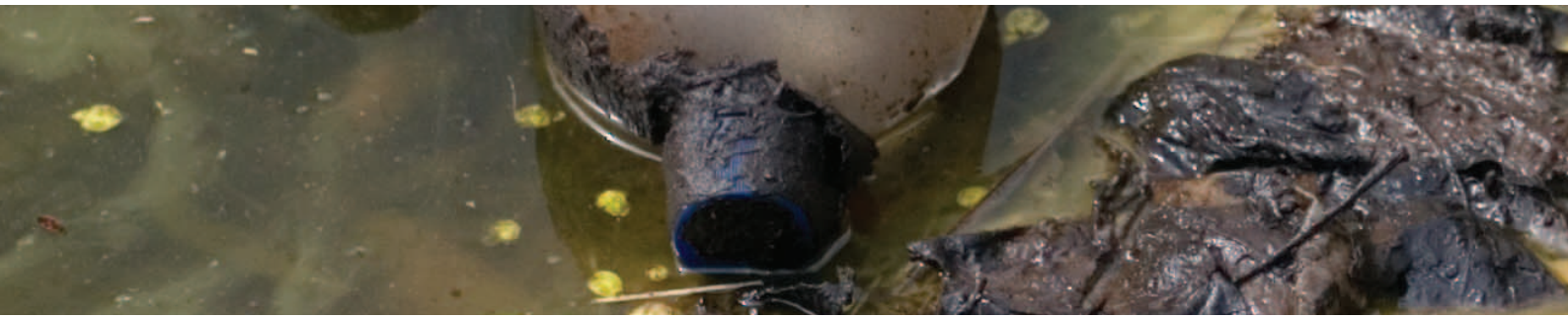
Waste Management

Waste management and planning authorities need to know and understand the materials they will be handling or disposing in order to be able to set up effective sustainable waste management programmes. Also, in setting up a waste management programme for a region or city, it is critical to have reliable data on waste stream characteristics such as the nature, characteristics, types and quantities of waste components in the waste streams of that locality. This will allow them to choose with fair certainty the kind of management options to consider for the implementation of an integrated solid waste management programme. The objective of a recent study was to analyse household solid waste to determine the type, nature and quantities of materials in the waste as generated so to provide useful information on the potentially available management choices in the some metropolis. Results show that, domestic solid waste in the metropolis can be routed via three distinctly different stream types; namely the High-Income Low-Density Population Waste Zone (HILDWZ), Middle-Income Medium-Density Waste Zone (MIMDWZ), and Low-Income High-Density population Waste Zone (LIHDWZ). These waste streams were also shown to consist of entirely different proportions of the waste components, but with an average percentage composition of 60% organic or putrescible materials, 8% paper & card, 8% plastic & rubber materials, 3% metal & cans, 2% glass, 11% residue or inert materials, and 2% miscellaneous or other waste.

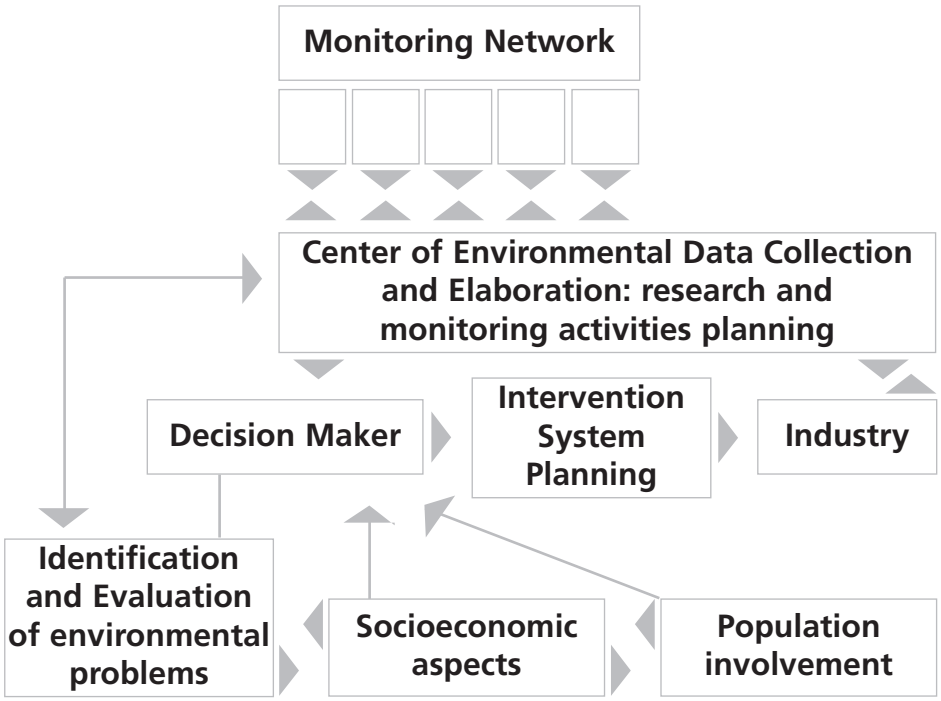


Recent literature on solid waste management in Kuwait has been reviewed and data analyzed on the total amount of solid waste generated in Kuwait. The results show a rapid increase in the total amount of municipal solid wastes and significant changes in their composition. These are related to the increased population in Kuwait and the lavish spending. The total solid waste generation has reached 1.4 kg per capita per day. Vehicles for waste collection include rear-loading compactors, noncompacting trucks, container hauling trucks, open tippers, and side loaders. Refuse analysis indicated a high percentage of food and paper/cardboard products. The total amount of industrial solid waste in Kuwait was about 124 tonnes in 1997. Also, the total amount of pharmaceutical wastes was about 25.2 tonnes in the same year. Factors affecting the important management issues in the operation of Kuwaitís solid waste management system are discussed. Key design data and other useful information selected from a variety of reliable sources are presented. The adoption of modern waste management practices should be emphasized in order to achieve greater efficiency.

GEMM
Gulf Environmental Monitoring and Management

GEMM Project

GEMM Project is dedicated to monitoring and environmental research in the Gulf region and could take advantage of the collaboration between established researcher and existing local structures working together in an exchange perspective.
The research structure will not be autonomous and isolated, but supported by a mechanism directed to obtain high efficiency from existing competences, introducing them in a coordinated context of high level research.
This purpose will be carried out through the application of tested methodologies, technological knowledge transfer to the local community, political sensitization campaigns, improvement of local scientific authority within the international scientific community.



GEMM research program will be directed to the carrying out of high quality integrated environmental monitoring and research activities. It will also provide scientific and technological coordination integrating different existing research and monitoring programs through a dedicated program for the enhancement and the improvement of local scientific activities (implementation of new monitoring stations, dedicated program for instrument calibration, application of QA/QC procedures in environmental network management…)

GEMM could become a focal point for the of environmental and technological research in Middle East thanks to the implementation of a structure able to carry out:
- Integrated environmental monitoring activities
- Environmental research and technological development
- High level academic education and training

GEMM's primary output will be the essential instruments to support scientific research in order to solve environmental problems, aiming at achieving excellence in the field of integrated environmental research and monitoring.

Specific Field of Action

Marine Environment

The oceanography of the Arabian Gulf and its coastal environment: the events of the last 50 years and the present forecasting capabilities - the Atlas of the Arabian Gulf

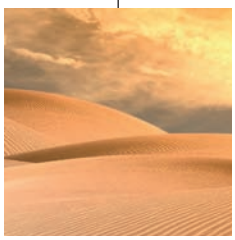
Remote sensing techniques for detection and monitoring of marine oil slicks

Modelling the behaviour of dangerous chemicals in the coastal environment (speciation, input-output, distribution, bioaccumulation, toxicity) and applicability of remediation techniques

Radiochemical approach for the monitoring and management of the environment

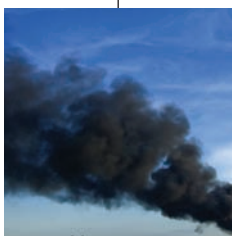
Ecotoxicological approach to safeguard human health and coastal aquatic ecosystem by toxic pollutants

Ecotoxicological and toxicological evaluation of the effects of dangerous chemicals in the Kuwait marine coastal environment



Earth environment and biodiversity

Remote sensing techniques for monitoring topographic stability through interferometric synthetic aperture radar technique



Atmosphere

Analysis of transport and diffusion of atmospheric pollution and aerosol in Kuwait by using advanced observation techniques and simulation codes

Air pollution monitoring network

Impact of mineral dust emitted from desert areas and VOC emitted from indoor sources on the human health and on air quality levels of Kuwait City

Waste management

Waste management to increase recovery of valuable resources and to minimize environmental impact

Innovative combined chemical and biological oxidation technologies for treating oil industry wastewater

Current Participating Institutes

Italian National Research Council
Earth and Environment Department

General objectives

In agreement with current international and national concerns, and the National Research Plan (2006-08) the objectives of this thematic area concern:

- Structure of the planet: main goal is to define temporal and spatial changes of the strucuture and composition of the different features constituting the Earth system, from the mantle to the atmosphere;
- Dynamics of the planet: study of the energetic exchanges among the several components of the Earth and the effects on its dynamics;
- Ecology and metabolism of the planet: the goal is to contribute to the understanding of terrestrial and marine ecosystems, to their evolution, to the interactions and the exchanges of the biosphere with the other components of the Earth system.

CNR-Earth and Environment Department Member Institutes

Institute for Coastal Marine Environment (IAMC)
Institute of Agro-envinronmental and Forest Biology (IBAF)
Institute for the Dynamics of Environmental Processes (IDPA)
Institute of Environmental Geology and Geoengineering (IGAG)
Institute of Geosciences and Earth Resources (IGG)
Institute for Atmospheric Pollution (IIA)
Institute of Methodologies for Environmental Analysis (IMAA)
Research Institute for Geo-hydrological Protection (IRPI)
Water Research Institute (IRSA)
Institute of Atmospheric Sciences and Climate (ISAC)
Institute for Mediterranean Agriculture and Forest Systems (ISAFoM)
Institute of Ecosystem Study (ISE)
Marine Science Institute (ISMAR)
Tree and Timber Institute (IVALSA)

CNR-Earth and Environment Department Participating Institutes

Institute for Applied Mathematics "Mauro Picone" (IAC)
Institute of Biophysics (IBF)
Institute of Biomedicine and Molecular Immunology "Alberto Monroy" (IBIM)
Institute of Protein Biochemistry (IBP)
Institute of Inorganic Chemistry and Surfaces (ICIS)
Institute of Acoustics "O. M. Corbino" (IDAC/IA)
Institute of Applied Physics "Nello Carrara" (IFAC)
Institute of Plant Genetics (IGV)
Institute for Applied Mathematics and Information Technologies (IMATI)
Methodological Chemistry Institute (IMC)
Institute for Electromagnetic Sensing of the Environment (IREA)
Institute of Intelligent Systems for Automation (ISSIA)

CNR-Earth and Environment Department Scientific advisor committee Projects:

1. The Earth system: interaction between solid Earth, sea, fresh waters, atmosphere and biosphere. Improvement of our understanding of processes that regulate the Earth system and the interactions between its components, aimed at predicting the main evolutionary trends.

2. Global change.
Evaluation of ancient and recent climatic changes in the Earth system as a result of natural and anthropic causes, using models and experimental measurements; to predict the ecological responses of species and communities.

3. Quality of environmental systems.
To improve the evaluation of environmental system quality; to support local and national policies devoted to the safeguard and recovery of land and marine ecosystems.

4. Sustainability of land and water systems.
To define the level of functionality of environmental systems and their response to human impact; to develop methods and standards to support sustainable management.

5. Natural and anthropic risks.
Improvement of the knowledge of the causes of natural and human induced risk in both inland and off-shore areas; development of efficient prevention and now-casting strategies; cooperation with Civil Protection.

6. Earth Observation.
Development of technologies to observe the Earth by ground-based, airborne and satellite instruments; to participate into Euro-Mediterranean infrastructure systems focused on global monitoring and security.

7. Pollution Control and Ecological Restoration.
Development of technologies and methods to reduce environmental pollution and to support ecological restoration, also providing new inputs to industrial technological development.

Ev-K2-CNR Committee

Ev-K2-CNR was founded in 1989 as independent, private, non-profit association, for the promotion and dissemination of cultural, scientific, research and humanitarian projects and activities in mountain environments, with particular emphasis on environmental research issues of regional and global interest like climate change and atmospheric pollution;
Ev-K2-CNR members include researchers from CNR institutes, Italian and foreign universities and other experts. Together, they form a strong network of collaboration operating through intergovernmental and inter-institutional agreements involving UN Agencies, national scientific institutions and NGOs, to ensure the high quality of research and optimization of results.
Ev-K2-CNR is also accredited with consultative status to the UNEP (United Nations Environmental Programme) and participates to the main monitoring networks and programs:

- **ABC** (Atmospheric Brown Cloud) Project

- **UNEP** (United Nations Environment Programme) Asia

- **CEOP** (Coordinated Enhanced Observing Period) and **GEWEX** (Global Energy and Water Cycle Experiment)

- **WMO** (World Meteorological Organization)

- **GEOSS** (Global Earth Observation System of Systems)

- **US EPA** (United States Environment Protection Agency)

- **AERONET** (Aerosol Robotic Network)

- **NASA** (National Aeronautic and Space Administration)

- **ILTER** (International Long Term Ecological Research)

- Partnership Institutional Consolidation for the coordinated and integrated **monitoring of natural resource towards sustainable Development and Environmental Conservation in the Hindu Kush - Karakorum - Himalaya Mountain Complex - IUCN** Asia (The World Conservation Union)

Ev-K2-CNR is member of the Gulf Desk which has been promoted by the Italian Ministry of Foreign Affairs and it contributes together with the Italian Ministry of Environment and Protection of Sea and Territory to coordinate the related "Environment Group for the Gulf Desk".

Kuwait Institute
for Scientific Research

Gulf Environmental Monitoring and Management

KISR (Kuwait Institute for Scientific Research

Kuwait Institute for Scientific Research (KISR) was established in 1967 by the Arabian Oil Company Limited (Japan) in fulfillment of its obligations under the oil concession agreement with the Government of the State of Kuwait. The Institute was established to carry out applied scientific research in three fields: petroleum, desert agriculture and marine biology. An Amiri Decree in 1981 (law No. 28) formally established KISR as an independent public institution. The law specified that the Institute remain to carry out applied scientific research that helps the advancement of national industry and to undertake studies relating to the preservation of the environment, resources of natural wealth and their discovery, sources of water and energy, methods of agricultural exploitation and promotion of water wealth. The law entrusted the Institute with undertaking research and scientific and technological consultations for both governmental and private institutions in Kuwait, The Gulf region and the Arab World.
The Central Analytical Laboratory (CAL), since it was established in 1977, provides analytical support and services to KISR's applied research programs and to many private and government agencies. It is made up of five labs: West Chemistry, Chromatography, Spectroscopy, Physical Chemistry and Trace Metals. To provide accurate analytical data CAL's analytical services are controlled through a quality control and quality assurance unit.

Activities
- Environment and urban development
- Water resources and technologies (31 projects)
- Food resources and arid land agriculture and greenery (27 projects)
- Petroleum research and studies (40 projects)
- Techno economics (11 projects)
- Research and development of pollution measurement systems (20 projects)
- Environmental recovery
- Building and energy technologies (15 projects)
- Coastal and aerodynamics (20 projects)
- Environmental sciences (20 projects)
- Biotechnology (34 projects)

Services
- Environmental monitoring
- Maintenance and sales of the ì.kwî domain on behalf of the Ministry of Communication
- Training courses for software use, management, science and technologies. Education level foresees university stages and post-graduate courses for high school students.

EPA (Environment Public Authority)

Environment Public Authority in Kuwait is the first promoter of the Environmental Ministry legislative initiatives. It is a High Interdepartmental Council consisting of:

- The Minister for Health
- The Minister for Planning
- The Minister for Oil
- The Minister for Commerce and Industry
- The Minister for Communications
- The Municipality Chief
- The Chairman - the Director General of the Public Authority for the Agriculture Affairs and Fish Resources
- The Director General of Kuwait Institute for Scientific Research

EPA is a lead institution in the field of environmental research. It operates with other federal agencies and local governments to develop and strengthen existing environmental laws. It is responsible for research and the establishment of national reference standards relating to the environmental and monitoring programs aimed at helping the country achieve appropriate environmental quality levels. The institution collaborates with industries and the government within voluntary prevention pr grams for pollution reduction and safeguarding of energy resources.

EPA has recently developed a ten-year plan for the protection and the conservation of the environment, focusing the attention on atmospheric pollution, water resources, education and information in government structure and industries. Plan strategy includes conservations of arts, main archite tonic structures and archaeological sites and environmental education and information programs.

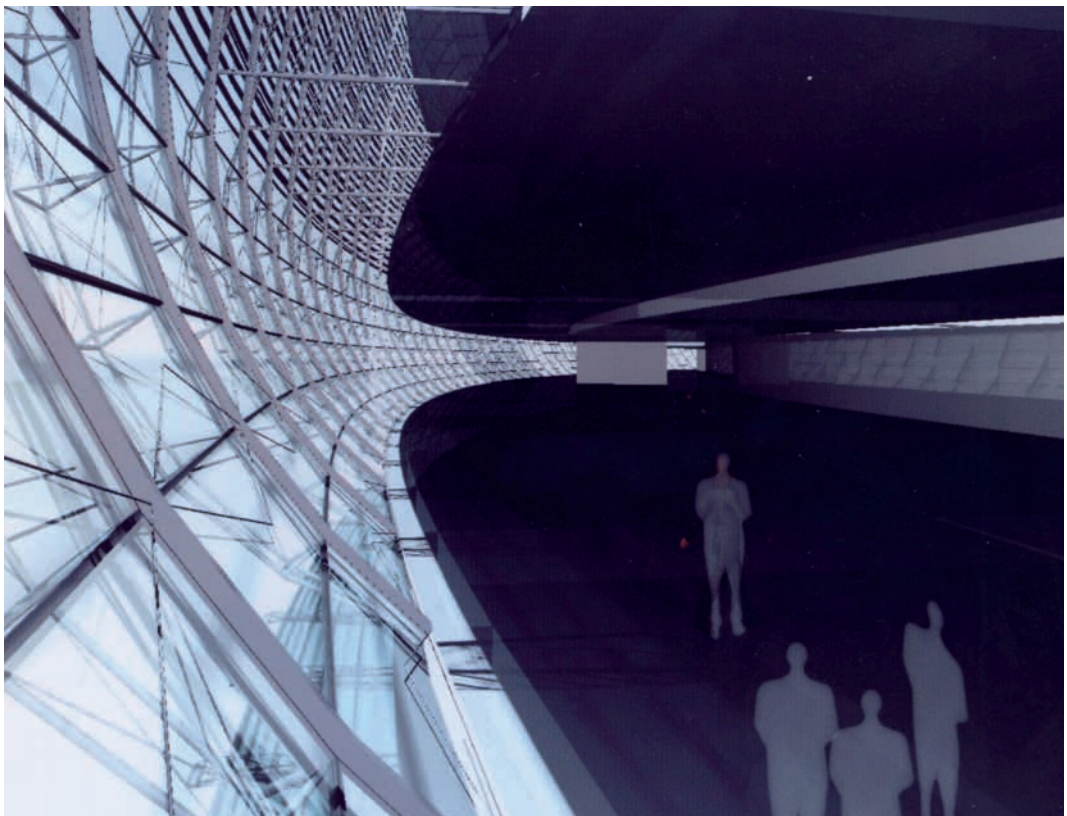
GEMM Future Perspectives

Implementation of an **ETP** (Environmental Technology Park) to combine academics, engineering studies and corporations with the specific purpose of achieving excellence in problem solving, engineering, construction and innovative solutions both for the Persian Gulf and the ME environment.
The aim is the creation a campus for multidisciplinary research where companies, universities, scientific associations and everyone involved can combine their skills. It will be a strategic link amongst international scientific experts, a place for exchange and investing and will produce innovations in environmental science and technologies.
The initiative could create strong link between basic science, industrial research, technological development and innovation **in order to**:

- Valorise all the potential and skills of Universities and public sector research not only at the regional level;
- Develop a mixed system, R&D, experimentation, hi-tech activities, services innovation support services;
- Create a collaboration network taking advantage of all the initiatives in order to achieve the objectives for development and public interest.

The Park will provide a number of benefits:

- an opportunity for research and industrial innovation raise the average level of industrial technology in the region
- growth of an agglomeration of innovative, competitive companies at the international level and one or more "innovative and high technology districts"
- an improvement in quality and competition of sectors of specialization and growth of new activities



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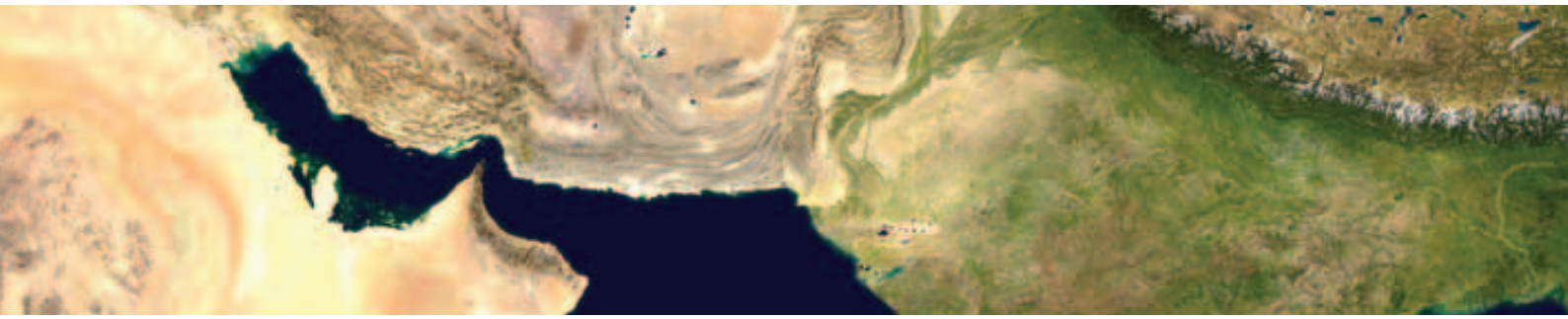

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