

# **National Strategy and Action Plan for Environmental Health**

UNITED ARAB EMIRATES  
2010



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.....

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**Eng. Zaid Al Siksek**, Chief Executive Officer, Health Authority—Abu Dhabi  
**Dr. Mariam Al Matrooshi**, Director, Department of Health Legislation, Ministry of Health  
**Dr. Mariam Al Shenasi**, Consultant, Minister of Environment and Water, Ministry of Environment and Water  
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**Eng. Bahkeet Salim Al Ameri**, Manager, Environment, Health and Safety, Supreme Petroleum Council  
**H.E. Khalid Ahmed El Shaikh Mubarak**, Assistant Director, Finance and Administration, Dubai Health Authority

## Technical Advisors

.....

**Dr. M. Z. Ali Khan**, World Health Organization, retired  
**Dr. Amir Johri**, World Health Organization

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.....

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**Dr. Salaheddine Moussa**, Occupational Health Team Leader, Abu Dhabi National Oil Company  
**Dr. Ali Al Marzouqi**, Director of Public Health, Dubai Health Authority

## Managers

.....

**Dr. Mahmoud Abdulrahim**, Director, Environment Management Sector, Environment Agency—Abu Dhabi  
**Dr. Ahmed Bashir**, Acting Director, Environment Awareness Sector, Environment Agency—Abu Dhabi

## Technical Staff

.....

**Ayesha Abushahab**, Environment Agency—Abu Dhabi  
**Abdullah Mohamed Al Rumaithi**, Environment Agency—Abu Dhabi  
**Ayesha Al Suweidi**, Environment Agency—Abu Dhabi  
**Ruqaya Mohamed**, Environment Agency—Abu Dhabi

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# Foreword

The Environment Agency–Abu Dhabi (EAD) in cooperation with the University of North Carolina–Chapel Hill and other organizations, including the Health Authority–Abu Dhabi, the Ministry of Health, the Dubai Health Authority, the Ministry of Environment and Water, and the Abu Dhabi National Oil Company, developed this *National Strategy and Action Plan for Environmental Health* in order to improve our environment for current residents and future generations.

This national strategy and action plan is intended to provide a focal point for the efforts of many national, emirate-level, and municipal agencies in the UAE toward the important objective of reducing the environmental burden of disease. Cooperation among the entities named as stakeholders in this document will be key to achieving this objective. Initiatives to aid the achievement of both short-term (2014) and long-term (2030) goals must be acted upon without delay. Suggested time frames for the undertaking and completion of these initiatives are included.

Already, we are making progress toward the targets presented in this document. Many of the listed initiatives are already under way. Our new Environment, Health and Safety Management System in Abu Dhabi is designed to ensure implementation of environmental guidelines to effectively manage and protect the environment. The 2009 Abu Dhabi Water Resources Master Plan examines the role we must play in promoting sustainable use of water and energy resources. EAD has partnered with the new Center of Waste Management Abu Dhabi to implement and enforce waste management policies.

Though these few examples focus on our efforts here in Abu Dhabi emirate, the need for national action and cooperation is real. No single agency acting alone can have the impact necessary to effect the change we need. Now is the time for all of us to work together, with full cooperation and communication, to strive for a position of world leadership on issues related to environmental health. By following the recommendations outlined here, the UAE can set an example of excellence for other nations to follow.



A handwritten signature in black ink, appearing to read 'Majid Al Mansouri'.

**Majid Al Mansouri**

Secretary General, Environment Agency–Abu Dhabi

Chairman of the Steering Committee, Environmental Health Project



# Introduction

The World Health Organization (WHO) has estimated that 24% of the global burden of disease is attributable to environmental factors. The United Arab Emirates is increasingly taking action to reduce preventable deaths and illnesses due to exposure to environmental pollutants. This document presents a national strategy and initial action plan to reduce the public health impacts of exposure to environmental pollution in the UAE.

In 2007, the UAE completed a national umbrella strategy that established broad goals for the country. The overarching goal of that national strategy was “to achieve sustainable and balanced development and ensure continued quality and high standards of living,” but it did not address environmental issues in detail. Yet, the protection of public health in the UAE from risks associated with environmental pollution is an important component of ensuring sustainable and balanced development. This strategy and action plan is an important step along the path to realizing the goal of sustainable long-term development for all seven emirates within the UAE.

Pollution does not respect borders between emirates. This strategy is intended to unite the emirates in identifying and implementing steps to protect people in the UAE from health risks of environmental pollution. Agencies in the public and private sectors across all seven emirates and at the federal level must cooperate to find effective solutions to the nation’s environmental challenges.

This strategy builds on many other related strategic planning efforts being carried out in government agencies throughout the emirates. It is not a replacement for these other plans, but rather it uniquely addresses environmental health while weaving in common threads from other strategies. This document provides further support for the importance of implementing other, related strategies.

While a wide variety of strategies and action plans have been completed in the UAE within the past several years, and while many of these strategies address aspects of environmental pollution and/or human health, this is the first nationwide strategy that emphasizes linkages between environmental quality and human health. Table 1 (page 4) lists selected other strategy documents from the UAE that contain recommendations pertinent to the environment or health. This strategy and action plan draws relevant key performance indicators (KPIs) and initiatives from these other strategic plans. It enhances these previous plans not only by assembling in one place the actions and KPIs relevant to protecting public health from environmental pollution, but also by providing new insights from the many stakeholders consulted in this process and from new scientific analyses of the environmental burden of disease in the UAE. A companion report on the environment and public health in the UAE describes the assessment of the environmental burden of disease in more detail.

The Environment Agency—Abu Dhabi (EAD) funded this strategic planning effort to benefit the entire nation. EAD works with the UAE Ministry of Environment and Water to implement environmental laws and issue regula-

tions in Abu Dhabi emirate. EAD has also pioneered the promotion and development of information technology (including databases such as the Environmental Database and the Abu Dhabi Global Environmental Data Initiative) to unite data collection across the emirates.

EAD requested the assistance of the WHO Centre for Environmental Health Activities in Amman, Jordan, to develop a framework for the strategic planning project. Also, EAD established a collaborative relationship with the University of North Carolina–Chapel Hill (UNC) Gillings

School of Public Health to provide scientific analysis in support of this strategy. UNC recruited several other organizations to assist with scientific analyses, including UAE University, the RAND Corporation, Resources for the Future (RFF), and the Norwegian Institute for Air Research. •

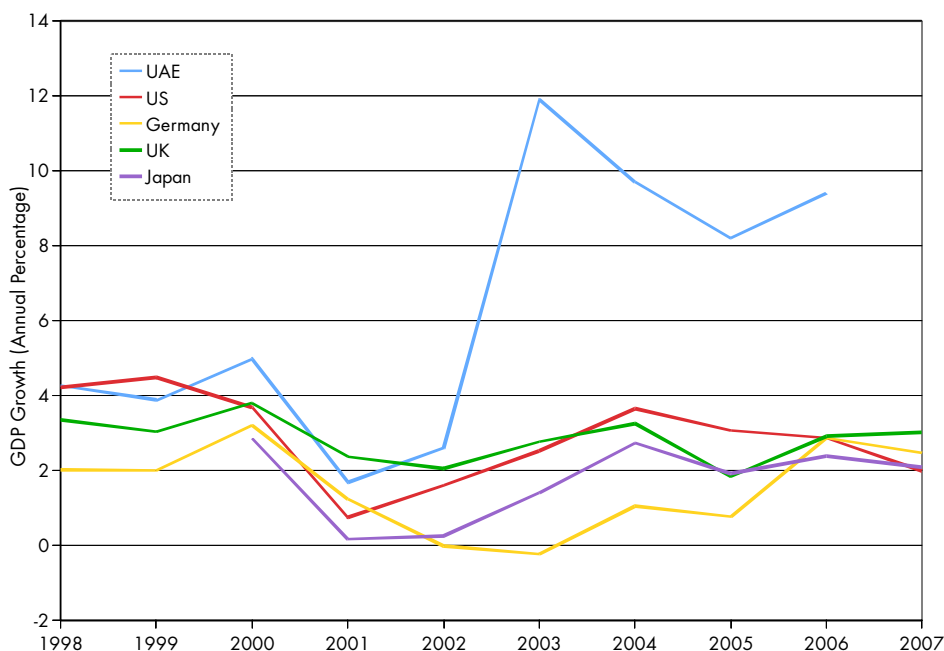
## Why the UAE Needs a National Environmental Health Strategy

The UAE has industrialized at a rate that is perhaps unprecedented in human history. Indeed, the UAE's growth rate in gross domestic product (GDP) is among the highest in the world (see Figure 1).

As a result of this development, public health in the UAE has improved dramatically. Overall life expectancy at birth for UAE citizens reached 78.3 years in 2005 (United Nations Development Programme 2008). This is in the top tier of world life expectancies, on par with that of other developed nations.

Paradoxically, while economic development has greatly increased life expectancy in the UAE, it has also created new kinds of health risks. The disease burden has shifted from infectious diseases to non-communicable diseases, many of which can be triggered or exacerbated by exposure to environmental pollutants. Environmental pollution jeopardizes further gains in life expectancy. Indeed, in the future, advances due to development could result in decreases in life expectancy due to increased exposure to environmental pollutants and changed lifestyles. Further, as life expectancy in the UAE increases, the lifetime burden of pollutants to which residents are exposed increases, thus increasing the importance of minimizing environmental risk factors over a lifetime.

Other countries have waited until late in the industrial development cycle to take



**Figure 1.** The UAE leads the world's major economies in GDP growth. Figure generated from World Bank data found in the Country Profiles of World Development Indicators Database (<http://go.worldbank.org/4C55Z0H7Z0>).

steps to curb environmental pollution. Infamous air pollution episodes in London, England, and in the U.S. steel manufacturing region in the 1940s and 1950s led to hundreds of thousands of hospitalizations and thousands of deaths (Trivedi 2002, Hamill 2008). A more recent example is the poisoning of more than 1,300 children in China in August 2009 due to lead pollution from a manganese smelter (Wines 2009).

The UAE is visionary in its effort to

seek a sustainable development paradigm before such severe problems emerge. The steps outlined in this document will help the UAE avoid the kinds of environmental crises that have plagued other nations. This national strategy and action plan is a component of the larger National Environment Health Project, which aims to identify and prevent environment-related threats to health and thus reduce the overall environmental burden of disease in the UAE. •

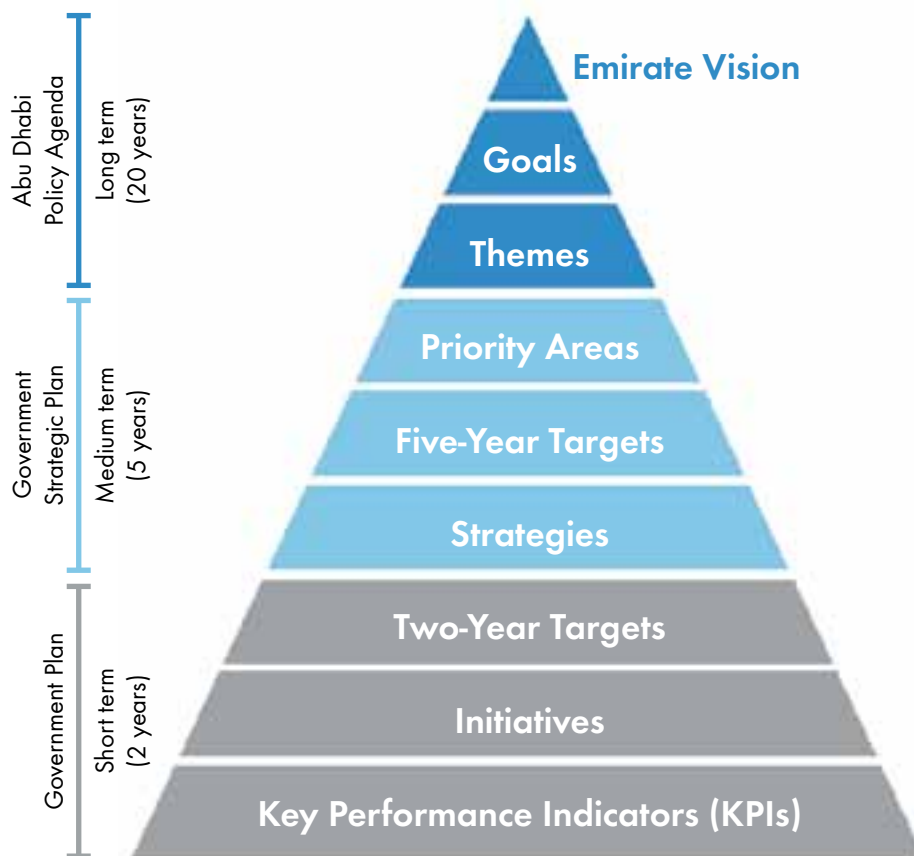
**Table 1.** Selected Strategy Documents Pertinent to Environmental Health in the UAE

<b>Federal government</b>		
<u>Document Title</u>	<u>Publisher/Organization</u>	<u>Year</u>
Highlights of the UAE Government Strategy	UAE government	2008
<b>Emirate government</b>		
<u>Document Title</u>	<u>Publisher/Organization</u>	<u>Year</u>
Policy Agenda 2007–2008, the Emirate of Abu Dhabi	Abu Dhabi Government, the Executive Council	2007
Abu Dhabi e-Government Strategic Targets 2008–2012	Abu Dhabi Systems and Information Committee	2007
Highlights of Dubai Strategic Plan (2015)	Dubai Government	2007
<b>Health</b>		
<u>Document Title</u>	<u>Publisher/Organization</u>	<u>Year</u>
Federal Health Strategy	Ministry of Health	2007
HAAD Standard for Healthcare Facilities – Occupational and Indoor Air Quality	Health Authority–Abu Dhabi (HAAD)	2009
HAAD Policy for Healthcare Facilities – Occupational and Indoor Air Quality	HAAD	2009
<b>Environment</b>		
<u>Document Title</u>	<u>Publisher/Organization</u>	<u>Year</u>
Abu Dhabi Environment Strategy 2008–2012	Environment Agency–Abu Dhabi (EAD)	2008
A Roadmap to the Future – Abu Dhabi Environment Strategy 2007–2011	EAD	2007
Draft Gap Analysis Report on Abu Dhabi Environment-Related Policies	EAD	2009
Entity Strategic Plan 2009–2013	EAD	2009
Abu Dhabi Climate Change Policy (Draft)	EAD	2009
Abu Dhabi Environmental Strategy and Action Plans	Environmental Research and Wildlife Development Agency	N/A
Abu Dhabi Noise Strategy	EAD	2006
<b>Transportation</b>		
<u>Document Title</u>	<u>Publisher/Organization</u>	<u>Year</u>
Surface Transport Master Plan – Connecting Abu Dhabi 2030	Department of Transport (Abu Dhabi)	2007
<b>Water</b>		
<u>Document Title</u>	<u>Publisher/Organization</u>	<u>Year</u>
Abu Dhabi Water Resources Master Plan (Draft)	EAD	2009
Abu Dhabi Water and Electricity Authority Strategic Plan 2008–2012	Abu Dhabi Water and Electricity Authority	2008
<b>Food</b>		
<u>Document Title</u>	<u>Publisher/Organization</u>	<u>Year</u>
Strategic Plan for Food and Agriculture Safety 2008–2012	Abu Dhabi Food Control Authority	2008
<b>Waste Management</b>		
<u>Document Title</u>	<u>Publisher/Organization</u>	<u>Year</u>
Abu Dhabi Waste Management Strategy	EAD	2008





## Process for Developing This Strategy



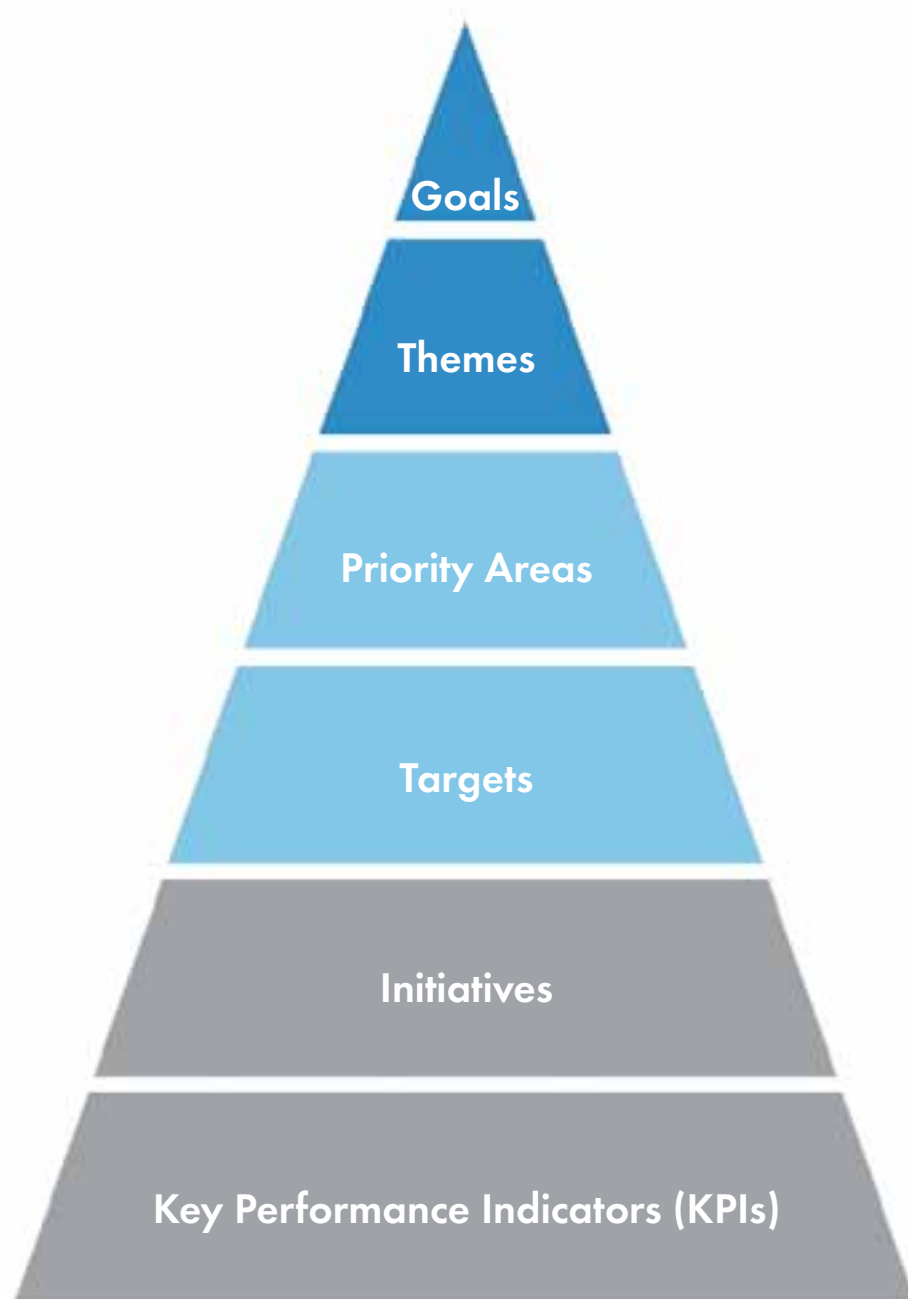
**Figure 2.** Steps in the strategic planning process outlined in the *Abu Dhabi Government Strategic Planning Handbook*, January 2007.

The process used to develop this strategy and action plan is consistent with recent guidelines on strategic planning presented in the *Abu Dhabi Government Strategic Planning Handbook*.

Figure 2 shows the strategic planning steps from that handbook. The process begins with the articulation of a vision, broad policy goals, and themes (illustrated in the top of the pyramid).

The handbook defines a goal as a description of “what the government aims to achieve in the long term.” A theme, as defined in the handbook, is a “high-level statement of the topics and focus areas the government will work on in order to reach its goals.”

The request for proposals that launched this planning initiative detailed the goals and themes that motivated this strategy and action plan. This request for proposals, entitled “National Strategy for Environment and Health, United Arab Emirates, Request for Proposals,” was written by EAD and WHO, and it formed the basis for the process used to develop this plan.



**Figure 3.** Illustration of the steps used in this strategic planning process.

The request for proposals outlined these overarching goals:

- Identify and prevent health threats caused by environmental factors.
- Reduce the burden of disease caused by these factors.
- Strengthen the capacity of the UAE government in this arena.

The request for proposals also outlined key themes intended to guide the strategy:

- Identify vital stakeholders, encourage strong partnerships, and promote communication and interaction among various agencies/organizations and de-

partments for the provision of adequate environment and health services.

- Expand the capacity of the UAE government to anticipate, recognize, and respond to environmental and health threats.
- Reduce the burden of disease caused by environmental factors in the UAE.
- Provide guidance through evidence-based information ... for improving decision making abilities of the UAE government in environment and health issues.
- Improve environment and health risk assessment and management systems within the UAE.

- Provide support for the environment and health services workforce by enhancing research and development, promoting development and training programs, and planning for the future.
- Raise awareness of environment and health issues at the policy, implementation, and general public levels and develop educational opportunities in the field of environment and health risk communication in the UAE.

Since the request for proposals identified the goals and themes, this report addresses the lower tiers of the pyramid in Figure 2: identifying priority areas, establishing targets, developing initiatives and strategies to achieve the targets, and identifying key performance indicators (KPIs) to measure progress toward each target.

This strategy and action plan deviates from the *Abu Dhabi Government Strategic Planning Handbook* only in time frame. The *Strategic Planning Handbook* separates targets into two groups: those that should be the focus for the next two years and those that should be the focus over five years. The request for proposals indicated that the time horizon for this planning effort is 10 years, and the planning team was later asked to extend that horizon to the year 2030. Thus, we identify priority areas and targets for 20 years (i.e., to be achieved by 2030).

Similarly, the request for proposals specified that the plan should focus on identifying initiatives (actions) that can be undertaken in the next four years. The request for proposals stated, "Keeping the [20-year] strategy as the basis, a comprehensive plan of action would be formulated with detailed activities to be undertaken in the next four years." Thus, although Figure 2 shows separate targets for two years and five years, this plan defines only one set of targets (for 20 years) and outlines initiatives that can be pursued during the next five years, consistent with the medium-term planning horizon of the *Abu Dhabi Government Strategic Planning Handbook*.

Figure 3 summarizes the elements of the process used to develop the priority areas, targets, initiatives, and KPIs presented in this document. Details on each of the steps are described in the next section. •

# Priority Areas

The Abu Dhabi Government Strategic Planning Handbook defines priority areas as follows: "Priority areas ... reflect the entity's areas of focus and thus frame target setting and strategy formulation."

The planning team used a systematic, multistep process to identify priority areas. The starting point was this list of 13 categories of environmental risks to public health, described by EAD and WHO in the request for proposals:

- Air (indoor and outdoor air pollution)
- Water resources and water quality
- Food safety and security
- Land pollution
- Waste management (solid, hazardous, and health care)
- Noise pollution
- Chemical safety
- Vector-borne disease (such as diseases carried by rodents)
- Climate change
- Electromagnetic fields
- Nonionizing radiation
- Depletion of the stratospheric ozone layer
- The built environment

The need for a separate focus on environmental hazards in occupational settings was also emphasized.

The request for proposals indicated that in setting priorities for the UAE national environmental health strategy, the research team should take an approach that included these four steps:

- Hazard identification
- Exposure assessment
- Dose-response assessment
- Risk characterization

This approach is consistent with the risk-assessment framework long recommended by the U.S. National Academy of Sciences. In the first step, hazard identification, analysts assess whether the proposed source of risk might cause adverse health effects. During the second step, exposure assessment, analysts consider the pathways by which people might become exposed to the risk factor of concern. The third step, dose-response assessment, involves esti-

imating the relationship between the dose of a contaminant to which an individual is exposed and the resulting health effects. In the final step, risk characterization, the risk analyst estimates the total amount of health hazard that might exist as a result of exposure to the specific environmental hazard.

The strategic planning team employed the first two steps of the risk-assessment process to reframe the 13 risk categories in the request for proposals. This reframing resulted in the elimination of two of the 13 risks from further consideration: vector-borne disease and nonionizing radiation.

During the hazard identification step, scientists supporting the planning team determined that evidence of health effects associated with vector-borne disease is lacking in the UAE population. Infectious disease information from the UAE indicates no evidence of diseases that would be expected if animal vectors were a sanitation concern. Therefore, the planning team did not include vector-borne illnesses in further development of the strategy.

Similarly, the planning team found no evidence other than radon to warrant inclusion of nonionizing radiation in the strategy and action plan. Data in the scientific literature indicate that background radiation levels across the UAE are lower than global averages. While risks of exposure to nonionizing radiation may exist from future accidents related to nuclear energy or nuclear materials processing in other countries in the region, this exposure route was not considered because it is more related to emergency response than to environmental health risk management.

During the exposure assessment step, scientists supporting the planning team reorganized the remaining items on the list of risk categories according to the possible routes of exposure to hazards. This reorganization was necessary for consistency with the risk assessment framework. The routes by which humans can become exposed to contaminants in the environment are by (1) breathing contaminated air; (2) drinking, inhaling, or coming into contact with

contaminated water; (3) eating or coming into contact with contaminated soil; (4) eating contaminated food; (5) hearing excess ambient noise; and (6) coming into contact with harmful forms of electromagnetic radiation.

Table 2 (page 8) organizes the risks listed by EAD and WHO in the request for proposals according to these major exposure routes (air, water, soil, food, noise, and electromagnetic radiation).

Table 2 also includes a separate category entitled "multiple exposure routes." This category includes occupational exposures and climate change. In occupational settings (for example, manufacturing facilities, petroleum refineries, and dry cleaning shops), workers may be exposed through multiple routes, including inhaling contaminated air and direct contact with hazardous chemicals. Climate change may affect exposures through all environmental media, due to climatic impacts on air, water, and soil quality.

The planning team used the 12 environmental hazards listed in the second column of Table 2 as the starting point for identifying priority areas in the National Environmental Health Strategy. The scientists supporting the team conducted preliminary risk assessments for all of these risk areas. The results of these preliminary risk assessments are documented in an appendix to the companion report on the state of the environment and public health in the UAE.

The planning team used a systematic process for setting priorities among the environmental hazards listed in Table 2. This process, known as the "deliberative method for ranking risks," is designed to overcome some of the limitations of comparative risk assessment that became evident during environmental health strategic planning and priority-setting projects carried out around the world during the 1980s and 1990s (Davies 1996). These limitations included a lack of systematic design, a lack of empirical validation, and inconsistency in results. In these previous comparative risk assessment projects, a list of priorities developed

**Table 2.** Framework for Categorizing Environmental Health Risks

Environmental-Hazard Exposure Routes	Environmental Hazards Evaluated for this Strategic Plan	Issues Specified in Request for Proposals
Air (breathing)	Outdoor air pollution	Outdoor air pollution
	Indoor air pollution in residential environments	Indoor air pollution
Water (drinking, bathing, inhaling droplets)	Drinking water contamination	Water
	Coastal water pollution	Water
Soil (dermal contact followed by ingestion)	Soil and associated groundwater pollution due to solid and hazardous waste disposal	Waste management
Food (eating)	Seafood contamination	Food
	Produce (fruits and vegetables) contamination	Food
Noise (hearing)	Ambient noise above healthful levels	Noise pollution
Electromagnetic radiation (contacting in ambient environment)	Ultraviolet radiation above natural levels as a result of stratospheric ozone depletion	Stratospheric ozone depletion
	Electromagnetic fields from power lines	Electromagnetic fields
Multiple exposure routes	Hazardous substances in occupational environments (in industry, construction, and agriculture)	Chemical safety
	Global climate change	Global climate change

by one group of people could be completely different from a list of priorities developed by a separate but similar group of people. The planning team sought to select a process to identify the UAE's environmental health priorities that would be robust across groups of stakeholders. That is, different groups composed of roughly similar kinds of stakeholders should reach the same conclusions about which risks are the highest priorities for the UAE. The deliberative method for ranking risks has been proven in numerous large studies to yield consistent results across groups (Morgan et al. 2001). Further, high levels of stakeholder satisfaction with the results have been observed in empirical studies, and the method has now been employed in several countries around the world (Morgan et al. 2001).

The deliberative method for ranking risks combines quantitative risk assessment information for each environmental risk factor with a process that involves stakeholders in environmental health, both individually and in groups, to set priorities among the environmental health risks based on the risk information provided. Essentially, the process involves voting on priorities. Indi-

viduals vote on priorities based on written information about each risk. The written information about each risk follows a standard four-page format that includes summary information on the magnitude and severity of the risk (such as annual fatalities expected due to the risk in a single year), the level of scientific understanding of the risk, and an individual's ability to control exposure to the environmental hazard. The format of these risk summary sheets was extensively tested in experimental studies by the developers of the analytic-deliberative method and was demonstrated to provide a means for promoting common understanding of risk information among experts and nonexperts (Florig et al. 2001).

After individual participants read the risk summary sheets and cast their votes on which risks should be ranked highest, they form groups (ideally of eight to 10 people) to discuss the risks and develop a group ranking. Finally, individuals reconsider their initial votes based on the group discussion.

The planning team, in cooperation with many stakeholders in environmental health from across the UAE, carried out this analytic-deliberative process for prioritizing

the 12 risk categories in Table 2 (environmental hazards evaluated). For each risk category, the team's scientists prepared risk summary sheets, which are contained in an appendix to the companion report on the state of the environment and public health in the UAE. Then, the planning team held a series of stakeholder workshops in the UAE to rank the risks using the analytic-deliberative process. Altogether, 73 individuals participated in these workshops. Appendix A lists the participants. Participants included representatives of the UAE federal government as well as emirate agencies concerned with the environment and public health. Also present were representatives of private-sector organizations (including the petroleum industry), nongovernment organizations (including environmental advocacy groups), and educational institutions. Participants included citizens of Abu Dhabi, Dubai, Sharjah, Fujairah, and Ajman emirates. A complete description of the workshops and results is provided in the companion report on the state of the environment and public health in the UAE.

Figure 4 shows the average final rankings of the risks considered by the involved

stakeholders. Note that for the purposes of this risk-ranking exercise, occupational exposures were separated into three categories: industrial, construction-related, and agricultural. Thus, Figure 4 lists a total of 14 risk areas.

The blue diamonds in Figure 4 show the average of the rankings submitted by the 56 workshop participants who submitted final rankings. (Because some individuals were unable to participate in the entire eight-hour workshop and the recorded rankings of others erroneously omitted some risks, this analysis could not be conducted on rankings from 17 of the 73 participants.) The horizontal bars show the 25th to 75th percentiles of these rankings. Each bar's width provides an indication of the level of agreement or disagreement among the workshop participants, with shorter bars indicating greater agreement and longer bars signifying disagreement. For example, the very short bar associated with outdoor air pollution indicates remarkable consensus among workshop participants that outdoor air pollution was the highest environmental health priority from among the hazards considered. In contrast, the long bar associated with drinking water indicates a lack of consensus on this topic. Twenty-five percent

of workshop participants ranked drinking water contamination among the top priority risks, even though, on average, it was ranked ninth in the list of 14 hazards. Also, 25% of participants ranked drinking water contamination as 12th in importance or lower, as can be seen from the 75th percentile value illustrated in Figure 4.

Figure 4 shows that, according to these rankings, strong consensus exists that the highest priority environmental health risks in the UAE are (1) outdoor air pollution; (2) indoor air pollution; and (3) occupational exposures in industry, construction, and agriculture. The final rankings produced by groups involved in these workshops supported these results.

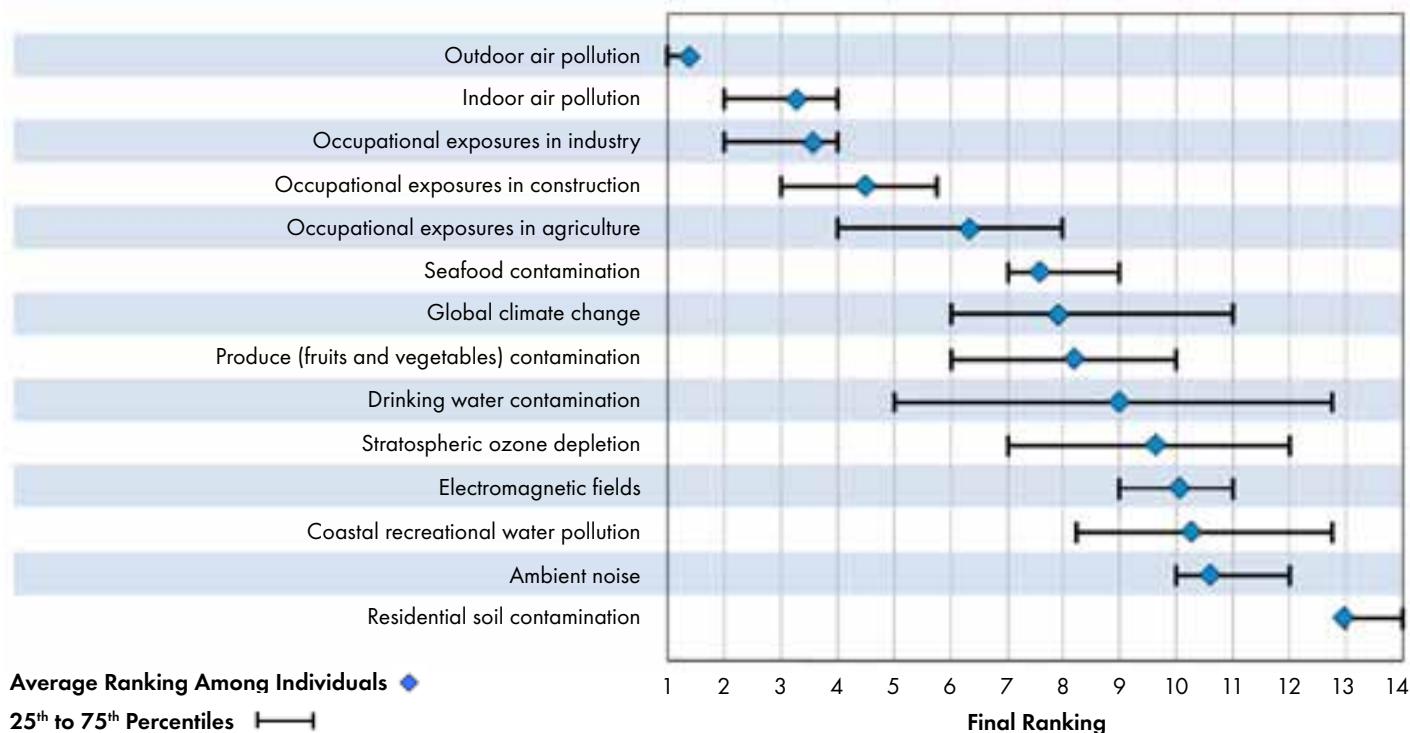
Upon discussion of the results from the workshops with EAD and WHO, the planning team retained on the list of priorities the following five environmental hazards, even though these were not identified as among the highest priorities in the priority-setting workshops: (1) climate change, (2) drinking water pollution, (3) coastal water pollution, (4) soil and groundwater pollution (from solid and hazardous wastes), and (5) contamination of food (fruits, vegetables, and seafood). The planning team decided that although not the highest environmental

health priorities for the UAE, these environmental health areas could become increasingly important if development in the UAE continues at its current, rapid pace.

The remainder of this document focuses on actions that can be used to reduce public health risks due to the eight priority areas identified during the stakeholder workshops and in further discussions among members of the planning team. In summary, these eight priority areas are (1) outdoor air pollution; (2) indoor air pollution; (3) occupational exposures in industry, construction, and agriculture; (4) climate change; (5) drinking water contamination; (6) coastal water pollution; (7) soil and groundwater pollution due to solid and hazardous waste; and (8) contamination of produce and seafood with environmental pollutants.

For simplicity and clarity in this document, the sections covering each of these priority areas in detail are titled as follows:

1. Outdoor Air
2. Indoor Air
3. Occupational Exposures
4. Climate Change
5. Drinking Water
6. Coastal Water
7. Soil and Groundwater
8. Produce and Seafood •



**Figure 4.** Final rankings of 14 environmental health hazards by 56 stakeholders in environmental health in the UAE.



# Targets

The Abu Dhabi Government Strategic Planning Handbook indicates that the purpose of defining targets is to “reflect what the strategy is ultimately planning to achieve ... based on the identified priority areas. It communicates the desired outcomes and thus sets the stage for and orients strategy formulation.”

The planning team set broad targets for environmental health improvement based on common themes that emerged in analyzing options for managing risks in each of the eight priority areas.

Regardless of the priority area, protecting public health from environmental risks will require reductions in levels of pollutants in the environment and/or reduced exposures of humans to those pollutants. In addition, for all of the priority areas, improved data on and scientific understanding of pollutant levels, exposures, and health effects are needed to make informed decisions. The UAE also needs to build its human and institutional capacity to address each of the

priority areas. Further, any effort to reduce environmental risks to public health must consider the effects of continued urban development on the quality of the environment and on human health. In fact, environmental risks to public health in the UAE are driven to a great extent by the pace and type of development occurring in the country, especially in its urban areas. Finally, improved environmental awareness among the public is an essential target, since many initiatives that might be pursued to decrease environmental risks to public health require both public participation and a public mandate.

Based on these themes, the planning team identified the six targets seen in Figure 5, applicable in general to each priority area. The priority areas and targets can be thought of as representing a two-dimensional matrix (Table 3) for organizing initiatives to improve environmental health. The initiatives that can be pursued to achieve the targets for each priority area fill in the cells of the matrix. •

## Target 1

Reduce pollutant levels and human exposures to pollutants

## Target 2

Improve data quantity and availability

## Target 3

Improve scientific understanding of environmental health risks

## Target 4

Build sustainable human and institutional capacity

## Target 5

Support urban development that promotes environmental health

## Target 6

Improve environmental awareness

**Figure 5.** The six broad targets of this strategy and action plan.

**Table 3.** Organization of Initiatives and KPIs into Priority Areas and Targets for This Strategy and Action Plan

	Priority Areas							
	Outdoor Air	Indoor Air	Occupational Exposures	Climate Change	Drinking Water	Coastal Water	Soil and Groundwater	Produce and Seafood
	Number of Initiatives ( Number of KPIs )							
<b>Target 1</b> Reduce pollutant levels and human exposures to pollutants	<b>16</b> ( 22 )	<b>9</b> ( 5 )	<b>19</b> ( 15 )	<b>26</b> ( 5 )	<b>11</b> ( 10 )	<b>5</b> ( 6 )	<b>6</b> ( 7 )	<b>4</b> ( 6 )
<b>Target 2</b> Improve data quantity and availability	<b>9</b> ( 7 )	<b>5</b> ( 6 )	<b>8</b> ( 7 )	<b>5</b> ( 1 )	<b>3</b> ( 3 )	<b>2</b> ( 2 )	<b>2</b> ( 3 )	<b>3</b> ( 3 )
<b>Target 3</b> Improve scientific understanding of environmental health risks	<b>3</b> ( 2 )	<b>4</b> ( none )	<b>1</b> ( 1 )	<b>7</b> ( 1 )	<b>1</b> ( none )	<b>2</b> ( 3 )	<b>1</b> ( 1 )	<b>0</b> ( none )
<b>Target 4</b> Build sustainable human and institutional capacity	<b>3</b> ( 4 )	<b>3</b> ( 4 )	<b>11</b> ( 9 )	<b>3</b> ( 3 )	<b>1</b> ( 1 )	<b>1</b> ( 3 )	<b>4</b> ( 2 )	<b>5</b> ( 7 )
<b>Target 5</b> Support urban development that promotes environmental health	<b>3</b> ( 4 )	<b>2</b> ( 1 )	<b>0</b> ( none )	<b>1</b> ( 2 )	<b>1</b> ( 1 )	<b>1</b> ( 1 )	<b>3</b> ( 1 )	<b>1</b> ( 1 )
<b>Target 6</b> Improve environmental awareness	<b>2</b> ( 2 )	<b>3</b> ( 4 )	<b>4</b> ( 2 )	<b>3</b> ( 4 )	<b>2</b> ( 1 )	<b>1</b> ( 1 )	<b>5</b> ( 3 )	<b>3</b> ( 2 )

# Initiatives

“Initiatives show how an entity will attain the previously defined ... targets in a concrete and specific way,” according to the *Abu Dhabi Government Strategic Planning Handbook*. The planning team worked with stakeholders in the UAE to identify initiatives for each priority area and each target.

First, scientific experts supporting the team drafted lists of potential initiatives in each priority area to meet each target, based on their own expertise, their experiences in environmental health protection around the world, reviews of relevant published literature, and written documentation on current environmental health practices in the UAE. Then, the planning team held workshops with a variety of environmental health stakeholders in the UAE. Appendix A lists participants in these workshops, held in January, April, and June 2009 in Abu Dhabi and Dubai. Stakeholders were divided into groups according to the eight priority areas. Each group reviewed and discussed the proposed initiatives. The groups then modified the initiatives to reflect each group’s consensus. The groups also, in most cases, developed suggested timelines for each initiative.

The remaining sections of this strategy and action plan describe in detail the recommended initiatives for each priority area and each target. Each section presents the recommended initiatives in the format of a chart that presents the suggested timing for each activity based on the estimates of planning-workshop participants and team scientists. (See Table 3, page 10, for the number of initiatives per target for each priority area.) Additional analysis is needed to assess the feasibility of completing the recommended initiatives in the suggested time frames.

The specific initiatives recommended differ for each priority area, but common themes emerged for the different targets, as described below.

**Reduce pollutant levels and exposure to pollutants.** Two common themes across priority areas are the need to review exist-

ing pollution control regulations to identify pollutant discharges or exposure routes that currently are not adequately controlled and the need for improved enforcement of existing regulations. Also important is the need for greater standardization of regulations across emirates.

**Improve data quantity and availability.** While the UAE has made substantial strides in collecting and organizing data through initiatives such as the Abu Dhabi Global Environmental Data Initiative, participants in the strategic planning process identified a number of additional needs related to collection and organization of data. These include the need to increase the number of environmental monitoring stations and to progressively centralize relevant databases (including developing linkages between government and private-sector data sets and linkages among databases compiled by different government entities). Increased compliance with existing data reporting requirements also emerged as a general need.

**Improve scientific understanding of environmental health risks.** Broad consensus emerged among those involved in the strategic planning process that a substantial increase is needed in the UAE’s commitment to research aimed at understanding environmental health risks in the UAE. Key topics for additional research include development of improved environmental models, epidemiologic studies of environmental health risks unique to the UAE, studies of exposure pathways and health threats associated with specific environmental factors (such as hazardous waste and desalinated water), new environmental-control and waste-reduction technologies, and cost-benefit analysis of alternative policy options.

**Build sustainable human and institutional capacity.** Across priority areas, it is clear that additional human resource capacity is needed in the UAE to address the broad array of environmental problems addressed in this strategy. Capacity-building

recommendations address people, infrastructure, and systems and include:

- Establishing additional graduate-level training programs in the UAE (especially PhD-level programs in fields related to environmental health)
- Increasing the number of graduate students trained in programs in the UAE in disciplinary areas relevant to environmental health
- Creating additional opportunities for employees of UAE environment and health agencies to pursue graduate training at universities abroad
- Creating career paths for those with such training or certification (for example, government positions requiring such qualifications)
- Developing additional in-service training opportunities
- Expanding laboratory capacity for analyzing environmental health data
- Creating additional research groups within existing agencies focused on specific environmental health priorities
- Increasing communication and information flows across emirates and between organizations/agencies within emirates

**Support urban development that promotes environmental health.** Urban development that promotes environmental health is a theme that tracks through nearly all of the priority environmental risk areas. In general, improved processes are needed to account for and reduce potential environmental impacts of new industrial, commercial, and residential developments.

**Improve environmental awareness.** The initiatives in the subsequent sections identify steps to improve public awareness of environmental health risks, including information campaigns (such as consumer product labeling); public alert systems (such as warning systems for beach closures and for periods during which air pollutant levels are high); and education programs for at-risk populations such as pregnant women, families with children, and workers exposed to hazards in their places of employment. •





# Key Performance Indicators (KPIs)

“Key performance indicators (KPIs) are needed to measure how much an entity is progressing (or not progressing) towards its objective, rather than ‘why’ such progress is or is not being made,” according to the *Abu Dhabi Government Strategic Planning Handbook*.

The KPI charts in this document list a wide variety of measures the UAE can use to track progress in reducing the burden of disease due to environmental health risks. The process for developing KPIs for each priority area was similar to that used to develop recommended initiatives.

Science experts supporting the planning team drafted lists of possible KPIs based on their previous experience, a review of literature on KPIs, and a review

of selected existing strategic plans in the UAE. Then, the planning team convened workshops of stakeholders in environmental health to review these KPIs and modify them as needed.

In some cases, the stakeholder groups identified five-year and 20-year goals for the KPIs. These values are not based on quantitative analysis and need to be revisited as implementation of the strategy and action plan proceeds. Additional analysis is needed to determine the feasibility of achieving the specified goals. Baseline values for these goals need to be established so that progress can be measured against existing conditions.

Many of the short- and long-term goals for the KPIs are labeled “To be determined.”

The strategic planning team lacked sufficient information to quantify these goals. The UAE should take steps in the near future to develop baseline estimates of the nation’s current status in meeting these goals and should then set achievable objectives for making progress along these indicators.

A number of the KPIs listed in this document are also included in other strategic planning documents in the UAE. While these KPIs may be included in other planning documents, it is important to include them in tracking of progress toward reducing the environmental burden of disease.

See Table 3 on page 10 for the exact number of KPIs recommended for each of the six targets within each of the eight priority areas. •

## Organization of This Document

The next eight sections provide details on initiatives and KPIs that can be used to improve environmental health in the UAE in each of the eight priority areas, for each of six targets.

Each section is organized into five main parts:

- **Problem Overview**, which provides an overview of the priority area and the potential public health impacts
- **Main Achievements and Successes**, which describes the UAE’s primary accomplishments thus far in reducing public health risks for the priority area
- **Main Unresolved Issues**, which outlines issues that should be addressed to make further improvements to public health
- **Recommendations**, which provides general steps to be taken toward meeting each of the targets applicable to the priority area
- **Initiatives and KPIs**, which list detailed information about specific initiatives (actions) for the next five years to improve environmental health and KPIs to measure progress toward achieving the targets for the priority areas

The concluding section of the document describes additional steps needed for successful implementation of this strategy and for making substantial further improvements in environmental health. It includes a final set of overarching initiatives and KPIs that can be used to combine all the common threads of this strategy. •

### A Note on Numbering

Initiatives and KPIs are identified via a three-part numbering scheme:

<b>EH-#</b>	Priority Area
<b>T-#</b>	Target
<b>I-# or K-#</b>	Item Number

These codes are combined to construct a unique identification number for each KPI or initiative.

“EH” stands for “Environmental Health,” which identifies this document. “T” stands for “Target,” “I” for “Initiative,” and “K” for “KPI.”

For example, the first KPI for the first target in the first priority area is numbered EH-1 / T-1 / K-1.

# Outdoor Air

## Problem Overview

Poor air quality is apparent in the UAE, as can be seen from ambient measurements and degraded visibility.

This poor air quality is a significant concern because air pollutants have been demonstrated, mainly in the United States and Europe, to cause many impairments to human health, including premature death and respiratory diseases such as asthma and chronic obstructive pulmonary disease.

Specifically, exposures to particulate matter (PM), ozone, and toxic compounds in the air are of major concern for the health of the population in the UAE. As an example, PM measured in Abu Dhabi exceeded the emirate's standard on about one-third of the days at each location where air quality was monitored during 2007.

PM is composed of many different types of particles, which differ in size, chemical composition, and origin. PM is typically classified according to the size of the particles:  $PM_{10}$  represents particles with diameters smaller than 10  $\mu m$ , while  $PM_{2.5}$  represents particles with diameters smaller than 2.5  $\mu m$ . Because of the arid climate in the UAE, a significant fraction of  $PM_{10}$  can be attributable to natural dust emissions. The highest measurements of  $PM_{10}$  concentration coincide with periodic dust storms.  $PM_{2.5}$  is potentially of greater concern for human health because smaller particles can penetrate more deeply into the lungs and thus cause more extensive damage.  $PM_{2.5}$  most commonly results from anthropogenic emissions.

To date, no data exist in the UAE to enable estimates of the fraction of  $PM_{10}$  that is  $PM_{2.5}$ . Similarly lacking are data on the chemical composition of the particles. Such analyses would more clearly indicate the fraction of natural origin (dust or sea salt) and of anthropogenic origin (such as that generated by transportation and industrial activities).

Ozone is a pollutant of particular concern for human health, and it may affect health even at concentrations well below the regulatory standard. Ozone concentrations might be expected to be high in the UAE due to its climate and significant emissions of ozone precursors. These precursors include emissions of volatile organic compounds (VOCs) and nitrogen oxides ( $NO_x$ ) from the petroleum industry, transportation, and power plants. Global-scale modeling predicts high ozone concentrations over the Arabian Gulf with significant transport of ozone from Europe and from elsewhere in the Middle East (Li et al. 2001; Liu et al. 2009; Lelieveld et al. 2008; Duncan et al. 2008; Reid et al. 2005). In addition, high ozone concentrations are observed in satellites, suggesting that ozone concentrations may be high above the surface (Liu et al. 2009; Duncan et al. 2008; Reid et al. 2005). Concentrations of ozone and of other gaseous compounds ( $SO_2$ ,  $NO_2$ ) measured routinely in Abu Dhabi emirate, however, do not exceed the emirate standard. This may be an artifact of measurement procedures, including the location of monitors.

Ozone may be suppressed at urban measurement stations by reaction with fresh emissions of nitrogen oxides from automobiles. If this hypothesis is correct, ozone may be significantly higher in other locations or may grow rapidly if emissions increase in the future.

Toxic compounds in air (such as benzene, toluene, ethylbenzene, and xylenes) are also a concern for human health, given that the petroleum industry has facilities near large populations in Abu Dhabi and Dubai.

Few measurements of the concentrations of toxic compounds in the air are available, including only select aromatic compounds at a few measurement stations. This makes the extent of health effects due to toxic compounds difficult to determine. •

## Main Achievements and Successes

Within the UAE, air quality management is growing and maturing through a tapestry of UAE-wide and emirate-specific policies and regulations. Several emirates have succeeded in establishing surface monitoring programs for routine measurement of air quality. Individual emirates have either adopted their own air quality standards or are using the standards established by the UAE government.

The federal government also has made strides in regulating air pollutant emissions from large industries by requiring environmental impact assessments and permits for new projects and environmental inspections for existing facilities. Federal laws set standards for emissions of air pollutants from industries and vehicles. In many cases, these federal laws are implemented by individual emirates, which may have their own regula-

tions. It is unclear how stringently the federal laws are enforced.

As a major source of industrial pollutants, the Abu Dhabi National Oil Company (ADNOC) has initiated projects to monitor and curb its emissions through projects to reduce flaring and improve operational efficiency. ADNOC's projects have become a model for other UAE oil and gas industries. The emirate of Abu Dhabi likewise has implemented policies to promote compressed natural gas as a fuel for transportation and to reduce the sulfur in diesel to 10 ppm by 2015. Abu Dhabi also is considering laws that would require imported vehicles to have catalytic converters.

Finally, because natural dust storms are an important problem, early warning systems have been established to alert the public. •

## Main Unresolved and Emerging Issues

While the federal government and individual emirates have made strides to understand, regulate, and control air pollutant emissions, important knowledge and regulatory gaps remain. Air pollutants are regularly transported across national and emirate boundaries, requiring a comprehensive regional analysis. Air quality measurements in individual emirates, however, have not been compiled to provide a more comprehensive picture of air quality in the UAE, nor is there a comprehensive plan to organize and improve air quality measurements throughout the nation.

The relative contribution of various sources to air pollution in the UAE has not been resolved because a detailed and comprehensive inventory of all pollutant

emissions (known as an emissions inventory) to outdoor air is lacking. Creating a comprehensive inventory is a large task requiring detailed reporting and accounting of every air-pollution source in the UAE. This inventory can then be incorporated into a regulatory air quality model that can be used to test the inventory against ambient measurements, to improve understanding of the sources and transport of pollutants, and to evaluate proposed emission control actions.

In addition, the nature and sources of PM remain uncertain. The Abu Dhabi Air and Climate Institute (ADACI) has begun to measure PM<sub>2.5</sub> routinely at three monitoring stations. PM<sub>2.5</sub> measurements will help resolve the question of what fraction of PM is

fine and what fraction is coarse, providing important information on the likely sources of the particles (coarse particles are likely composed primarily of dust). The measurements also will provide a basis for future PM<sub>2.5</sub> standards. Chemical-composition analysis of particles will more clearly identify their sources.

Finally, clear assessments are needed to determine how effectively existing laws are being implemented in each emirate. These assessments should address the procedures through which outdoor air standards and emissions standards (such as for industrial facilities or motor vehicles) are determined, revised, applied, and enforced. These are crucial steps for improving air quality in the future. •

## Recommendations

The UAE can pursue a variety of opportunities to improve outdoor air quality, which is perhaps the most important contributor to the environmental burden of disease in the UAE. To reduce the potential for related health risks, the UAE should:

### **Reduce pollutant levels and human exposure to pollutants.**

Air quality standards in the UAE should be periodically reviewed and revised, and responsible agencies should develop expertise and processes for establishing and updating standards. The UAE should likewise consider adopting uniform air quality standards, rather than separate standards and processes in individual emirates. Responsible agencies need to develop procedures for declaring violations of outdoor air standards and plans for enforcement of the standards. In particular, new standards for  $PM_{2.5}$  are needed because  $PM_{2.5}$  is important for human health and is typically dominated by anthropogenic emissions. ADACI recently began measuring  $PM_{2.5}$ . Decisions concerning a new standard should be informed by a thorough analysis of at least one year of  $PM_{2.5}$  measurements.

Similarly, emissions standards are needed for industry and motor vehicles, including procedures and criteria for setting, revising, implementing, and enforcing them. The process for issuing environmental permits and auditing for compliance should likewise be reviewed for its overall effectiveness and improved in all emirates. Industrial emissions can be controlled through (1) adopting best practices in all industries, including the elimination of flaring; (2) improving the efficiency of and emission controls for power generation and desalination; (3) increasingly adopting alternative sources of electricity, including renewable sources; and (4) evaluating the use of nuclear power.

**Improve data quantity and availability.** An emissions inventory is a critical element of air quality management. ADACI is working to improve available information to support the development of an emissions database. This work should aim to produce a comprehensive inventory of all relevant air emissions ( $NO_x$ , VOCs,  $CO$ ,  $SO_2$ ,  $PM_{10}$ ,  $PM_{2.5}$ , etc.) for all emirates every three years and for all relevant source categories (mobile, point, area, and biogenic). It is important to follow international standards for emissions inventories and for relevant government institutions to develop infrastructure for managing, updating, and disseminating large amounts of data to the public. Industrial emissions are an important source of uncertainty in assessing options to improve air quality. Improving self-reporting of emissions by large industries, particularly petroleum, is critical. Industry should expand the continuous monitoring of emissions and make emissions data readily available to responsible government agencies. Industry should also consider VOC leak-detection technologies that can be employed on a large scale.

**Improve scientific understanding of environmental health risks.** Incomplete understanding of air pollution limits the ability to quantify the efficacy of policy actions toward controlling outdoor air pollution. Therefore, as it moves forward to improve air quality, the UAE should emphasize actions to improve emissions inventories, ambient measurements of air quality and meteorological parameters, and air quality modeling tools, which together will improve knowledge infrastructure, permit identification of key problems, and support implementation of effective regulations.

**Build sustainable human and institutional capacity.** Existing outdoor-air monitoring networks should be expanded and improved based on the recent findings discussed above and the UNC review of UAE air quality monitoring programs to be completed in 2010. Some specific recommendations include (1) improving standards and training in quality assurance practices for operation of air monitoring stations; (2) increasing the monitoring of  $PM_{2.5}$  at selected monitoring stations; (3) conducting measurements of the chemical speciation of  $PM_{2.5}$  and  $PM_{10}$ , as ADACI is planning; (4) encouraging coordination among air monitoring activities in all emirates; and (5) expanding the monitoring of air toxics, especially those emitted by petroleum industries.

Air quality modeling tools should be improved to support regulatory decisions, as recommended in the findings of the UNC project, forthcoming in 2010.

**Support urban development that promotes environmental health.** It is clear that cars and trucks are an important and growing source of emissions in urban areas such as Abu Dhabi and Dubai. Traffic in these urban areas is a critical problem on its own, in addition to causing air pollutant emissions. Land-use and transportation planning to reduce traffic should be encouraged. The development of mass transit facilities, including the urban rail system being constructed in Dubai, will reduce motor vehicle traffic, as will subsidies for public transportation or other economic instruments such as raising gasoline prices or instituting congestion pricing in city centers.

Laws should be established to require that imported vehicles include strict emission-control technologies, such as to match European or U.S. standards. Inspection of existing vehicles can be a cost-effective means to identify highly polluting vehicles and require that they be repaired to remain in service. Efforts to reduce sulfur in fuel and to increase the percentage of vehicles fueled by compressed natural gas are beneficial.

**Improve environmental awareness.** The UAE should strengthen efforts to improve public awareness of health risks associated with air pollution, including the improvement of existing alert systems for high air pollution episodes such as those caused by dust storms or temperature inversions. Such efforts should make clear how the public can avoid or reduce exposure and when such actions would be desirable. •

### Section Overview

# of Initiatives	# of KPIs	
<b>36</b>	<b>41</b>	<b>TOTAL</b>
16	22	Target 1
9	7	Target 2
3	2	Target 3
3	4	Target 4
3	4	Target 5
2	2	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative.

They may include nonspecific entities as well as these specific entities:

ADNOC	Abu Dhabi National Oil Company	MOEcon	Ministry of Economy
ADPD	Abu Dhabi Police Department	MOEW	Ministry of Environment and Water
ADWEA	Abu Dhabi Water and Electricity Authority	MOH	Ministry of Health
DOT	Abu Dhabi Department of Transport	MOI	Ministry of Interior
EAD	Environment Agency—Abu Dhabi	MOJ	Ministry of Justice
Etidama	Etidama Initiative (Abu Dhabi)	NTA	National Transport Authority
HAAD	Health Authority—Abu Dhabi	UPC	Urban Planning Council (Abu Dhabi)

## Outdoor Air (EH-1):

### Initiatives to Reduce the Burden of Disease Due to Outdoor Air Pollution

Initiatives specific to Abu Dhabi are marked with an asterisk.

#### Target 1: Reduce pollutant levels and human exposure to pollutants

#### Stakeholders

##### EH-1 / T-1 / I-1

Assign responsible parties across emirates to a working group for ensuring International Organization for Standardization (ISO) 14001 standard for environmental management systems.

2010

?

MOEW

##### EH-1 / T-1 / I-2

Issue policy directives on criteria to be used for updating and setting concentration limits for outdoor air pollutants. The directive should apply to all emirates.

2010

?

MOEW

##### EH-1 / T-1 / I-3

Update the process for setting sector-specific emissions standards, such as for motor vehicles and major industries, and update the standards according to this process on a periodic basis.

2010

?

Appropriate emirate agencies

MOEW

##### EH-1 / T-1 / I-4

Establish system for determining the air quality attainment status of each emirate and sets of activities that the emirates must put in place when one or more outdoor air quality standards is violated.

- Develop the legal framework to permit governments to carry out actions to analyze and achieve compliance.
- Develop protocols for assessing compliance status.
- Consider use of permitting as an inducement to obtain compliance, with industrial permits denied if emirate is not making progress toward compliance.

2010

?

Appropriate emirate agencies

MOEW

##### EH-1 / T-1 / I-5

Continually update Executive Bylaw 12/2006 to Federal Law 24 of 1999 to develop and achieve appropriate air quality standards.

2010

?

MOEW

##### EH-1 / T-1 / I-6

Develop legal framework to set PM<sub>2.5</sub> standards. Establish and enforce daily and yearly standards.

2010

?

MOEW

**EH-1 / T-1 / I-7**

Develop protocols for estimating costs and benefits of new outdoor air quality regulations, using appropriate outdoor air quality model as an input.

2010	2011	2012	2013	2014	MOEcon
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**EH-1 / T-1 / I-8**

Review adequacy of current reporting and auditing procedures for emissions from stationary sources. Require or enforce requirement of audit and inspection to renew permit to operate.

2010	?	Appropriate emirate agencies	MOEW
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**EH-1 / T-1 / I-9**

Develop best practices manuals for control of air emissions from all sources.

2010	?	Appropriate emirate agencies	MOEW
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**EH-1 / T-1 / I-10**

Establish through permitting program a mandate to detect, control, and repair fugitive emissions of VOCs and oil from industrial facilities, storage tanks, pipelines, and barges. This task includes establishing methods and mandatory reporting procedures.

2010	2011	2012	2013	2014	Appropriate emirate agencies	MOEW
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**EH-1 / T-1 / I-11**

Introduce regulations and efficiency initiatives to reduce power sector emissions. Review retirement or replacement of current power plants.

2010	?	Appropriate emirate agencies	MOEW	ADWEA
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**EH-1 / T-1 / I-12**

Work with oil and gas sector to reduce flaring caused by shutdowns in the petroleum sector.

2010	2011	2012	2013	2014	Representatives from oil and gas industries in every emirate
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**EH-1 / T-1 / I-13**

Update standards for emissions of NO<sub>x</sub> and other pollutants from all motor vehicles.

2010	2011	2012	2013	2014	Appropriate emirate agencies	MOEW
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**EH-1 / T-1 / I-14**

Improve motor vehicle inspection and maintenance programs to require emission testing of hydrocarbons, nitrogen oxides, and carbon monoxide; establish remote roadside testing program.

2010	?	Appropriate emirate agencies	MOI
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**EH-1 / T-1 / I-15**

Develop policies to reduce emissions from aviation and ships at UAE ports.

2010	?	Unknown for federal and other emirates	DOT
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**EH-1 / T-1 / I-16 \***

Increase the cost of driving and freight by road through demand management systems and methods.

2010	?	DOT	NTA
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**Target 2: Improve data quantity and availability****Stakeholders****EH-1 / T-2 / I-1**

Continue process of developing monitoring protocols and data entry/storage/output systems for linking outdoor air quality monitors throughout UAE into centralized database.

2010	2011	2012	2013	2014	Appropriate emirate agencies	MOEW
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HAAD	Health Authority–Abu Dhabi	UPC	Urban Planning Council (Abu Dhabi)

### EH-1 / T-2 / I-2

Mandate submissions of cardiopulmonary and respiratory disease cases (including cancers) and deaths by all medical facilities. Standardize reporting procedures, format, and frequency.



### EH-1 / T-2 / I-3

Ensure data availability and accessibility for all emirates.



### EH-1 / T-2 / I-4

Establish a national methodology for developing emissions inventories. The development of the emissions inventory and repository of data should take place at the emirate level.



### EH-1 / T-2 / I-5

Standardize and increase self-reporting and public disclosure of emissions by large industries.



### EH-1 / T-2 / I-6

Continue to improve outdoor air quality monitoring stations.



### EH-1 / T-2 / I-7\*

Install additional PM<sub>2.5</sub> monitors to determine baseline and track ambient concentrations.



### EH-1 / T-2 / I-8\*

Establish plan for monitoring carbon monoxide levels in road and metro tunnels (including future underground roadways). Install continuous monitors. Develop emergency management plan.











### EH-1 / T-2 / I-9\*

Quantify benefit of possible increased use of compressed natural gas vehicles.



\*Specific to Abu Dhabi

Target 3: Improve scientific understanding of environmental health risks		Stakeholders
<b>EH-1 / T-3 / I-1</b> Build UAE capacity to produce air quality model inputs and predictions. 		To be determined
<b>EH-1 / T-3 / I-2</b> Design and conduct field campaigns and advanced studies to answer relevant questions about health and outdoor air. 		Appropriate emirate agencies MOEW
<b>EH-1 / T-3 / I-3</b> Enhance research capability in all scientific fields, including air quality. 		To be determined
Target 4: Build sustainable human and institutional capacity		Stakeholders
<b>EH-1 / T-4 / I-1</b> Develop national capacity in outdoor air quality by providing environment and health agency employees with educational opportunities and training in the atmospheric sciences through internships or university programs. 		Appropriate emirate agencies MOEW
<b>EH-1 / T-4 / I-2</b> Create an infrastructure and organization to oversee updating and dissemination of the emissions inventory every three years. 		To be determined
<b>EH-1 / T-4 / I-3</b> Establish procedures for enforcement of violations of outdoor air quality standards 		Appropriate emirate agencies MOEW MOJ
Target 5: Support urban development that promotes environmental health		Stakeholders
<b>EH-1 / T-5 / I-1</b> Take measures to increase the availability and convenience of public transit. 		Appropriate emirate agencies DOT NTA
<b>EH-1 / T-5 / I-2*</b> Establish energy efficient building and product standards to reduce power demands. 		UPC Estidama
<b>EH-1 / T-5 / I-3*</b> Support Masdar Initiative to help demonstrate viability of wind and solar power, hydrogen fuel cells, and carbon capture and sequestration technologies. Issue regular progress reports on the status of Masdar and these technologies. 		ADNOC EAD DOT
Target 6: Increase environmental awareness		Stakeholders
<b>EH-1 / T-6 / I-1</b> Conduct public information campaigns about the risks of outdoor air pollution, and conduct surveys to gauge awareness and gaps in knowledge surrounding air quality risks. 		Appropriate emirate agencies MOEW



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### EH-1 / T-6 / I-2\*

Develop an outdoor air quality index and a Web site, newsletters, and e-mail lists of sensitive individuals for advance notification of high-pollution days.



\*Specific to Abu Dhabi

## Outdoor Air (EH-1): Key Performance Indicators

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 1: Reduce pollutant levels and human exposure to pollutants</b>			
EH-1 / T-1 / K-1	Incidence of acute respiratory infections in children under five years of age	To be determined	To be determined
EH-1 / T-1 / K-2	Mortality rates due to respiratory disease (asthma, acute respiratory infections, chronic obstructive pulmonary disease): 1. Total mortality 2. Total respiratory disease mortality 3. Cause-specific mortality, all ages 4. Total respiratory disease mortality in children younger than 5 5. Total respiratory disease mortality in elderly adults	To be determined	To be determined
EH-1 / T-1 / K-3	Percentage of UAE-wide Environmental, Health and Safety Management System (EHSMS) that is fully operational (to include outdoor air emissions data and health data)	100%	100% operational and available
EH-1 / T-1 / K-4	Percentage of time that each of the following pollutants is found at levels that exceed standards (given that rules may allow for a number of hours/days that exceed standards): NO <sub>2</sub> , SO <sub>2</sub> , O <sub>3</sub> , CO, and PM <sub>10</sub>	To be determined	0%
EH-1 / T-1 / K-5	Percentage of time that PM <sub>2.5</sub> exceeds new standard(s)	To be determined	0%
EH-1 / T-1 / K-6	Amount by which concentrations of each of the following pollutants exceeds ambient standard, on average (expressed as the ratio of average concentration exceeding standard to the standard): NO <sub>2</sub> , SO <sub>2</sub> , O <sub>3</sub> , CO, and PM <sub>10</sub>	To be determined	0
EH-1 / T-1 / K-7	Amount by which concentration of PM <sub>2.5</sub> exceeds the new standard(s), on average (expressed as ratio of average concentration when standard is exceeded to standard value)	To be determined	0
EH-1 / T-1 / K-8	Percentage of industrial sectors with updated emissions standards	To be determined	100%

KPI No.	Description	2014 Goal	2030 Goal
EH-1/T-1/K-9	Percentage of industrial facilities that comply with emissions standards	To be determined	100%
EH-1/T-1/K-10	Percentage of stationary emissions sources that are audited annually	To be determined	To be determined
EH-1/T-1/K-11	Total mass or volume of VOC leaks and spills from all industrial sources, including industrial facilities, storage tanks, pipelines, and barges	To be determined	To be determined
EH-1/T-1/K-12	Tons per year of emissions from the power sector, industrial sources, and commercial point sources	10% decrease compared with 2000, for two sectors	To be determined
EH-1/T-1/K-13	Percentage of electricity generated from renewable sources	To be determined	7% (by 2020)
EH-1/T-1/K-14	Volume of gas flared	0	0
EH-1/T-1/K-15	Percentage of taxis, government cars, and training vehicles that are fueled by compressed natural gas	20% (by 2012)	To be determined
EH-1/T-1/K-16	Percentage of registered vehicles meeting updated standards	To be determined	To be determined
EH-1/T-1/K-17	Percentage of diesel fuel consumed that contains 10 ppm sulfur (percent by volume)	To be determined	To be determined
EH-1/T-1/K-18	Percentage of transportation fuels from renewable sources (expressed as percentage of all fuels by gasoline gallon equivalents)	To be determined	To be determined
EH-1/T-1/K-19	Annual reduction in freight sector emissions (in tons) of PM <sub>2.5</sub> , NO <sub>x</sub> , and SO <sub>2</sub>	To be determined	To be determined
EH-1/T-1/K-20	Annual reduction in maritime emissions (in tons) of PM <sub>2.5</sub> , NO <sub>x</sub> , and SO <sub>2</sub>	To be determined	To be determined
EH-1/T-1/K-21	Annual reduction in emissions of PM <sub>2.5</sub> , NO <sub>x</sub> , and SO <sub>2</sub> (in tons) from light-duty vehicles	To be determined	To be determined
EH-1/T-1/K-22	Annual reduction in emissions of PM <sub>2.5</sub> , NO <sub>x</sub> , and SO <sub>2</sub> (in tons) from heavy-duty vehicles	To be determined	To be determined

## Target 2: Improve data quantity and availability

EH-1/T-2/K-1	Percentage of stationary sources providing all emissions data to centralized database	To be determined	To be determined
EH-1/T-2/K-2	Percentage of health-care facilities reporting cardiopulmonary and respiratory disease cases and deaths (expressed as # of facilities reporting each month / # of facilities required to report, or as % of facilities submitting at least 10 monthly reports per year within one month of due date)	To be determined	To be determined
EH-1/T-2/K-3	Number of chemical species monitored by continuous monitors in each industrial sector (by emirate)	To be determined	To be determined
EH-1/T-2/K-4	Percentage of existing outdoor air pollutant monitors that are in UAE-wide outdoor-air monitoring network	100% of currently operating monitors	To be determined
EH-1/T-2/K-5	Percentage of regulated sources submitting emissions data to centralized Spatial Data Infrastructure (SDI) database	To be determined	To be determined
EH-1/T-2/K-6	Government agencies (including federal and emirate level) with access to SDI	EAD, parallel institutions in other emirates	To be determined
EH-1/T-2/K-7	Interval (in months) between updates of national emissions inventory	To be determined	To be determined

#### Section Overview

# of Initiatives	# of KPIs	
<b>36</b>	<b>41</b>	<b>TOTAL</b>
16	22	Target 1
9	7	Target 2
3	2	Target 3
3	4	Target 4
3	4	Target 5
2	2	Target 6

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 3: Improve scientific understanding of environmental health risks</b>			
EH-1 / T-3 / K-1	Dirhams per year spent on research to improve understanding of outdoor air pollution	To be determined	To be determined
EH-1 / T-3 / K-2	Modeling of ambient ozone, PM, their precursors, and other air pollutants important for health in both the UAE and the entire Middle East is operational and continuously updated	To be determined	To be determined
<b>Target 4: Build sustainable human and institutional capacity</b>			
EH-1 / T-4 / K-1	Number of continuous emissions monitors in each industrial sector (by emirate)	To be determined	To be determined
EH-1 / T-4 / K-2	Number of outdoor-air monitors in the national air-quality monitoring network operated by trained and certified technicians	To be determined	To be determined
EH-1 / T-4 / K-3	Number of PM <sub>2.5</sub> monitors in the air-quality monitoring network nationally	To be determined	To be determined
EH-1 / T-4 / K-4	Number of employees studying outdoor air pollution in each relevant government agency	To be determined	To be determined
<b>Target 5: Support urban development that promotes environmental health</b>			
EH-1 / T-5 / K-1	Number of people living within 100 m of a major road	To be determined	To be determined
EH-1 / T-5 / K-2	Average commute time by mode	Zero increase in average commute time, compared with 2009	To be determined
EH-1 / T-5 / K-3	Percentage of journeys taken on public transit	To be determined	To be determined
EH-1 / T-5 / K-4	Percentage of freight moved by non-road haulers	To be determined	To be determined
<b>Target 6: Increase environmental awareness</b>			
EH-1 / T-6 / K-1	Percentage of population with basic understanding of how to reduce risk of disease from outdoor air pollution	To be determined	To be determined
EH-1 / T-6 / K-2	Percentage of population displaying avoidance behavior, such as staying indoors or avoiding outdoor exercise on high pollution days	To be determined	To be determined



# Indoor Air

## Problem Overview

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Air pollution exposure has long been identified as a controllable cause of preventable diseases. Historically, the bulk of the research on air pollution has focused on the outdoor air component, with results repeatedly showing an association between air pollution and adverse health effects (Dockery et al. 1993; Cohen et al. 2005; Pope 1991). More recently, however, recognition of indoor air pollution as a high priority environmental health risk has increased around the globe.

In the last several years, risk-ranking exercises by a number of organizations have placed indoor air pollution in the highest category of environmental risks (California Air Resources Board 2005; De Brouwere et al. 2007). Indoor air pollution ranked as the second-highest risk of concern in the recent UAE national-scale ranking of environmental risks (Figure 4, page 9).

Several factors may be contributing to increased awareness of indoor air pollution as a significant environmental health risk: (1) the recognition that people spend a majority of their time indoors; (2) the identification of many potential sources of air pollutants in indoor environments; (3) a growing body of evidence documenting that indoor concentrations of air pollutants can exceed health thresholds and present increased risks; and (4) the realization that energy-efficient buildings are potentially contributing to increased risk due to tight sealing of the building envelope, which increases the accumulation of pollutants indoors.

Indoor air pollutant concentrations are a function of indoor source emissions and the infiltration of outdoor air pollution into dwellings via building leakage. Many indoor pollutants are similar to outdoor air pollutants and have the potential to trigger comparable adverse health effects.

Time is an important factor when assessing health risks due to indoor pollutants. Exposure to indoor pollutants is a function of the concentration of indoor pollutants and the time spent in that micro-environment. When these two factors are taken into account, personal exposure to a given pollutant may be 10 to 50 times higher indoors than outdoors (U.S. EPA 1998). In the United States, Klepeis et al. (2001) report that people spend approximately 87% of their time indoors. In more extreme climates, such as in the UAE, the percentage of time spent indoors may be even higher and so, too, may be the health risk from exposure to indoor pollutants (Dales et al. 2008).

Multiple sources of indoor pollutants can be found in any home, and concentrations may vary considerably from one home

to another. Frequently identified sources include combustion products such as gas, wood, or kerosene; tobacco products in any form; damp building materials or high humidity environments that result in surface condensation and mold growth; manufactured wood products; chemicals associated with furnishings such as carpets and upholstery; cleaning products; deteriorating or damaged lead-based paint; and asbestos-

containing building materials.

Other sources contributing to poor indoor air quality that are not necessarily emitted within the building envelope include radon gas, which may permeate through the soil and enter the home through cracks and other breaches in the foundation, and outdoor air pollution, which can infiltrate through open windows or other points of entry. •

## Main Achievements and Successes

Numerous initiatives to reduce the health risk attributable to indoor air pollutants have been undertaken in the UAE, in Abu Dhabi emirate in particular.

Banning the import and use of asbestos and lead in products that may be used in residential and commercial environments is a large step toward reducing exposure to two well-characterized hazardous materials associated with numerous chronic and potentially life-threatening health conditions. The recent organization of the Emirates Standardization and Metrology Authority (ESMA) will increase the control and organization of other similar initiatives. Currently, there are efforts to monitor the entry of hazardous materials at six points along the country's border. Also, EAD has taken the lead to implement an electronic tracking system that, when fully operational, will provide coordinated oversight for all hazardous materials entering the country.

A progressive ban on smoking in public areas is another example of a policy the UAE has implemented to protect the health and well-being of the public, especially susceptible populations such as children and the elderly. Educational awareness

campaigns related to smoking have become more prominent and frequent. While smoking is unlikely to be banned in private residences, as is also the case in other countries, the effort to educate the public and reduce exposure to secondhand smoke in public areas may indirectly influence smoking habits in residential environments.

The recently organized Urban Planning Council (UPC) in Abu Dhabi and other UAE organizations are involved in a large initiative to introduce environmentally friendly "green" requirements into building construction/renovation and promote sustainability. Efforts such as this will reduce background levels of numerous pollutants that are routinely identified in indoor environments and recognized as health risks.

UPC has drafted a comprehensive document that addresses many critical indoor air issues, including: emissions of formaldehyde and other chemicals from building materials; ventilation; management of asbestos-containing building materials; elimination of environmental tobacco smoke; and indoor air quality management. Implementation of the recommendations of

such a document across all emirates will improve indoor air quality in the UAE.

Additionally, EAD has taken the lead in developing environmental, health, and safety protection policies as part of the new Abu Dhabi Environment, Health and Safety Management System (EHSMS). The indoor air quality component of the EHSMS addresses indoor air issues that may be confronted in commercial and public buildings.

This proactive approach by EAD includes the specification of indicators (e.g., carbon dioxide) and acceptable indicator levels for indoor air quality, as well as directives for indoor air quality management.

Dubai Municipality has also made great strides in addressing indoor air quality issues, including the formation of a unit that responds to complaints and concerns from the public. Trained engineers within the unit inspect ventilation equipment and collect measurements for various indicators of poor indoor air quality (e.g., carbon dioxide levels, ventilation parameters). Results are used to guide recommendations for improving indoor air quality for building occupants. •

# Main Unresolved and Emerging Issues

The UAE is undergoing unprecedented growth and urbanization, and the impacts on public health from this expansion are numerous.

With leadership from EAD, Abu Dhabi emirate is making significant progress on indoor air quality issues. Dubai Municipality is serving as a leader as well through its inspection services and recommendations

for improving indoor air quality to anyone requesting the service.

Unfortunately, initiatives in other emirates are lacking. The primary unresolved and emerging issue for the UAE is a need for all emirates and municipalities to adopt and abide by similar measures as those instituted by EAD and Dubai Municipality.

For the UAE to see a positive impact on

public health at a national level with regard to indoor air issues, a unified approach that is at least comparable in effort to that of EAD and Dubai Municipality needs to occur across all emirates. Additionally, existing laws and regulations (e.g., a federal ban on asbestos) that have potential to affect indoor air quality need to be enforced in all emirates and municipalities. •

## Recommendations

To reduce the potential for health risks due to indoor air pollution, the UAE should:

**Reduce pollutant levels and human exposure to pollutants.** Government agencies should focus attention on mechanical ventilation systems and ensure their adequacy for minimizing exposure to indoor pollutants. In extreme climates, such as in the UAE, the use of mechanical ventilation systems is more extensive, which necessitates more oversight through measures such as building code requirements. Requiring compliance with recognized ventilation guidelines and standards for these systems is critical to controlling indoor contaminants and reducing human exposures. In addition, actions designed to restrict contaminant-generating activities in populated spaces (e.g., smoking in public areas, renovation or demolition activities in occupied buildings) should be implemented.

**Improve data quantity and availability.** Surveys of a number of indoor pollutants in a representative number of residential, commercial, and public buildings are necessary to establish baseline information about indoor air quality. EAD has already demonstrated commitment to this type of initiative through the 700-home epidemiologic study scheduled to conclude in the spring of 2010 that will measure indoor concentrations of several common pollutants (e.g., particulate matter, carbon monoxide) nationwide. Comparable efforts for radon, lead-based paint, and asbestos-containing building materials are advisable. Additionally, tandem efforts to implement and/or improve surveillance systems for tracking diseases associated with indoor pollutant exposures are critical to gathering information about the potential adverse health effects of indoor air pollution.

**Improve scientific understanding of environmental health risks.** The UAE government should sponsor additional

research to identify factors that influence indoor air pollutant concentrations and occupant exposures. For example, surveys to measure air exchange rates in residential areas could be conducted to identify whether certain types of housing affect exposure more than others. Also, these surveys could assess the effect of geographical differences on exposures to indoor air pollutants.

**Build sustainable human and institutional capacity.** As the UAE advances its programs on indoor air quality, it should increase educational opportunities for professional personnel concerned with indoor air quality. Educational needs include training programs for building engineers as well as graduate-level education for those conducting field assessments or managing larger indoor air programs at the federal, emirate, or municipal level.

**Support urban development that promotes environmental health.** The UAE has undergone unprecedented growth in the last two decades. The UAE will save money in the long run and help protect its population from indoor air pollution by being cognizant during the design phase of how material substitution, ventilation requirements, and land use affect indoor air quality in new buildings.

**Improve environmental awareness.** UAE government leaders (federal, emirate, and municipal) need to encourage public participation in activities designed to curtail exposure to indoor air pollution and promote behaviors that improve indoor air quality. The UAE could initiate product-labeling or building-material substitution campaigns in addition to campaigns aimed at behaviors (e.g., smoking) that should be modified to reduce indoor air pollution and exposure to pollutants. Other countries and regions have successfully implemented similar programs and could serve as models for the UAE. •



Priority Area 2:  
Indoor Air



# Indoor Air (EH-2):

## Initiatives to Reduce the Burden of Disease Due to Indoor Air Pollution

Target 1: Reduce pollutant levels and human exposure to pollutants						Stakeholders
<b>EH-2 / T-1 / I-1</b> Commission an independent review of the adequacy of existing residential and commercial building codes (and the enforcement of these codes) to minimize indoor air pollution through minimizing sources of indoor air pollutants and maximizing efficiency of ventilation rates. Follow International Code Council ( <a href="http://www.iccsafe.org">http://www.iccsafe.org</a> ) codes as appropriate.						Emirate environment agencies, municipalities
2010	2011	2012	2013	2014		MOEW
<b>EH-2 / T-1 / I-2</b> Identify and adopt international best practices in building ventilation standards.						Emirate environment agencies, municipalities
2010	2011	2012	2013	2014		MOEW
<b>EH-2 / T-1 / I-3</b> Review and assess indoor air quality guidelines and regulations for new residential, public, and commercial buildings. Use existing Dubai Municipality, European Union, and U.S. guidelines as examples.						Emirate environment agencies, municipalities
2010	2011	2012	2013	2014		MOEW
<b>EH-2 / T-1 / I-4</b> Review and assess feasibility of mandatory annual inspection and monitoring of heating, ventilating, and air-conditioning (HVAC) systems in all commercial and public buildings. <ul style="list-style-type: none"> <li>Identify building HVAC mechanical engineers and assign inspection duties.</li> <li>Require inspector certification through American Society of Heating, Refrigerating, and Air-Conditioning Engineers Operations and Performance Personnel Certification (<a href="http://www.ashrae.org/certification/page/1899">http://www.ashrae.org/certification/page/1899</a>).</li> <li>Develop procedures for establishing indoor air quality management plans if poor conditions are identified.</li> <li>Establish a process to notify building owner of confirmed poor indoor air quality conditions and permit legal action if remediation is not completed within a certain time.</li> </ul>						Emirate environment agencies, municipalities
2010	2011	2012	2013	2014		MOEW
<b>EH-2 / T-1 / I-5</b> Control and eventually ban smoking of all tobacco products in all public buildings, including restaurants, cafes, and office buildings.						Emirate environment agencies, municipalities
2010	2011	2012	2013	2014		MOEW MOH MOI EAD HAAD
<b>EH-2 / T-1 / I-6</b> Require all hazardous materials to be removed prior to demolition of buildings and personnel removing them to be trained in proper removal and disposal procedures, following best international practices.						Emirate environment agencies, municipalities
2010	2011	2012	2013	2014		MOEW
<b>EH-2 / T-1 / I-7</b> Establish an assistance program for workers, renters, and others exposed to indoor air pollutants in commercial, residential, and public buildings.						Emirate environment agencies
2010	2011	2012	2013	2014		MOEW MOH
<b>EH-2 / T-1 / I-8</b> Establish health inspection units within each emirate that can respond to complaints of residential and commercial occupants related to poor indoor air quality, following the example of Dubai Municipality.						Unknown for federal and other emirates
2010	2011	2012	2013	2015		MOEW MOH



## Priority Area 2: Indoor Air

### Section Overview

# of Initiatives	# of KPIs	TOTAL
26	20	
9	5	Target 1
5	6	Target 2
4	0	Target 3
3	4	Target 4
2	1	Target 5
3	4	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative.

They may include nonspecific entities as well as these specific entities:

EAD	Environment Agency—Abu Dhabi	MOH	Ministry of Health
HAAD	Health Authority—Abu Dhabi	MOI	Ministry of Interior
MHESR	Ministry of Higher Education and Scientific Research	MOP	Ministry of Planning
MOEW	Ministry of Environment and Water	UPC	Urban Planning Council (Abu Dhabi)

### EH-2 / T-1 / I-9

Require reporting of radon levels, presence of asbestos, presence of lead-based paint, and HVAC cleanliness and performance prior to rental or sale of all residential dwellings.

- Encourage unit testing through incentive programs or subsidies to owners and management companies.
- Implement law that requires disclosure by owner and management company at contract signing.
- Provide avenue for occupant to pursue action against owner if testing is not conducted and suspected health impacts result.



### Target 2: Improve data quantity and availability

#### Stakeholders

### EH-2 / T-2 / I-1

Conduct baseline survey for presence of asbestos-containing materials in residential, commercial, and public buildings across the UAE.

- Use trained, qualified asbestos inspectors who can assess conditions and recommend appropriate remediation.
- Conduct asbestos air sampling in buildings where asbestos-containing materials are damaged or highly friable.



### EH-2 / T-2 / I-2

Design and carry out studies of indoor air quality in public buildings in the UAE.

- Visually inspect buildings for conditions that could exacerbate poor indoor air quality (e.g., leaky roof, improper storage of chemicals, pressed-wood furniture, inadequate ventilation).
- Interview occupants for concerns or symptoms.
- Use qualified personnel to conduct indoor air quality inspection, including measuring airborne pollutants of interest.
- Compare results against appropriate international guidelines and standards.



### EH-2 / T-2 / I-3

Conduct baseline radon survey across all emirates, and map hot spots. Enlist a hired contractor or appropriately trained EAD personnel to conduct sampling in a representative number of homes across the UAE.



### EH-2 / T-2 / I-4

Establish and fund an independent surveillance body and system for tracking occurrences of diseases associated with indoor air pollution, including carbon monoxide poisoning, childhood lead poisoning, lung cancer, allergies, asthma, mesothelioma, Legionnaires' disease, and sick building syndrome.



**EH-2 / T-2 / I-5**

Establish routine monitoring of blood lead levels in all children ages 1-5 as part of regular check-ups.

- Establish and fund an independent research body.
- Require physicians and medical facilities to report blood lead levels above the threshold to an emirate agency for follow-up. Use internationally accepted threshold for reference.
- Require local health agencies to report elevated blood lead levels to the Ministry of Health, where a central surveillance database is developed and maintained.
- Organize a health unit within each emirate that investigates elevated blood lead levels by inspecting homes and schools for conditions or sources that may be contributing to lead exposure.
- Request remediation of those conditions or sources upon discovery.
- Make lead remediation enforceable by law.

Local universities, health agencies, and environment agencies



MOEW MOH

**Target 3: Improve scientific understanding of environmental health risks****Stakeholders****EH-2 / T-3 / I-1**

Conduct studies to identify the areas and specific building types most vulnerable to infiltration of pollutants from outdoor air. Establish a research body to conduct these studies in collaboration with universities and funded by the Urban Planning Council, federal ministries, and local authorities.

Universities, local health agencies, municipalities



UPC

**EH-2 / T-3 / I-2**

Conduct studies to measure air exchange rates in different building types.



Municipalities, universities, appropriate ministries and emirate agencies

**EH-2 / T-3 / I-3**

Study indoor air quality in green design; compare with traditionally designed and constructed buildings.



Municipalities, universities, appropriate ministries and emirate agencies

**EH-2 / T-3 / I-4**

Study indoor air issues associated with arid climates relative to climates with greater humidity; include special focus on microbiological pollutants.



Municipalities, universities, appropriate ministries and emirate agencies

**Target 4: Build sustainable human and institutional capacity****Stakeholders****EH-2 / T-4 / I-1**

Increase number of staff in key UAE environmental agencies with graduate-level training in indoor air quality by funding mechanical engineering and other indoor-air-related programs at local universities.



MHESR

**EH-2 / T-4 / I-2**

Increase number of staff in key UAE environmental agencies with doctoral degrees focused on air quality engineering or environmental-health-related disciplines with an indoor air quality component by funding programs at one or more local universities.



MHESR

**EH-2 / T-4 / I-3**

Implement an annual audit and evaluation of staff expertise in indoor air in each emirate.



Emirate environment agencies, municipalities

MOEW MOH

## Section Overview

# of Initiatives	# of KPIs	
<b>26</b>	<b>20</b>	<b>TOTAL</b>
9	5	Target 1
5	6	Target 2
4	0	Target 3
3	4	Target 4
2	1	Target 5
3	4	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative. They may include nonspecific entities as well as these specific entities:

EAD	Environment Agency–Abu Dhabi	MOH	Ministry of Health
HAAD	Health Authority–Abu Dhabi	MOI	Ministry of Interior
MHESR	Ministry of Higher Education and Scientific Research	MOP	Ministry of Planning
MOEW	Ministry of Environment and Water	UPC	Urban Planning Council (Abu Dhabi)

## Target 5: Support urban development that promotes environmental health

### Stakeholders

### EH-2 / T-5 / I-1

Determine whether a green building-certification program is feasible and how indoor air quality could be incorporated into such a program.



Municipalities

MOEW

### EH-2 / T-5 / I-2

Evaluate urban planning strategies and regulations to determine how indoor air is incorporated and whether measures are sufficient to contribute to improvement of indoor air quality.



Municipalities

MOEW

UPC

## Target 6: Increase environmental awareness

### Stakeholders

### EH-2 / T-6 / I-1

Establish product standards and a labeling program for all consumer products that are potentially sources of indoor air pollution (e.g., cleaning products, pesticides, rodenticides, fabrics, particle board, floor finishes, paints, cosmetics, disinfectants).

- Identify and categorize potentially harmful products.
- Institute a program similar to the European Union's REACH (Registration, Evaluation, Authorization, and Restriction of Chemical substances) regulation on chemicals and their safe use.
- Establish central database to monitor and manage information on chemicals brought into the UAE.
- Establish an agency to test the potential effects of consumer products on indoor air quality.
- Supplement product labeling program with consumer education campaigns.



Emirate environment agencies

MOEW

### EH-2 / T-6 / I-2

Develop public information campaigns about risks due to indoor air pollution, including secondhand smoke, radon, and other contaminants.

- Consult model programs developed by other nations.
- Consider using TV campaigns, newspaper ads, and radio spots.
- Initiate incentives or subsidies during campaign period for the action wanted, e.g., government subsidies for, or giveaway of, carbon monoxide detectors.
- Develop calendars, brochures, and magnets with tips and reminders.



Emirate environment and health agencies

MOEW

MOH

### EH-2 / T-6 / I-3

Encourage installation of carbon monoxide monitors in all residential rental units and private homes through educational awareness campaigns.



Emirate environment agencies, municipalities

MOEW



## Indoor Air (EH-2): Key Performance Indicators

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 1: Reduce pollutant levels and human exposure to pollutants</b>			
EH-2/T-1/K-1	Percentage of emirates adopting a system for establishing and updating indoor air quality guidelines and regulations	100%	To be determined
EH-2/T-1/K-2	Establishment of system for annual inspection and monitoring of heating, ventilating, and air-conditioning (HVAC) systems in public and commercial buildings: <ol style="list-style-type: none"> <li>1. Percentage of residential buildings inspected as part of this system</li> <li>2. Percentage of residential buildings meeting requirements</li> <li>3. Percentage of commercial buildings inspected</li> <li>4. Percentage of commercial buildings meeting requirements</li> </ol>	50%	100%
EH-2/T-1/K-3	Percentage of public buildings in the following categories that enforce bans on smoking and tobacco products: <ol style="list-style-type: none"> <li>1. Federal government buildings</li> <li>2. Emirate government buildings</li> <li>3. Public transportation facilities (airports, bus terminals, etc.)</li> <li>4. Restaurants</li> </ol>	75%	100%
EH-2/T-1/K-4	Percentage of renovation or demolition projects in the following categories that use appropriate engineering controls to minimize exposures to hazardous materials containing asbestos, lead, mercury, PCBs, or other materials banned or regulated by other international agencies: <ol style="list-style-type: none"> <li>1. Residential buildings</li> <li>2. Commercial buildings</li> <li>3. Decommissioned laboratories</li> <li>4. Decommissioned industrial facilities</li> </ol>	75%	To be determined
EH-2/T-1/K-5	Percentage of residential rental units with carbon monoxide monitors in place	75%	100%
<b>Target 2: Improve data quantity and availability</b>			
EH-2/T-2/K-1	Percentage of buildings tested to identify the presence and condition of asbestos-containing building materials that may potentially present a health risk: <ol style="list-style-type: none"> <li>1. Residential buildings</li> <li>2. Commercial buildings</li> <li>3. Public buildings</li> </ol>	30%	100%

#### Section Overview

# of Initiatives	# of KPIs	
<b>26</b>	<b>20</b>	<b>TOTAL</b>
9	5	Target 1
5	6	Target 2
4	0	Target 3
3	4	Target 4
2	1	Target 5
3	4	Target 6

KPI No.	Description	2014 Goal	2030 Goal
EH-2 / T-2 / K-2	Percentage of schools and public buildings with contaminant levels below internationally acceptable concentrations or threshold levels for lead, mercury, formaldehyde, asbestos, radon, and mold.	100%	100%
EH-2 / T-2 / K-3	Percentage of residential, commercial, and public building exceeding radon thresholds.	<25%	<5%
EH-2 / T-2 / K-4	Incidence of diagnosed cases of illnesses associated with indoor air pollution (per 100,000 population)	To be determined	To be determined
EH-2 / T-2 / K-5	Mortality due to illnesses associated with indoor air pollution (deaths per 100,000 population)	To be determined	To be determined
EH-2 / T-2 / K-6	Percentage of children ages 1-5 with blood lead levels above internationally acceptable levels	0%	0%

#### Target 3: Improve scientific understanding of environmental health risks

	No pertinent KPIs		
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#### Target 4: Build sustainable human and institutional capacity

EH-2 / T-4 / K-1	Percentage increase in the number of indoor air quality experts in UAE with graduate-level training	50%	100%
EH-2 / T-4 / K-2	Percentage increase in the number of PhD-trained indoor air quality experts in the UAE government	25%	75%
EH-2 / T-4 / K-3	Percentage of municipalities with expert indoor air services	50%	100%
EH-2 / T-4 / K-4	Percentage increase in the number of building and construction management staff who are trained in indoor air quality	75%	100%

#### Target 5: Support urban development that promotes environmental health

EH-2 / T-5 / K-1	Percentage of UAE urban planning strategies and regulations that incorporate indoor air quality mitigation measures	50%	100%
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#### Target 6: Increase environmental awareness

EH-2 / T-6 / K-1	Percentage of consumer products that may contribute to indoor air quality problems that are properly labeled	30%	100%
EH-2 / T-6 / K-2	Percentage of consumers who can demonstrate understanding of warning labels on products that may cause indoor air problems	25%	75%
EH-2 / T-6 / K-3	Percentage of the public who can demonstrate awareness of indoor air pollution risks	50%	100%
EH-2 / T-6 / K-4	Percentage of population displaying avoidance behavior, such as staying indoors or avoiding outdoor exercise on high pollution days	To be determined	To be determined

# Occupational Exposures

## Problem Overview

Workers in many occupations are at risk of being exposed to various physical, chemical, and biological hazards that may lead to illness.

Depending on the dose, the route and duration of exposure, and the chemical properties of the hazardous substance, exposures may lead to symptoms ranging from mild discomfort to debilitating conditions, even death. Sudden exposure to a large amount of a toxic compound may lead to acute poisoning, whereas chronic exposure to even trace amounts of other substances may cause serious health effects such as cancer or reproductive effects years after the exposure has ceased. Workers may also put their families at risk by carrying toxic substances to their homes on contaminated work clothes or vehicles (Curl et al. 2002; Thompson et al. 2003).

Due to rapid economic growth and the related huge demand for labor, the workforce in the UAE has been growing at an unforeseen rate in recent years. The vast number of development projects makes it challenging to ensure the health and safety of all workers.

The UAE's labor law, established in 1980, was modified in 2007 to update the penalties for violations. Except for that

update, however, the law has changed little since 1980 and remains outdated in many respects. When compared with international best practices and standards, the occupational exposure limits in the law are outdated. The law lacks the special regulations needed to protect workers in high-risk occupations and does not provide for assessment and management of risks, including adverse health outcomes attributable to occupational exposures. In addition, as a result of insufficient capacity in both federal and local agencies, the law is enforced neither effectively nor consistently. Occupational health and safety (OHS) inspectors trained to monitor conditions and compliance with OHS regulations at workplaces are in short supply. In addition, due to a lack of personnel, equipment, and specific guidelines, the requirement for screening the health status of workers before, during, and after employment is not fulfilled as intended in the UAE's labor law.

Occupational illnesses, injuries, and deaths are seriously underestimated in the UAE because they may not be coded systematically as being work related. In addition, employers and hospitals are not required to document and report work-related incidents.

Health-care facilities have a strong incentive not to document and report work-related injuries and diseases to health insurance companies as being work related because such health outcomes are excluded from insurance claim reimbursement (as in Abu Dhabi, for example). The health-care sector bears the majority of the costs of treating occupational diseases and injuries because many employers of injured workers fail to pay for treatment.

In addition, injury and illness data are neither centrally stored nor exchanged among concerned authorities, which prevents easy access for surveillance purposes. The lack of reliable information on the prevalence of work-related illnesses hampers the early detection of occupational illnesses and the ability to link occupational exposures with adverse health outcomes. This, in turn, makes it challenging to hold employers liable for violating OHS regulations. More information is also needed on the levels of occupational exposures at workplaces. This requires the development of industrial hygiene capacity within the UAE in both government and private companies that can offer consulting services to industry. An accredited reference laboratory capable of analyzing samples collected in occupational settings is also needed. •

## Main Achievements and Successes

The importance of protecting the health and safety of the labor force is gaining recognition across different sectors in the UAE. New federal and local government regulations and projects are under way, as well as an increasing number of environmental and OHS programs in businesses, particularly in larger companies. The Ministry of Labor (MOL) has established new departments for environmental health and safety management and for occupational accidents that will focus on improving occupational health and safety in the UAE. MOL is also in the process of preparing health and safety standards for workplaces.

In addition, plans are in progress for new regulations of the construction industry to ensure better safety for workers and harsher penalties for companies that do not comply. Construction work is also prohibited during the hottest part of the day in the summer. Guidelines were recently passed to regulate the quarrying industry in an effort to reduce air pollution and noise.

The enormous development boom in the UAE has placed a huge demand on MOL for workplace inspections, particularly at construction sites. Even though the shortage of trained labor inspectors is severe, the number of inspectors has been increased and workshops are under way to educate the inspectors on basic hazard identification and the labor law.

Training sessions have also been offered for farm laborers on the safe application of ag-

ricultural pesticides and associated risks. To decrease the use of harmful chemical pesticides, only approved pesticides can be used, and the government is promoting organic farming and research on biological pest control.

Of the seven emirates, Abu Dhabi has taken the lead in raising awareness of OHS issues. The Health Authority–Abu Dhabi (HAAD) has several projects under way to improve the safety of workers, including development of a program for the management of work in hot environments. Extreme summer heat in the UAE causes a significant health risk and affects a large number of outdoor workers, particularly in construction and in the oil and gas industries. Thus, HAAD is developing a heat-stress index and launching a heat-stress campaign to provide training materials and increase awareness of heat-related issues.

HAAD is also developing guidelines for pre-employment and periodic health screening for workers in high-risk occupations and has drafted a policy to manage occupational and indoor air risks at health-care facilities.

Another extensive initiative under way in Abu Dhabi emirate is the Environment, Health, and Safety Management System (EHSMS), which aims to ensure effective management and protection of the environment, human health, and worker safety through implementation of environmental guidelines across all major economic sectors (EAD 2009b). •

## Main Unresolved and Emerging Issues

The UAE federal labor law was amended in 2007, but the modifications concerned only penalties. The law lags behind international exposure standards and neither covers many of the hazardous substances present at workplaces nor sufficiently protects workers in high-risk occupations (e.g., agriculture, construction). The legislation also lacks adequate compensation for work-related illnesses and injuries, and it covers only a small number of health conditions (such as poisonings) while excluding a wide range of work-related diseases (such as cancers

and respiratory problems). Employers are not routinely held liable with penalties for violations of OHS regulations, and many fail to pay for worker treatment.

The extremely fast rate of development, rapidly growing population, and unique composition of the labor force all pose challenges for ensuring workers' health and safety in the UAE. Government agencies at the federal and local levels are understaffed and lack resources. Further, personnel trained in occupational health and safety and occupational hygiene



are needed in the numerous companies where workers are potentially exposed to occupational hazards. Exposure and risk assessment, hazard-control programs, and worker-education programs are more common in large international entities but are lacking in smaller local companies.

Very limited information is available on hazardous workplace exposures and occupational illnesses and injuries in the UAE. Employers are not required to systematically monitor and report exposures, and work-site inspections lag seriously behind the growing need. Inspectors trained in hazard identification, exposure and risk assessment, and the labor law are lacking. Also, even though the labor law indicates that employers who do not comply must face penalties, in practice employers are rarely penalized for violating regulations because enforcement is inconsistent.

In addition to insufficient monitoring of conditions and management of risks at workplaces, occupational health-status screening of workers is inadequate, particularly for workers in high-risk occupations. The intended purpose of occupational health check is to ensure the worker is fit to perform the tasks safely and to detect any possible adverse health effects early. At present, however, the occupational health checks are used to screen workers for certain infectious diseases only to fulfill visa requirements for foreign workers. Follow-up periodic health screening is important but largely not undertaken. Health-care facilities lack personnel and equipment for health screening of workers, and occupation-specific guidelines are nonexistent.

Due to problems with recognition and coding of injuries and illnesses due to occupational exposures as being work related and a lack of injury surveillance and reporting programs, occupational illnesses and injuries are grossly underreported in the UAE. Under the current insurance and hospital cost-recovery scheme, employers are able to avoid liability for occupational illnesses and injuries, and the cost of medical treatment falls on the health-care system. The fact that occupational illnesses are not covered under the health-insurance system encourages the withholding of the true cause of work-related adverse health effects.

The UAE has neither a national reference laboratory nor enough accredited private and public laboratories capable of analyzing environmental and biological samples collected in occupational settings. Occupational hygiene services are needed to help companies comply with requirements of law, particularly for smaller companies that may not have enough knowledge or resources themselves. In general, the larger emirates have more resources for promoting prevention of occupational illnesses and injuries, and their local OHS legislation may be ahead of that of other emirates.

Overall, the labor law in its current form and lenient enforcement do not adequately guarantee the health and safety of workers in the UAE. In addition, the tendency to assign blame for accidents and injuries discourages investigations to reveal root causes and reporting of true causes. In turn, failure to identify and report true causes of workplace illnesses, injuries, and fatalities hinders subsequent follow-up action to avoid repetition of such incidents. •

## Recommendations

To reduce the potential for health risks due to occupational exposures, the UAE should:

**Reduce pollutant levels and human exposure to pollutants.** Effective enforcement of occupational health and safety laws across the whole UAE is a key component of the strategy. A clearly defined federal body or system of local authorities should be established to oversee the implementation of regulations and to promote occupational health and safety.

Updating the UAE labor law is also critical. This includes revising the exposure limits to correspond with the latest science-based international occupational health and safety standards, and the identification and inclusion of hazards and high-risk occupations that are not currently covered by the law. Whistle-blower programs and up-to-date regulations for compensation for occupational illnesses, injuries, and fatalities should be incorporated into the law as well. Strict penalties for employers in violation of occupational health and safety laws should be enforced under the law.

Compliance with occupational health and safety requirements needs to be monitored by regular inspections. This, in turn, requires developing a priority-based inspection plan, increasing the number of properly trained inspectors, and educating inspectors in key areas such as hazard identification and exposure assessment as well as the requirements of the labor law. Developing a system to record inspection results, including violations observed and corrective actions taken, will allow fines and the cancellation of permits and commercial licenses to be used to force employers to comply with regulations.

To control hazardous exposures at workplaces, employers should be required to conduct hazard identification as well as exposure- and risk-assessment processes. Where these assessments reveal undue risk, employers should implement appropriate risk-management strategies. As part of a risk-based control program, employers should be required to provide information and training for employees on occupational hazards and appropriate control measures. Incentives should be provided to encourage monitoring and reporting of occupational exposures



and adverse health effects, and for organization of and participation in educational programs.

**Improve data quantity and availability.** Reliable information on the true incidence and prevalence of occupational diseases, injuries, and fatalities is the basis for directing protection measures at the right places and informing updates in policies, regulations, and guidelines to protect workers. Mandatory pre-employment and periodic health screenings should be performed and systematically documented based on occupation-specific guidelines, paying special attention to workers in high-risk occupations such as agriculture, construction, and mining. To facilitate surveillance of work-related diseases, injuries, and fatalities, the health-care-facility-based reporting and surveillance system should be revised to better capture work-related conditions. It is important to teach health-care personnel how to correctly document causes and diagnoses of work-related illness based on the new ICD-10 international diagnostic coding system, so that work-related adverse health effects can be linked with occupational exposures, to the extent possible.

The exclusion of occupational injuries and diseases from health-insurance coverage needs to be addressed, with the costs being borne by employers of injured workers through a premium-based insurance system as opposed to being borne by the health-care system and workers, which is the current practice. Employers should also be required to have a reporting program in place for occupational illnesses, injuries, and fatalities. A centralized system to store occupational exposure and health outcome data should be established.

**Improve scientific understanding of environmental health risks.** Key problems in occupational settings can be identified by conducting monitoring and surveys, including hazard identification, risk assessment, and exposure assessment. Reliable information on the levels of contaminants at workplaces is important for setting target levels, identifying the most effective control measures, and implementing occupational health and safety regulations.

**Build sustainable human and institutional capacity.** Since occupational health and safety laws and regulations work as intended only if implemented and enforced effectively, capacity building is a critical part of the strategy.

An important goal is to increase the number of trained occupational health and safety personnel at both federal and local agencies and at workplaces where workers are potentially exposed to occupational hazards. This can be achieved by creating educational programs at various levels, such as graduate-level programs at universities and training opportunities for relevant government officials and small business managers. This is a rich area of capacity development for people in the UAE, with opportunities for new careers and advancement in an area of need that could help set a leading example for all Gulf Cooperation Council countries. Certification programs should be developed for workers in high-risk jobs such as pesticide application, welding, and confined-space work.

Occupational-health services should be available for companies, especially small ones, to help them comply with requirements for monitoring workplace exposures and reporting occupational illnesses, injuries, and fatalities. An accredited national reference laboratory should be established, as should accredited public and private laboratories capable of analyzing samples collected in occupational settings.

**Support urban development that promotes environmental health.** No recommendations at this time.

**Improve environmental awareness.** Awareness of occupational risks and the related health effects can improve commitment to prevention programs and provide guidance in the selection of effective control measures. Increasing such awareness among employers and employees is important. Workplace managers need to be visibly committed to minimizing occupational exposures, implementing occupational health and safety programs, and promoting safe working practices. Workshops and other training sessions should be offered for employers, occupational health and safety personnel, and workers in high-risk jobs. Additionally, educational materials should be distributed at workplaces and information made available online. To address these issues, the Ministry of Labor has established an awareness sector that holds lectures and workshops and distributes materials that promote occupational health and safety to both managers and employees.

Overall, effective risk management and prevention of occupational illnesses, injuries, and fatalities are beneficial for both workers and employers. •



## Section Overview

# of Initiatives	# of KPIs	TOTAL
43	34	
19	15	Target 1
8	7	Target 2
1	1	Target 3
11	9	Target 4
0	0	Target 5
4	2	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative. They may include nonspecific entities as well as these specific entities:

MHESR	Ministry of Higher Education and Scientific Research	MOH	Ministry of Health
MOE	Ministry of Education	MOI	Ministry of Interior
MOEW	Ministry of Environment and Water	MOL	Ministry of Labor
MOF	Ministry of Finance		

## Occupational Exposures (EH-3):

### Initiatives to Reduce the Burden of Disease Due to Occupational Exposures

#### Target 1: Reduce pollutant levels and human exposure to pollutants

#### Stakeholders

##### EH-3 / T-1 / I-1

Establish a clearly defined higher federal committee and local authorities (e.g., Occupational Health Authority of Abu Dhabi or Dubai) to regulate occupational health and safety (OHS) laws in the UAE.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOEW	MOH	MOI
MOL		

##### EH-3 / T-1 / I-2

Adopt nationwide the Environment, Health and Safety Management System (EHSMS) class 1 indicators adopted by Abu Dhabi (Code of Practice 15–Hazardous Materials, version 1.2, July 2009). In addition:

- Identify and assess occupational health workplace hazards and develop a risk management system in line with international standards and best practices.
- Implement risk management strategies and controls, applying hierarchy of control principles.
- Conduct periodic review and monitoring of the effectiveness of applied occupational-health control measures.

2010	2011	2012	2013	2014
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Emirate environment and health agencies, along with industry and labor representatives

MOEW	MOH	MOL
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##### EH-3 / T-1 / I-3

Compare the UAE federal labor law with international standards, following the EHSMS regulatory framework. Revise the law as appropriate. In addition:

- Establish new standards for exposures relevant to the UAE, where these do not exist presently under UAE law.
- Consider developing one federal standard, as a minimum, which must be implemented in all emirates.
- Consider the adoption of international occupational exposure standards and biological exposure indices, such as the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values, U.K. workplace exposure limits, and German Research Foundation (DFG) standards.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOEW	MOH	MOL
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##### EH-3 / T-1 / I-4

Revise emirate laws regarding OHS and update annually; and harmonize federal and emirate regulations.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOEW	MOH	MOI
MOL		

##### EH-3 / T-1 / I-5

Implement, inspect, and enforce occupational exposure standards.

2010	2011	2012	2013	2014
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Appropriate emirate agencies

MOH	MOL
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##### EH-3 / T-1 / I-6

Increase the size and competency of work-site inspection teams in relevant federal ministries and emirate authorities.

2010	2011	2012	2013	2014
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Appropriate emirate agencies

MOH	MOI	MOL
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**EH-3 / T-1 / I-7**

Educate inspectors on basic occupational hygiene principles, hazard identification, occupational hygiene monitoring, risk assessment techniques, occupational exposure and indoor air quality standards, biological monitoring principles, biological exposure indices and standards, and labor law requirements (including reporting requirements for occupational health incidents). (This step may be facilitated by establishing accredited training programs.)

2010	2011	2012	2013	2014
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Appropriate emirate agencies

MOEW MOH MOL  
MHESR

**EH-3 / T-1 / I-8**

Develop and implement a system to record the results of workplace inspections, observed violations, and actions taken by companies to correct violations. Consider a federal list of facilities with repeated violations and a procedure for removal of facilities from this list following adequate remedial action. Potentially restrict the issuance of government contracts for those in breach of regulations.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOI MOL

**EH-3 / T-1 / I-9**

Develop and implement a system to record workplace accidents and injuries and to document actions taken by the company, employer, or entity to prevent them.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOL

**EH-3 / T-1 / I-10**

Design an inspection plan with priorities based on a site-specific targeting program, focusing on high-risk industries, workplaces with a poor track record of accidents and illnesses, and those with poor compliance with notification or other OHS requirements.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOL

**EH-3 / T-1 / I-11**

Develop a notification process for employee reporting of hazards and risks to work-site inspection teams.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOL

**EH-3 / T-1 / I-12**

Provide training on hazards and risks in the workplace as well as take-home and other secondary exposures. Provide training on risk control measures according to the hierarchy of control and the use of personal protective equipment.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOL

**EH-3 / T-1 / I-13**

Provide accessible health and safety information to employees.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOI MOL

**EH-3 / T-1 / I-14**

Provide incentives for employers to encourage development and maintenance of worker training programs and appropriate safety measures to reduce worker exposures.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOI MOL

**EH-3 / T-1 / I-15**

Implement, inspect, and enforce training and risk management control requirements. Link approval of a work process to provision of a training program, adequate engineering controls, and provision of personal protective equipment.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOL

**EH-3 / T-1 / I-16**

Establish a system to review and compare compensation guidelines in the federal labor law with best practices.

- Guidelines should cover compensation for lost wages, cost of medical treatment and rehabilitation, and permanent disability.
- The initial accident inspection should be conducted by an independent work-site inspection team, e.g., MOL or appropriate local agencies.

2010	2011	2012	2013	2014
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Emirate health agencies

MOH MOL

## Priority Area 3: Occupational Exposures

### Section Overview

# of Initiatives	# of KPIs	
<b>43</b>	<b>34</b>	<b>TOTAL</b>
19	15	Target 1
8	7	Target 2
1	1	Target 3
11	9	Target 4
0	0	Target 5
4	2	Target 6

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MOE	Ministry of Education	MOI	Ministry of Interior
MOEW	Ministry of Environment and Water	MOL	Ministry of Labor
MOF	Ministry of Finance		

### EH-3 / T-1 / I-17

Conduct government-led economic assessment of revised financial compensation guidelines for occupational illnesses and injuries.

2010	2011	2012	2013	2014	MOF	MOL
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### EH-3 / T-1 / I-18

Implement, inspect, and enforce compensation requirements of the labor law.

2010	2011	2012	2013	2014	MOF	MOL
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### EH-3 / T-1 / I-19

Extend federal labor law penalties to violations of occupational health laws. Use inspections and audits to document violations and to apply, renew, and cancel permits.

2010	2011	2012	2013	2014	MOL
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Appropriate emirate agencies

## Target 2: Improve data quantity and availability

### Stakeholders

### EH-3 / T-2 / I-1

Develop OHS screening and/or surveillance standards for employees in specified occupations, and develop and register screening programs.

- Programs should screen health before employment, periodically during employment, after sickness, and upon termination of employment, with a view to assessing impact on the safe performance of work.
- Programs may include specific occupation-based screening and/or surveillance standards, beginning with those in high-risk occupations (e.g., workers exposed to noise, heat, or chemicals such as inorganic lead or asbestos).

2010	2011	2012	2013	2014	MOH	MOL
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Appropriate emirate agencies

### EH-3 / T-2 / I-2

Implement, inspect, and enforce occupational-health screening and/or surveillance requirements of the UAE labor law.

- Enforce mandatory health-screening and/or surveillance programs for workers.
- Establish a system that allows follow-up of individual workers using a unique identifier (e.g., Emirates ID number).
- Provide incentives for tracking and reporting employee health over time.
- Conduct audits to ensure that relevant health screenings are conducted periodically.
- Link approval process of workplace operating permits to maintenance of adequate health-screening programs in high-risk industries and workplaces.

2010	2011	2012	2013	2014	MOH	MOL
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Appropriate emirate agencies

### EH-3 / T-2 / I-3

Implement a hospital-based work-related injury and illness identification and reporting program in each emirate. Educate health-care personnel on the importance of documenting the source and diagnosis of the illness so that it can be accurately coded.

2010	2011	2012	2013	2014	MOH	MOL
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Appropriate emirate agencies

### EH-3 / T-2 / I-4

Revise hospital treatment cost-recovery schemes and insurance so that employers are held responsible for medical costs of work-related injuries and diseases.

2010	2011	2012	2013	2014	MOH	MOL
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Appropriate emirate agencies



**EH-3 / T-2 / I-5**

Establish standards for risk-based monitoring of occupational exposures by employer, or by government-approved consultants for employers that lack the capacity to do so themselves (e.g., small companies). Set up industrial hygiene services or accredited providers to help companies comply with this monitoring requirement.

2010	2011	2012	2013	2014
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Appropriate emirate agencies

MOH MOL

**EH-3 / T-2 / I-6**

Conduct audits and inspections to ensure that risk assessments have been conducted and that exposure monitoring and appropriate hazard and risk management programs are in place.

- Enforce penalties for violations of the law and/or codes of practice.
- Provide incentives to encourage development and maintenance of monitoring programs.
- Conduct random assessments of exposure levels in companies.
- Link approval process to the presence and registration of a monitoring program.

2010	2011	2012	2013	2014
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Appropriate emirate agencies

MOH MOL

**EH-3 / T-2 / I-7**

Periodically report lost time due to notifiable occupational diseases, injuries, and deaths to the entity established by EH-3 / T-1 / I-1 or to local health authorities.

- Provide guidance to entities on what to report, set up OHS services to help companies comply with this reporting requirement, provide incentives to develop programs, and conduct audits to ensure programs are in place.
- Link workplace operating-permit approval process to presence and registration of reporting program.

2010	2011	2012	2013	2014
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Appropriate emirate agencies

MOH MOL

**EH-3 / T-2 / I-8**

Establish a centralized system for storing occupational exposure and periodic health screening and/or surveillance data (thus linking exposure monitoring results with health data).

- Allocate funds to create cross-agency (health, environment, safety) division to store, maintain, and analyze data.
- Allocate and train personnel.
- Designate how data will be obtained from employers.
- Pilot test the system.
- Revise and scale up the system.

2010	2011	2012	2013	2014
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Appropriate emirate agencies

MOH MOL

**Target 3: Improve scientific understanding of human health risks****Stakeholders****EH-3 / T-3 / I-1**

Establish baseline occupational exposure information for each sector (as defined in the Abu Dhabi EHSMS regulatory framework), and then set appropriate targets.

2010	2011	2012	2013	2014
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Appropriate emirate agencies

MOH MOL

**Target 4: Build sustainable human and institutional capacity****Stakeholders****EH-3 / T-4 / I-1**

Conduct a needs assessment, and prepare a report on staffing and training needs related to OHS specialties in MOL, MOH, appropriate emirate agencies, and in the private sector.

- Determine the type and number of industrial hygienists, occupational physicians, occupational health nurses, safety practitioners, and other OHS specialists needed in the UAE, in both the public and private sectors.
- Form a committee from the responsible entities to delineate the types of positions, type of accreditation required, and accrediting organizations. Review needs annually (or at an appropriate frequency, to be determined).

2010	2011	2012	2013	2014
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Emirate environment and health agencies, education authorities, universities and colleges

MOH MOL

**EH-3 / T-4 / I-2**

Develop OHS training programs for general physicians and other health-care personnel.

2010	2011	2012	2013	2014
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Emirate environment and health agencies, education authorities, universities and colleges

MOH MOL

**EH-3 / T-4 / I-3**

Collaborate with local and foreign universities and other institutions to share research results and to develop specialized training programs.

2010	2011	2012	2013	2014
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Emirate environment and health agencies, education authorities, universities and colleges

MOH MOL



## Priority Area 3: Occupational Exposures

### Section Overview

# of Initiatives	# of KPIs	TOTAL
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MOE	Ministry of Education	MOI	Ministry of Interior
MOEW	Ministry of Environment and Water	MOL	Ministry of Labor
MOF	Ministry of Finance		

#### EH-3 / T-4 / I-4

Increase awareness of these programs and potential OHS employment opportunities among prospective students.

2010	2011	2012	2013	2014
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Emirate environment and health agencies, education authorities, universities and colleges

MOH MOL

#### EH-3 / T-4 / I-5

Designate funds from the emirates and the federal government for scholarships in OHS specialties.

2010	2011	2012	2013	2014
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Emirate environment and health agencies, education authorities, universities and colleges

MOH MOL

#### EH-3 / T-4 / I-6

Determine what constitutes "credentialed" for occupational health purposes (e.g., only those with formal training, or those with more general training who could be grandfathered in with specified years of experience).

2010	2011	2012	2013	2014
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Emirate environment and health agencies, education authorities, universities and colleges, the committee defined in EH-3 / T-1 / I-1

MOH MOL

#### EH-3 / T-4 / I-7

Increase number of staff with graduate-level training in OHS in MOL, MOH, and environment and health agencies in individual emirates.

- Provide professional training opportunities in OHS for government personnel in relevant agencies.
- Provide incentives for personnel to take OHS-related courses.

2010	2011	2012	2013	2014
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Emirate environment and health agencies, education authorities, universities and colleges, the committee defined in EH-3 / T-1 / I-1

MOH MOL

#### EH-3 / T-4 / I-8

Develop a training center with government support or create capacity to train OHS personnel to assist companies in complying with OHS requirements.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOI MOL

#### EH-3 / T-4 / I-9

Establish a whistle-blower protection law or regulations and programs to protect workers who report OHS violations to employers and regulatory agencies.

2010	2011	2012	2013	2014
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Legislature, emirate environment and health agencies

MOH MOL

#### EH-3 / T-4 / I-10

Develop certification programs in workplace safety for workers in high-risk fields such as pesticide application, welding, and working in confined spaces.

- Develop workshops and short courses.
- Link certification with employee work permits and employer permits.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOI MOL



#### EH-3 / T-4 / I-11

Develop a nationally accredited environmental and occupational health reference laboratory for the UAE, and increase the number of private or public accredited laboratories capable of analyzing biological or environmental samples collected in occupational exposure settings.

- Determine specific needs for laboratory services in each emirate.
- Allocate funding and personnel for labs.
- Establish fully functional reference laboratory for the UAE.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOL

### Target 5: Support urban development that promotes environmental health

No recommendations at this time.

### Target 6: Increase environmental awareness

#### Stakeholders

#### EH-3 / T-6 / I-1

Develop OHS materials such as posters, leaflets, Web sites, and videos relevant to the issues and culture of the UAE; distribute at workplaces.

2010	2011	2012	2013	2014
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Emirate environment and health agencies

MOH MOI MOL

#### EH-3 / T-6 / I-2

Provide workshops or short courses on OHS for employers, OHS personnel, and high-risk workers.

2010	2011	2012	2013	2014
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Emirate environment and health agencies, universities, training organizations

MOH MOI MOL

#### EH-3 / T-6 / I-3

Require companies to register with a regulatory agency (e.g., HAAD) to receive information packages (e.g., training manuals on working in heat) so that the potential impact can be measured.

2010	2011	2012	2013	2014
------	------	------	------	------

Emirate environment and health agencies, universities, training organizations

MOH MOL

#### EH-3 / T-6 / I-4

Develop OHS educational programs in secondary schools, colleges, and universities.

2010	2011	2012	2013	2014
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MOE MHESR

## Section Overview

# of Initiatives	# of KPIs	TOTAL
<b>43</b>	<b>34</b>	
19	15	Target 1
8	7	Target 2
1	1	Target 3
11	9	Target 4
0	0	Target 5
4	2	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative.

They may include nonspecific entities as well as these specific entities:

MHESR	Ministry of Higher Education and Scientific Research	MOH	Ministry of Health
MOE	Ministry of Education	MOI	Ministry of Interior
MOEW	Ministry of Environment and Water	MOL	Ministry of Labor
MOF	Ministry of Finance		

# Occupational Exposures (EH-3): Key Performance Indicators

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 1: Reduce pollutant levels and human exposure to pollutants</b>			
EH-3/T-1/K-1	Number and percentage of entities using required risk assessment process required of employers: 1. Number of emirate governments 2. Percentage of emirate government entities 3. Percentage of regulated facilities that meet standard, by emirate, in all employment sectors including health, transport, industry, tourism, oil and gas, building and construction, waste, agriculture, and mining/quarrying	1. 3-4 2. 100% in 3-4 emirates 3. 25% in 3-4 emirates	1. All emirates 2. 100% 3. 70%
EH-3/T-1/K-2	Government entities that have revised occupational exposure limits and that are implementing these limits: 1. Federal government 2. Number of emirate governments 3. Percentage of emirate governments implementing standards in policy	1. Yes 2. 3-4 3. 100% in 3-4 emirates	1. Yes 2. All emirates 3. 100%
EH-3/T-1/K-3	Percentage of regulated facilities that meet the new occupational exposure standards, by emirate, in all employment sectors	25% in 3-4 emirates	70%
EH-3/T-1/K-4	Number of emirates providing and maintaining evidence of risk-based employee training, instruction, and information on occupational hazards	3-4	All emirates
EH-3/T-1/K-5	Percentage of emirate government entities providing and maintaining evidence of risk-based employee training, instruction, and information on occupational hazards	100% in 3-4 emirates	100%
EH-3/T-1/K-6	Percentage of employers of regulated facilities that provide and maintain evidence of risk-based employee training, instruction, and information on occupational hazards	25% in 3-4 emirates	70%
EH-3/T-1/K-7	Percentage of regulated facilities in each employment sector (e.g., health, transport, etc., as specified above) with risk-based control program in place (e.g., through EHSMS)	20% in each sector	70% in each sector
EH-3/T-1/K-8	Number of work-site inspections conducted (for each type of regulated facility) per year	To be determined	To be determined
EH-3/T-1/K-9	Percentage of occupational health and safety violations adequately addressed within one year, by employment sector and emirate	20%	70%
EH-3/T-1/K-10	Percentage of regulated facilities that exceed occupational exposure limits per year, by employment sector and emirate	<70%	<20%
EH-3/T-1/K-11	Percentage of facilities with any employee exceeding biological exposure indices, by employment sector and emirate	<70%	<20%
EH-3/T-1/K-12	Percentage of regulated facilities that meet biological exposure indices standard, by sector and emirate	20%	70%

KPI No.	Description	2014 Goal	2030 Goal
EH-3/T-1/K-13	Incidence of total reportable cases of injury or illness by sector, based on international benchmarks (8.8 per million worker hours for Australia and 13.1 for the United States, including fatalities and nonfatalities; 6.6 for the United Kingdom, including only nonfatalities)	To be determined	10 per million worker hours per year (international benchmark)
EH-3/T-1/K-14	Federal labor law revised to incorporate international standards for compensation of work-related illnesses, injuries, and fatalities	Yes	Yes
EH-3/T-1/K-15	Statutory authority extended to include penalties for violation of occupational health laws	Yes	Yes

## Target 2: Improve data quantity and availability

EH-3/T-2/K-1	Percentage of emirate governments and emirate government entities with potential workplace hazards that have pre-employment and periodic health screening programs for workers in place, by emirate	100% in 3-4 emirates	100%
EH-3/T-2/K-2	Percentage of regulated facilities that meet requirements for pre-employment and periodic health screenings of workers, by sector and emirate	25% in 3-4 emirates	70% in all emirates
EH-3/T-2/K-3	Percentage of health-care facilities adopting ICD-10 coding to attribute illnesses, injuries, and deaths to workplace exposures / hazards, specified according to the following categories of facility: (a) public hospitals, (b) private hospitals, and (c) all other health-care facilities	25%	100%
EH-3/T-2/K-4	Percentage of companies with a risk-based occupational exposure monitoring program that is registered with local and federal authorities	To be determined	To be determined
EH-3/T-2/K-5	Percentage of emirate government entities with a program for reporting workplace health incidents (injuries and illnesses)	100% in 3-4 emirates	100% in all emirates
EH-3/T-2/K-6	Percentage of regulated facilities with a program for reporting workplace health incidents (injuries and illnesses), by employment sector and emirate	25% in 3-4 emirates	70% in all emirates
EH-3/T-2/K-7	Number of emirates with a centralized occupational health data system	2	All emirates

## Target 3: Improve scientific understanding of environmental health risks

EH-3/T-3/K-1	Annual funding for occupational health research for each major employment sector	To be determined	To be determined
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## Target 4: Build sustainable human and institutional capacity

EH-3/T-4/K-1	Number of dedicated government positions requiring OHS-credentialed employees, by year, for the following categories: 1. Occupational medicine 2. OHS 3. Industrial hygiene 4. Workplace inspection	To be determined	To be determined
EH-3/T-4/K-2	Number of accredited UAE-based graduate OHS training programs, in the following areas: 1. Occupational medicine 2. OHS 3. Industrial hygiene 4. Workplace inspection	To be determined	To be determined
EH-3/T-4/K-3	Number of graduates from UAE-based graduate-level OHS training, in each of the following areas: 1. Occupational medicine 2. OHS 3. Industrial hygiene 4. Workplace inspection	To be determined	To be determined

Section Overview

# of Initiatives	# of KPIs	
<b>43</b>	<b>34</b>	<b>TOTAL</b>
19	15	Target 1
8	7	Target 2
1	1	Target 3
11	9	Target 4
0	0	Target 5
4	2	Target 6

KPI No.	Description	2014 Goal	2030 Goal
EH-3 / T-4 / K-4	Number of scholarships granted for OHS-related study	To be determined	To be determined
EH-3 / T-4 / K-5	Number of credentialed government OHS employees in federal, emirate, and emirate entity positions, for each of the following employment categories: 1. Occupational medicine 2. OHS 3. Industrial hygiene 4. Workplace inspection	To be determined	To be determined
EH-3 / T-4 / K-6	Percentage of high-risk workers who receive required training (including introductory and refresher training) related to relevant specific hazards for each of the following categories of employers: 1. Federal government 2. Emirate government 3. Emirate government entity 4. Regulated facility (by employment sector and emirate)	Increasing trend	Increasing trend
EH-3 / T-4 / K-7	Number of emirates with occupational whistle-blower programs	To be determined	All emirates
EH-3 / T-4 / K-8	Establishment and enforcement of worker safety certification programs: 1. Number established, federal government 2. Percentage enforcement, federal government 3. Number established in each emirate 4. Percentage enforcement in each emirate	To be determined	1. To be determined 2. To be determined 3. To be determined 4. To be determined
EH-3 / T-4 / K-9	Accredited national reference laboratories established with the following specific capabilities: 1. Occupational medicine 2. Industrial hygiene 3. Environmental health	1-3: Yes	1-3: Yes

**Target 5: Support urban development that promotes environmental health**

	No pertinent KPIs		
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**Target 6: Increase environmental awareness**

EH-3 / T-6 / K-1	Number of government OHS initiatives, programs, or awareness campaigns conducted per year by: 1. The federal government 2. Emirate governments 3. Emirate government entities	1. 2 2. 2 3. 2	1. 2 2. 2 3. 2
EH-3 / T-6 / K-2	Percentage of the workforce that can demonstrate awareness or other desired outcomes (e.g., behaviors) associated with OHS	To be determined	100%



# Climate Change

## Problem Overview

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Climate change is an important and long-term global problem associated with greenhouse gas (GHG) emissions from energy use, industrial processes, transportation, agriculture, land-use change, and waste management. This extremely complex problem has large variations in its regional sources and impacts. Because the UAE is hot and arid, expected changes in the climate may be particularly important. The Intergovernmental Panel on Climate Change (IPCC) projects that average surface temperatures in the Arabian Peninsula region will likely increase 1-2 °C by 2030–2050, with increases predicted in winter regional precipitation levels as well (Watson et al. 1997).

Future climate change will have a variety of impacts in the UAE, but few of these impacts can be precisely estimated because regional data and models on climate change impacts for the UAE are limited and require further study. Significant influences on human health could include an increase in mortality and morbidity due to increased drought, increased frequency and intensity of heat waves, a rise in sea level, and potential changes in disease vector ecology (Campbell-Lendrum and Woodruff 2007). Climate change will also be an important influence on water resources through changes in precipitation, increased evaporation, and the increased salinity of groundwater near the coast, affecting natural ecosystems and agriculture. Further, as development along the coast continues, coastal infrastructure will be increasingly vulnerable to a future rise in sea level.

Because the climate change problem is caused by global GHG emissions, the UAE cannot fully decrease climate change impacts by reducing its own emissions. The UAE will need to continue to work with other nations to reduce global emissions. Future climate change is inevitable, so it is important for the UAE to plan effectively to anticipate and adapt to impending change. •



## Main Achievements and Successes

The UAE is already a participant in international efforts to address climate change. It has signed the United Nations Framework Convention on Climate Change (UNFCCC) and participates in the Kyoto Protocol. The UAE ratified the UNFCCC in 1995 and has submitted one national communication as part of its obligations under this treaty. The country ratified the Kyoto Protocol in January 2005, though it is not subject to binding targets due to its non-Annex-I status. The UAE has also been a recipient of foreign investment to reduce GHG emissions through the Clean Development Mechanism of the Kyoto Protocol.

Efforts to reduce desertification help reduce the impacts of climate change. The UAE issued the National Action Program

and Strategy for Combating Desertification in 2003 (UAE Ministry of Energy 2006). The government has invested in planting mangrove forests along the coastline and subsidizes the planting of new trees by Emiratis.

The UAE also has launched numerous initiatives to reduce energy consumption. It hosted the first World Summit on Energy for the Future in January 2008. Abu Dhabi has been a leader in promoting the development of energy-conserving technology with its multibillion dollar Masdar initiative, part of which includes Masdar City. This 50,000-person city is intended to be the world's first carbon-neutral city powered by solar, wind, and other alternative power sources (Craft 2008). Abu Dhabi

has also announced a \$15 billion initiative to develop clean energy technologies using hydrogen.

In addition, Abu Dhabi's forthcoming energy policy includes a target of 7% renewable energy use by 2020, and Abu Dhabi has launched a green building initiative, Estidama (EAD 2009a). EAD's forthcoming Abu Dhabi Climate Change Policy exemplifies the initiatives of the emirate toward reducing the rate of global warming.

Dubai has recently implemented progressive policies, including building codes to conserve energy, incrementally higher pricing for water and electricity, solar-powered parking meters, and a green building initiative (Kazim 2007). •

## Main Unresolved and Emerging Issues

Greenhouse-gas emissions are likely to continue to grow as the UAE population and economy grow. The UAE has not adopted a binding economy-wide target for emission reductions.

In order to develop appropriate policies, the UAE will need an accurate and detailed inventory of its current sources and sinks of GHGs. The existing GHG inventory in the UAE, from 1994 (UAE Ministry of Energy 2006), is outdated. Many of the emissions estimates from the 1994 inventory were based on international emissions factors, such as from the IPCC, rather than on UAE-specific factors.

The post-Kyoto-Protocol era of international climate policy is quickly emerging, and the UAE must be prepared to be an effective participant in these negotiations. An up-to-date, accurate GHG emissions inventory is imperative to support the UAE's

participation. Such an inventory will allow the UAE to determine effective and realistic targets for its own GHG emissions, as well as to help shape effective international GHG emissions targets.

The UAE's initial communication (2006) to the UNFCCC recommends that these data quality issues be addressed through strengthening institutional capacity, developing local emission factors, and reducing information gaps for the energy, industrial, agriculture, waste, land-use change, and forestry sectors. Information gaps about the emissions sources for each emirate are also significant.

While the UAE's total GHG emissions are lower than in many countries, the UAE has the second highest per-capita GHG emissions in the world, partly due to the country's high rates of energy use for water desalination and other activities (Baumert,

Herzog, and Pershing 2005). Effective greenhouse gas mitigation strategies will need to address these underlying trends of high rates of energy use and per-capita emissions. Because the public may have limited awareness of the climate change problem, educational strategies will be important in encouraging both mitigation and adaptation.

A global response to climate change will likely have a significant impact on oil-producing nations, including the UAE. Although the UAE has been diversifying its economy for several decades to avoid relying solely on revenue from fossil fuel exports, global GHG mitigation actions will likely reduce fossil fuel consumption and negatively impact the national economy. Planning for these global changes will be an important part of a long-term national climate-change strategy. •



## Recommendations

Solving the climate change problem will require mitigation measures to stabilize global atmospheric GHG concentrations as well as adaptation measures to reduce the effects of climate change that will occur in the emirates. To develop a successful mitigation and adaptation strategy, the UAE must:

**Reduce GHG emissions.** Increasing energy efficiency, increasing the market share of clean energy sources, decreasing GHG emissions from the transportation sector, and developing and implementing carbon capture and sequestration technology will all help reduce total GHG emissions. Worldwide, the primary source of GHG emissions is the extraction and combustion of fossil fuels. The UAE can directly reduce GHG emissions by substituting renewable energy sources for natural gas or oil combustion. In this regard, the UAE has shown leadership in some forward-looking and high-profile actions to reduce emissions, such as through the development of Masdar City. The UAE should continue to implement renewable energy projects and support further research and development on these technologies, as this will lead to growth in the energy sector. The UAE has only recently begun to implement energy conservation and efficiency measures and should continue these efforts, especially in the industrial sector and in desalination plants because energy use in these sectors accounts for 95% of the UAE's GHG emissions (UAE Ministry of Energy 2006).

The UAE can play an important role in international negotiations on climate change, which are now focusing on binding emissions reductions for the post-Kyoto-Protocol period after 2012. In particular, the UAE can take a leading role in reducing emissions, as its per-capita GHG emissions are currently among the highest in the world (Baumert, Herzog, and Pershing 2005). The Abu Dhabi Climate Change Policy already calls for a GHG registry system to track, monitor, and raise awareness of GHG emissions. The UAE should also explore the possibility of making a public commitment to reduce GHG emissions. Although the UAE is not required to make reductions under existing international climate agreements, a binding commitment to reduce emissions would demonstrate strong leadership and a forward-thinking approach to addressing this critical issue.

**Improve data quantity and availability.** An accurate inventory of the UAE's GHG emissions is the key ingredient needed to guide future climate change strategies in the UAE. The seven emirates vary significantly in terms of population, develop-

ment, local circumstances, and resources, implying intranational variation in the sources and impacts of climate change in the UAE. In order for a mitigation and adaptation strategy to be effective, it is essential to consider these regional variations in the development of climate change policies. Therefore, while a national GHG inventory is critical, GHG inventories should be emirate-specific as well.

Once an appropriate system is in place to conduct accurate GHG inventories, updating emissions data annually will permit the UAE to track the progress and success of policy measures. In addition, an increase in available climate change data specific to the UAE will improve the accuracy of emissions estimates. This system would encourage the development of a GHG registry and software to assist in tracking GHG emissions.

**Improve scientific understanding of environmental health risks.** An important first step toward adapting to climate change will be to conduct a dedicated study of how global climate change will impact the UAE—an analysis that should be coordinated and undertaken by the federal government. It is essential that the UAE begin now to actively anticipate the consequences of global climate change and to adapt to them, in order to reduce the impacts and costs. Once climate change impacts are better understood, additional adaptation policies can be explored and implemented. For example, an expanded health infrastructure is one key priority for adapting effectively to climate change. Actions should be taken to improve the overall understanding of how climate change will affect human health, including improving the monitoring of conditions likely to result from climate change; educating health-care professionals on climate-related health impacts; and identifying priority actions for health protection, disease prevention, and health-care infrastructure to address climate-related health impacts. A system for early warning and effective protection against extreme heat waves, for instance, is one highly recommended measure to decrease heat-related illnesses.

Water availability is a critical issue in the UAE, and water supply may be impacted by accelerated global warming. Some regional climate models predict that the Arabian Peninsula may experience slightly increased precipitation as a result of climate change (Watson et al. 1997), whereas other models project decreased precipitation. These effects have not been precisely estimated for the UAE. Consequently, it will be important to study the expected impacts on national water supply in more detail, continuing the efforts of the Climate Change Impact Study on Water Resources in Abu Dhabi. Water conservation

can help reduce vulnerability through implementing water efficiency measures, increasing public awareness, and water pricing policies. Water conservation will help prepare the nation in the event that climate change decreases water supply, and it will help mitigate climate change by using less energy for desalination plant operations.

**Build sustainable human and institutional capacity.** Building institutional capacity and interorganizational cooperation is important to facilitate updating and maintenance of the UAE's GHG inventory. The UAE can also increase research on carbon capture and sequestration (CCS) technology. Globally, only a few demonstration CCS projects exist, but this technology has the potential to grow rapidly. In the UAE, CCS could take the form of using CO<sub>2</sub> for enhanced oil recovery to increase extraction of oil from existing wells through injection. New power plants could be designed and built to allow for future CCS.

**Support urban development that promotes environmental health.** The transportation sector in the UAE is steadily expanding and is likely to be an even larger source of GHG emissions in the future. Strengthening fuel efficiency standards, increasing mass transportation, switching fuels to varieties with lower GHG emissions, and discouraging driving via congestion pricing are all policy tools that could reduce GHG emissions from transportation.

The UAE can also adopt policies to assist with adaptation to the economic and social impacts of climate change. These would include building farther away from the coast, planning now for the consequences of an increase in sea level in the emirates' extensive seaside urban areas and infrastructure, and modifying the built environment to reduce the heat island effect. Developing methods for ranking the cost and benefits of mitigation and adaptation measures, including public investment costs as well as GDP impacts and externalities, will provide essential support for cost-effective action against climate change.

**Improve environmental awareness.** Public awareness campaigns can be a catalyst for measures to mitigate and adapt to climate change. Energy conservation programs to raise public awareness as well as energy pricing to encourage conservation are highly recommended. The government can also improve energy efficiency through mandated energy efficiency standards in building construction, appliances, and air conditioners, both in homes and in larger commercial, office, and multifamily residential buildings. •

# Climate Change (EH-4):

## Initiatives to Reduce the Burden of Disease Due to Global Climate Change

Note that Target 1 is worded differently for this priority area.

Target 1: Reduce GHG emissions	Stakeholders
<b>EH-4 / T-1 / I-1 *</b> Convene technical committee to oversee climate change policy. <div> <div>2010</div> <div>2011</div> <div>2012</div> <div>2013</div> <div>2014</div> </div>	Appropriate emirate agencies <div>MOEW EAD</div>
<b>EH-4 / T-1 / I-2</b> Commission climate change adaptation plan for the entire UAE, with additional adaptation plans for specific emirates. <div> <div>2010</div> <div>?</div> </div>	Committee created by EH-4 / T-1 / I-1, appropriate emirate agencies <div>MOEW</div>
<b>EH-4 / T-1 / I-3</b> Develop early warning systems for heat episodes, using improved meteorological data collection and prediction. <div> <div>2010</div> <div>?</div> </div>	Emirate and municipal agencies <div>MOH</div>
<b>EH-4 / T-1 / I-4 *</b> Create plans to ensure water availability under future climate change, particularly in areas relying on groundwater. <div> <div>2010</div> <div>2011</div> <div>2012</div> <div>2013</div> <div>2014</div> </div>	Appropriate emirate agencies <div>MOEW ADWEA</div>
<b>EH-4 / T-1 / I-5 *</b> Develop plans for coastal development, accounting for future climate change. <div> <div>2010</div> <div>?</div> </div>	<div>MOEW EAD UPC</div>
<b>EH-4 / T-1 / I-6</b> Develop nationally coordinated policies and regulations for the management of sensitive ecosystems, accounting for future climate change. <div> <div>2010</div> <div>?</div> </div>	Appropriate emirate agencies <div>MOEW</div>
<b>EH-4 / T-1 / I-7 *</b> Develop an emergency plan for coastal areas. <div> <div>2010</div> <div>?</div> </div>	Appropriate emirate agencies <div>MOEW</div>
<b>EH-4 / T-1 / I-8 *</b> Commission a comprehensive energy supply and GHG mitigation plan for the UAE, including delineation of federal and emirate responsibilities. <div> <div>2010</div> <div>?</div> </div>	Committee created by EH-4 / T-1 / I-1, energy agencies <div>MOEW</div>
<b>EH-4 / T-1 / I-9</b> Accept binding GHG reduction targets that specify the amount of reduction and target date, for the entire economy or for particular sectors, subject to the availability of emissions inventories of sufficient quality. <div> <div>2010</div> <div>?</div> </div>	Industry <div>MOEW ADNOC</div>
<b>EH-4 / T-1 / I-10</b> Consider cap-and-trade program to reduce carbon emissions, subject to the availability of emissions inventories of sufficient quality. <div> <div>2010</div> <div>?</div> </div>	Industry <div>MOEW ADNOC</div>
<b>EH-4 / T-1 / I-11</b> Reduce subsidies for electric power, gasoline, and diesel, possibly in phases. <div> <div>2010</div> <div>2011</div> <div>2012</div> <div>2013</div> <div>2015</div> </div>	Energy agencies <div>MOEW</div>

## Section Overview

# of Initiatives	# of KPIs
<b>45</b>	<b>16</b>
26	5
5	1
7	1
3	3
1	2
3	4

## TOTAL

Target 1

Target 2

Target 3

Target 4

Target 5

Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative.

They may include nonspecific entities as well as these specific entities:

ADNOC	Abu Dhabi National Oil Company	HAAD	Health Authority—Abu Dhabi	MOEW	Ministry of Environment and Water
ADWEA	Abu Dhabi Water and Electricity Authority	Khalifa	Khalifa Foundation	MOF	Ministry of Finance
EAD	Environment Agency—Abu Dhabi	Masdar	Abu Dhabi Future Energy Company	MOH	Ministry of Health
Emirates	Emirates Foundation	MOE	Ministry of Education	NILU	Norwegian Institute for Air Research
				UPC	Urban Planning Council

### EH-4 / T-1 / I-12

Establish standards for energy-efficient products (e.g., lighting, air conditioning, appliances).

2010	2011	2012	2013	2014	To be determined
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### EH-4 / T-1 / I-13

Establish and/or tighten fuel-efficiency standards for vehicles.

2010	2011	2012	2013	2014	To be determined
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### EH-4 / T-1 / I-14\*

Investigate opportunities for carbon capture and sequestration (CCS) technology, including enhanced oil recovery.

2010	ONGOING				To be determined
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### EH-4 / T-1 / I-15

Plan the construction of new power plants to allow the future addition of CCS technology.

2010	ONGOING				To be determined
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### EH-4 / T-1 / I-16\*

Introduce a renewable portfolio standard for electricity generation, mandating a fraction of power to be generated from renewable sources (e.g., wind, solar).

2010	2011	2012	2013	2014	Emirate and local energy agencies, other appropriate emirate agencies
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### EH-4 / T-1 / I-17

Provide subsidies as an incentive for renewable power generation (e.g., wind, solar).

2010	?				Emirate and local energy agencies
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### EH-4 / T-1 / I-18\*

Promote microgeneration by setting targets for small-scale renewable power production and household adoption of other renewable energy technology such as solar water heaters and solar cooling.

2010	2011	2012	2013	2014	Emirate and local energy agencies
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### EH-4 / T-1 / I-19

Establish a feed-in tariff system to pay for home power generation.

2010	?				Emirate and local energy agencies
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### EH-4 / T-1 / I-20\*

Establish green building standards in all emirates.

2010	2011	2012	2013	2014	Environment and urban planning agencies
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### EH-4 / T-1 / I-21

Provide subsidies and/or awards for green building construction.

2010	?				Environment and urban planning agencies
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\*Included in Abu Dhabi Climate Change Policy

**EH-4 / T-1 / I-22**

Implement the Masdar City initiative.



Masdar

**EH-4 / T-1 / I-23 \***

Improve the efficiency of power generation and water desalination.



Emirate-level water and electricity authorities

**EH-4 / T-1 / I-24**

Identify and implement actions that will be particularly effective at reducing emissions of both air pollutants and greenhouse gases.



To be determined

**EH-4 / T-1 / I-25**

Submit the Second National Communication to the United Nations Framework Convention on Climate Change.



Committee created by EH-4 / T-1 / I-1

**EH-4 / T-1 / I-26**

Engage positively in international negotiations on possible post-Kyoto-Protocol international agreements.



To be determined

**Target 2: Improve data quantity and availability****Stakeholders****EH-4 / T-2 / I-1 \***

Develop GHG registry system for all major sources of GHG emissions for each emirate and for the entire UAE.



Committee created by EH-4 / T-1 / I-1, appropriate local agencies

MOEW

**EH-4 / T-2 / I-2**

Construct/improve UAE national carbon accounting (GHG registry) by designating responsible parties in each agency.



Emirate environment agencies

MOEW

**EH-4 / T-2 / I-3 \***

Design and develop a software tool to be shared across all emirates that can be used by emitters to track and report GHG emissions.



Appropriate emirate agencies

MOEW

**EH-4 / T-2 / I-4 \***

Publicize GHG registry/emissions data, at least for largest emitters.



To be decided

**EH-4 / T-2 / I-5**

Complete an updated comprehensive national GHG emissions inventory, including all relevant sources, and make this available to the public.



Committee created by EH-4 / T-1 / I-1

MOEW

NIU

**Target 3: Improve scientific understanding of environmental health risks****Stakeholders****EH-4 / T-3 / I-1**

Commission and perform studies in the UAE to determine actions that will reduce vulnerabilities to climate change, using the Stockholm Environmental Institute's work for the UAE as starting point.



Committee created by EH-4 / T-1 / I-1

MOEW



## Priority Area 4: Climate Change

### Section Overview

# of Initiatives	# of KPIs
<b>45</b>	<b>16</b>
26	5
5	1
7	1
3	3
1	2
3	4

### TOTAL

Target 1

Target 2

Target 3

Target 4

Target 5

Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative.

They may include nonspecific entities as well as these specific entities:

ADNOC	Abu Dhabi National Oil Company	HAAD	Health Authority—Abu Dhabi	MOEW	Ministry of Environment and Water
ADWEA	Abu Dhabi Water and Electricity Authority	Khalifa	Khalifa Foundation	MOF	Ministry of Finance
EAD	Environment Agency—Abu Dhabi	Masdar	Abu Dhabi Future Energy Company	MOH	Ministry of Health
Emirates	Emirates Foundation	MOE	Ministry of Education	NILU	Norwegian Institute for Air Research
				UPC	Urban Planning Council

### EH-4 / T-3 / I-2

Commission studies on the threats of climate change to human health, to include suggested priority actions for health-care and other urban infrastructure.

2010	2011	2012	2013	2014
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Universities, consultants, emirate environment agencies

HAAD UPC

### EH-4 / T-3 / I-3

Fund research and development of new energy technologies with lower GHG emissions, including renewable energy sources (e.g., solar), efficiency improvements, and carbon capture and sequestration.

2010	?
------	---

MOE MOF Masdar  
Emirates Khalifa

### EH-4 / T-3 / I-4

Conduct evaluations of adaptation and mitigation options (e.g., costs and benefits), and rank in terms of feasibility.

2010	2011	2012	2013	2014
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To be determined

### EH-4 / T-3 / I-5\*

Commission improvements to meteorological prediction capabilities, including regional scale studies of the effects of climate change.

2010	?
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Appropriate emirate agencies, other Gulf Cooperation Council nations

MOEW

### EH-4 / T-3 / I-6

Disseminate meteorological prediction and studies of the effects of climate change to federal, emirate, and local agencies for developing adaptation plans.

2010	?
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Appropriate emirate agencies, other Gulf Cooperation Council nations

MOEW

### EH-4 / T-3 / I-7

Designate emirate-level committees to explore and oversee government research and development funding for low-carbon technologies.

2010	?
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To be determined

## Target 4: Build sustainable human and institutional capacity

### Stakeholders

### EH-4 / T-4 / I-1

Develop governmental capabilities to coordinate actions to address air quality and climate change, and evaluate strategies' cost effectiveness for addressing both problems.

2010	?
------	---

To be determined

### EH-4 / T-4 / I-2\*






Develop new office for climate change mitigation and adaptation within the federal and emirate governments. Link climate change centers in emirate agencies to other relevant agencies (e.g., transport, energy) through official channels.

2010	2011	2012	2013	2014
------	------	------	------	------

Emirate environment agencies

MOEW

\*Included in Abu Dhabi Climate Change Policy

<b>EH-4 / T-4 / I-3</b> Establish curriculum and certification programs on climate change in relevant professional education programs.		Universities
		
<b>Target 5: Support urban development that promotes environmental health</b>		<b>Stakeholders</b>
<b>EH-4 / T-5 / I-1</b> Convene a UAE working group on carbon-reducing urban planning options to share and disseminate knowledge across emirates and cities.		Federal government (e.g., Higher Committee on Climate Change)
		
<b>Target 6: Increase environmental awareness</b>		<b>Stakeholders</b>
<b>EH-4 / T-6 / I-1</b> Establish consumer labeling system to identify efficient appliances for energy use and life-cycle emissions.		Appropriate federal and local agencies
		
<b>EH-4 / T-6 / I-2</b> Establish residential-, commercial-, and industrial-building energy audit programs in all emirates.		To be determined
		
<b>EH-4 / T-6 / I-3*</b> Design and develop public awareness campaigns at the emirate level on climate change risks and individual mitigation strategies. Campaign materials should be based on surveys that identify key gaps in public understanding of climate change issues.		To be determined
		

\*Included in Abu Dhabi Climate Change Policy

## Climate Change (EH-4): Key Performance Indicators

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 1: Reduce greenhouse-gas (GHG) emissions and adapt to global warming</b>			
EH-4/T-1/K-1	Total amount of GHG (CO <sub>2</sub> -equivalent) emissions from energy production and use: 1. Total CO <sub>2</sub> production 2. Carbon intensity	To be determined	To be determined
EH-4/T-1/K-2	Percentage of obligations achieved under the United Nations Framework Convention on Climate Change (UNFCCC)	To be determined	100%
EH-4/T-1/K-3	Total amount of electricity generated by renewable and low-carbon <sup>1</sup> sources: 1. Total renewable generation 2. % of total power generation	To be determined	1. To be determined 2. 10%
EH-4/T-1/K-4	Percentage of newly constructed commercial buildings that meet or exceed green building standards per year: 1. Total for UAE 2. By emirate	To be determined	To be determined
EH-4/T-1/K-5	Rates of heat-related cases and fatalities	To be determined	To be determined

## Section Overview

# of Initiatives	# of KPIs
<b>45</b>	<b>16</b>
26	5
5	1
7	1
3	3
1	2
3	4

## TOTAL

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative.

They may include nonspecific entities as well as these specific entities:

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Emirates	Emirates Foundation	MOE	Ministry of Education	NILU	Norwegian Institute for Air Research
				UPC	Urban Planning Council

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 2: Improve data quantity and availability</b>			
EH-4/T-2/K-1	GHG inventory coverage: 1. Number of emirates covered 2. Percentage of sectors covered by emirate 3. Number of major GHGs <sup>2</sup> included in inventory 4. Frequency of public reporting	1. To be determined 2. 50% 3. To be determined 4. To be determined	1. All emirates 2. 100% 3. To be determined 4. Annually
<b>Target 3: Improve scientific understanding of environmental health risks</b>			
EH-4/T-3/K-1	Funding per year for research into carbon-reducing technologies by emirate: 1. Total 2. As a percentage of all energy research and development funding	To be determined	To be determined
<b>Target 4: Build sustainable human and institutional capacity</b>			
EH-4/T-4/K-1	Percentage of students who can demonstrate awareness of climate change (by level of education)	To be determined	To be determined
EH-4/T-4/K-2	Percentage of health-care workers who can demonstrate awareness of potential health impacts	To be determined	To be determined
EH-4/T-4/K-3	Number of emirates with climate change adaptation plans	4	All emirates
<b>Target 5: Support urban development that promotes environmental health</b>			
EH-4/T-5/K-1	Cities per emirate with plans addressing adaptation to climate change	To be determined	To be determined
EH-4/T-5/K-2	Cities per emirate with plans addressing mitigation options for climate change	To be determined	To be determined
<b>Target 6: Increase environmental awareness</b>			
EH-4/T-6/K-1	Number of products that have CO <sub>2</sub> emissions labeling, including upstream and downstream emissions	To be determined	To be determined
EH-4/T-6/K-2	Percentage of products with efficiency ratings labeling (e.g., energy factor)	To be determined	To be determined
EH-4/T-6/K-3	Number of completed energy audits: 1. Residential 2. Commercial 3. Industrial	To be determined	To be determined
EH-4/T-6/K-4	Percentage of the public aware of climate change risks and the link between GHG emissions and climate change	To be determined	To be determined

<sup>1</sup> E.g., wind, solar, ocean-based, nuclear

<sup>2</sup> Carbon dioxide, methane, nitrogen oxides, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride



# Drinking Water

## Problem Overview

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As a country with one of the lowest supplies of fresh water in the world (World Bank 2005), the UAE relies on desalinated water as its main source of drinking water (Ali Murad, Al Nuaimi, and Al Hammadi 2007). Desalinated water meets more than 95% of the domestic water use demand in Abu Dhabi emirate (EAD 2009c), and a similarly high percentage is estimated for the other emirates. Although it is believed that water leaving the desalination plants and transported through the major trunk lines is of high quality, concerns exist about contaminants that might be introduced when water is transported to the point of use either as bottled water or through a piped distribution system.

Microbial contamination, which can result in gastrointestinal diseases, may be introduced at bottling plants or wherever breaks or cross-connections occur in a piped distribution system. Disinfection chemicals such as chlorine are used, as they are in most modern systems, to reduce microbial contamination, but this process also produces disinfection by-products that have been associated with certain cancers and negative reproductive outcomes (WHO 2000).

For bottled water there are concerns about chemicals that could migrate from bottles into the water, but recent studies have shown either that there are no detectable levels of these chemicals in the most widely used type of bottles (Al Mudhaf, Alsharifi, and Abu Shady 2009) and that the chemicals themselves are not a concern at the levels seen (Agluk-kaq 2008).

The demineralization that occurs during desalination is generally reversed through blending of highly mineralized water or the addition of additives in order to protect infrastructure and to address concerns that drinking demineralized water may be unhealthy (WHO 2005). •

## Main Achievements and Successes

By all accounts, the construction and operation of the many desalination plants in the UAE has been done well. New plants incorporate the latest technology, such as reverse osmosis, to produce water with far less energy and cost. The finished water leaving these plants is believed to be of high quality (Elshorbagy and Abdulkarim 2006).

The UAE has established water quality regulations for drinking water that are comparable to international guidelines (EAD 2004). These regulations include monitoring requirements, recordkeeping provisions, and the assurance of public ac-

cess to monitoring results. The Abu Dhabi Water Resources Master Plan for the emirate of Abu Dhabi (EAD 2009c) addresses concerns over energy use associated with desalinating water and general sustainability concerns. It documents issues such as unaccounted-for water and other indicators of breaches in distribution system integrity.

Regulations, oversight, and education concerning water supply have been improving (e.g., Regulation and Supervision Bureau 2009) and actions are being taken in response to data obtained through monitoring, as was done to eliminate bromate contamination (Shamseddine 2006). •

## Main Unresolved and Emerging Issues

Ensuring the quality of drinking water as it travels through the piped distribution systems of the various municipalities is a challenge. Rapid population growth has stressed existing distribution systems and water supply and has resulted in the expansion of distribution systems with a consequential increase in water residence times. Contamination can happen through physical breaks that occur in every distribution system, the same breaks that are responsible for water loss through leakage. Water supply challenges have resulted in intermittent water supply in some areas, creating

low-pressure events that allow infiltration of contaminated water through these leakage sites. There are direct health risks from the contaminants themselves as well as increased risks from disinfection by-products resulting from the higher disinfection loads needed to address the potential contamination.

Bottled water is the prevalent source of drinking water for those who can afford it. Tap water is seen as unhealthy due to the historic use of high-saline groundwater and the perceived degradation of water quality during storage in rooftop and underground

storage tanks. Although standards exist in some emirates as to how new storage tanks should be built (RSB 2009), it is unknown whether the existing infrastructure meets these standards and whether the water quality is degraded because of the high ambient temperatures to which these tanks are exposed, airborne contamination through vents, and lack of mixing within the tanks. Monitoring by the distribution system companies ends just before water reaches residences so the microbial, disinfection by-product, and other pollutant concentrations at the point of use are unknown. •

## Recommendations

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To reduce the potential for health risks due to contamination of potable water, the UAE should emphasize steps to increase water quality monitoring, prevent contamination through infiltration into the piped distribution system, and prevent water degradation in local storage tanks. Some emirates have already implemented many of the recommendations presented here, and their expertise will facilitate the national implementation of these practices.

**Reduce pollutant levels and human exposure to pollutants.** Addressing infiltration requires improving the integrity of the distribution system and reducing the number of low-pressure episodes. Distribution companies should document current leakage rates and develop programs that allow them to monitor the integrity of their systems while reducing the leakage rates to an acceptable level.

National standards that ensure the proper maintenance and oversight of distribution systems are also recommended.

**Improve data quantity and availability.** The UAE should implement routine monitoring efforts throughout the distribution system and at the point of use. Statistically sampling water throughout the system will allow the assessment of water quality against drinking water quality standards that incorporate international standards and local needs. Similar testing is needed for groundwater when it is used as a drinking water source and for bottled water.

Uniform national standards would facilitate this effort, and adherence to nationally recognized standards of sample tracking and testing will ensure the validity of the results.

**Improve scientific understanding of environmental health risks.** Storage tanks have been identified as a concern, and it is recommended that steps be taken to understand their role in water quality and the degree to which they are maintained so as to ensure healthy drinking water. Statistical sampling of water quality and maintenance levels of less than 1% of such systems should provide a wealth of information that would allow these systems to be improved and to allay public concern over the quality of tap water.

There are special concerns associated with desalinated marine water, such as how to best remineralize the treated water, how to manage disinfection by-products, and how the water may degrade in distribution systems

and storage tanks. Funding targeted research into these and other areas will provide knowledge on how to best tailor water quality standards, treatment, and distribution to the unique conditions found in the UAE.

**Build sustainable human and institutional capacity.**

The increase in water monitoring will require the development of increased capacity for accurate and rapid water quality testing along with advanced data systems to record, organize, and report these data to the appropriate water managers and oversight institutions. The results of this testing should be available not only to the managers of the water production and distribution systems but also to the water users. Using these data in an ongoing public health assessment and review of the safety and acceptability of drinking water supplies would contribute to the protection of public health by promoting improvement of the quality, quantity, and accessibility of water supplies.

**Support urban development that promotes environmental health.** Preventing infiltration also requires constant pressure in the distribution system so that the unavoidable breaks in the system result in water flowing out of the system, not into it. It is understood that some systems in the UAE experience intermittent water supply and therefore have periods of low pressure. It is recommended that goals for reducing the number of low-pressure events be established; that analyses be performed to identify loss reduction, capacity building, and demand management strategies to bring systems within the established target; and that monitoring be implemented to measure progress towards these goals.

Urban planning needs to include the development of drinking water supplies to ensure new development can be served adequately.

**Improve environmental awareness.** The likelihood of drinking water being contaminated increases as the quality of the source water decreases. It is therefore important that programs to protect drinking water sources be expanded and that development plans include environmental impact assessments evaluating the effects of development on drinking water supply and source water quality.

The agricultural community also needs to be aware of the effects of pesticides and fertilizers on groundwater sources. •





# Drinking Water (EH-5):

## Initiatives to Reduce the Burden of Disease Due to Drinking Water Contamination

Target 1: Reduce pollutant levels and human exposure to pollutants						Stakeholders
<b>EH-5 / T-1 / I-1</b> Review adoption and enforcement mechanism of national water quality criteria for all drinking water (municipal and bottled). <ul style="list-style-type: none"><li>Review adopted national standard.</li><li>Compile and evaluate emirate exceptions to the standards, and decide whether exceptions should be adopted nationally.</li><li>Review science associated with candidate changes to potable water standards.</li><li>Identify national and emirate agencies responsible for interpreting, promulgating, and enforcing these standards.</li></ul>						<div>Emirate food-control and environment agencies, distribution companies</div> <div>MOEWESMAHAAD</div> <div>RSB</div> <div>Emirate food-control and environment agencies, distribution companies</div> <div>RSB</div> <div>Emirate environment agencies, distribution companies</div> <div>MOEWFEWARSB</div> <div>Emirate environment agencies, distribution companies</div> <div>MOEWFEWARSB</div> <div>Emirate food-control and environment agencies, distribution companies</div> <div>MOEWFEWAHAAD</div> <div>RSB</div> <div>Emirate environment agencies</div> <div>MOEWFEWA</div>
2010	2011	2012	2013	2014		
<b>EH-5 / T-1 / I-2</b> Establish and integrate monitoring of public drinking water at treatment facilities, in water-distribution system, and at point of use. <ul style="list-style-type: none"><li>Establish sampling locations representative of overall population.</li><li>Establish sampling protocol including collection method, preservation, and chain of custody.</li><li>Determine protocol for reporting noncompliance of various contaminants.</li><li>Test for contaminants in a timely manner.</li><li>Make results of tests available to oversight authority through electronic access to database and periodic reports.</li></ul>						
2010	2011	2012	2013	2014		
<b>EH-5 / T-1 / I-3</b> Establish minimum pressure requirements for all potable-water distribution systems that are consistent with international standards. <ul style="list-style-type: none"><li>Evaluate infrastructure, supply, and water consumption to determine causes of low-pressure events.</li><li>Develop plan to upgrade infrastructure and manage supply and water use to comply with benchmarks for maintenance of pressure in the distribution system.</li><li>Initiate plan while evaluating progress through monitoring for low-pressure events.</li></ul>						
2010	2011	2012	2013	2014		
<b>EH-5 / T-1 / I-4</b> Improve the integrity of water distribution systems to minimize distribution system intrusion and leakage. <ul style="list-style-type: none"><li>Implement improvements recommended by EH-5 / T-1 / I-3 to avoid low-pressure incidents.</li><li>Perform water audit to understand extent of integrity breaches.</li><li>Establish integrity goals for each system.</li><li>Upgrade systems to meet integrity targets.</li></ul>						
2010	2011	2012	2013	2014		
<b>EH-5 / T-1 / I-5</b> Establish standards for stabilizing demineralized and desalinated water with a balanced composition of food-grade minerals.						
2010	2011	2012	2013	2014		
<b>EH-5 / T-1 / I-6</b> Expand programs to protect sources of drinking water (marine and groundwater) from contamination. <ul style="list-style-type: none"><li>Identify drinking water sources.</li><li>For groundwater wells providing drinking water, establish permitting system that mandates monitoring.</li><li>Review land-use practices in areas where groundwater is used for drinking, and address activities with potential to contaminate groundwater.</li><li>Establish maximum pollutant-loading criteria for pollutants of concern in the marine environment.</li><li>Establish system of monitoring and limiting point discharges to ensure total loading is below allowable limit.</li><li>Periodically review permissible maximum pollutant loading to ensure effectiveness.</li></ul>						
2010	2011	2012	2013	2014		

## Section Overview

# of Initiatives	# of KPIs	TOTAL
19	16	
11	10	Target 1
3	3	Target 2
1	0	Target 3
1	1	Target 4
1	1	Target 5
2	1	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative. They may include nonspecific entities as well as these specific entities:

ESMA	Emirates Authority for Standardization and Metrology	MOEW	Ministry of Environment and Water
FEWA	Federal Electricity and Water Authority	MOH	Ministry of Health
HAAD	Health Authority—Abu Dhabi	RSB	Regulation and Supervision Bureau

### EH-5 / T-1 / I-7

Establish system for conducting routine surveys of groundwater quality where groundwater is a drinking water source.

2010	2011	2012	2013	2014
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Emirate environment agencies

MOEW	ESMA
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### EH-5 / T-1 / I-8

Ensure that existing testing programs for bottled water include tests for microbes, disinfection by-products, and other potential contaminants; ensure that programs are carried out in all emirates.

2010	2011	2012	2013	2014
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Emirate food-control agencies

ESMA
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### EH-5 / T-1 / I-9

Create guidelines for bottled-water industry best manufacturing practices, process control, and bottled-water transport and storage, accounting for temperature and duration of storage.

2010	2011	2012	2013	2014
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Emirate food-control and environment agencies

### EH-5 / T-1 / I-10

Monitor the new UAE unified surveillance system for infectious diseases for waterborne disease outbreaks.

2010	2011	2012	2013	2014
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Emirate food-control and health agencies

MOH	HAAD
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### EH-5 / T-1 / I-11

Establish a public-health assessment and review process of the safety and acceptability of drinking water supplies.

2010	2011	2012	2013	2014
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Emirate food-control and environment agencies, distribution companies

MOEW	ESMA	FEWA
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## Target 2: Improve data quantity and availability

## Stakeholders

### EH-5 / T-2 / I-1

Develop systems of reporting and action to ensure compliance with standards for potable water.

- Create uniform electronic reporting format for finished water quality results.
- Create system for creating summary reports.
- Continue and expand as necessary the independent review of water quality results.
- Develop response plan for detection of unacceptable levels of particular contaminants.

2010	2011	2012	2013	2014
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Emirate food-control and environment agencies, distribution companies

MOEW	ESMA	FEWA
HAAD		

### EH-5 / T-2 / I-2

Establish an online database with all potable-water quality testing and compliance results from all water providers and water distribution companies.

2010	2011	2012	2013	2014
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Emirate food-control and environment agencies, distribution companies

MOEW	ESMA	FEWA
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### EH-5 / T-2 / I-3

Quantify the fraction of the population in each category of drinking water source (e.g., desalinated marine water, desalinated groundwater, treated groundwater, untreated groundwater, mineral water, bottled desalinated water), by supplier and location.

2010	2011	2012	2013	2014
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Emirate food-control and environment agencies

MOEW	ESMA	FEWA
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Target 3: Improve scientific understanding of environmental health risks						Stakeholders	
<div>EH-5 / T-3 / I-1</div> <div>Fund research into potential health threats due to reliance on desalinated water (including low mineral content and disinfection by-product formation).</div> <div><ul style="list-style-type: none"><li>• Determine research priorities.</li><li>• Identify research team.</li><li>• Design research protocol.</li><li>• Obtain funding.</li><li>• Implement research.</li><li>• Publish and disseminate findings, including to UAE policy makers.</li></ul></div>						<div><div>MOEW</div><div>ESMA</div><div>HAAD</div></div>	
<div><div>2010</div><div>ONGOING</div></div>							
Target 4: Build sustainable human and institutional capacity						Stakeholders	
<div>EH-5 / T-4 / I-1</div> <div>Improve methods for measuring water quality, including new detection methods.</div> <div><ul style="list-style-type: none"><li>• Establish labs of adequate capacity to measure contaminant levels.</li><li>• Develop quality-assurance and quality-control procedures.</li><li>• Determine protocol for reporting noncompliance of various contaminants.</li><li>• Test for contaminants in a timely manner.</li><li>• Make results of tests available to oversight authorities through electronic access to database and periodic reports.</li></ul></div>						<div>Emirate food-control and environment agencies, distribution companies</div> <div><div>MOEW</div><div>ESMA</div><div>FEWA</div></div>	
<div><div>2010</div><div>2011</div><div>2012</div><div>2013</div><div>2014</div></div>							
Target 5: Support urban development that promotes environmental health						Stakeholders	
<div>EH-5 / T-5 / I-1</div> <div>For all new development projects, require assessment of impact on drinking water supply and demand.</div>						<div>Emirate environment agencies, distribution companies</div>	
<div><div>2010</div><div>2011</div><div>2012</div><div>2013</div><div>2014</div></div>							
Target 6: Increase environmental awareness						Stakeholders	
<div>EH-5 / T-6 / I-1</div> <div>Provide residents with information on the quality of tap water.</div> <div><ul style="list-style-type: none"><li>• Determine water quality metrics easily understood by the public.</li><li>• Require water distributors to perform adequate testing to calculate these metrics.</li><li>• Establish a uniform reporting format for both online and printed distribution.</li><li>• Require periodic distribution of water quality information.</li></ul></div>						<div>Emirate food-control and environment agencies, distribution companies</div>	
<div><div>2010</div><div>2011</div><div>2012</div><div>2013</div><div>2014</div></div>							
<div>EH-5 / T-6 / I-2</div> <div>Increase public awareness of proper installation and maintenance of water storage tanks.</div> <div><ul style="list-style-type: none"><li>• Develop research program to assess water quality issues associated with different types of rooftop storage tanks.</li><li>• Create national installation and maintenance criteria that preserve stored water quality.</li><li>• Develop and implement program of education, incentives, and permitting to ensure appropriate installation and maintenance.</li></ul></div>						<div>Emirate food-control and environment agencies</div> <div><div>MOEW</div><div>ESMA</div><div>HAAD</div></div>	
<div><div>2010</div><div>2011</div><div>2012</div><div>2013</div><div>2014</div></div>							

## Drinking Water (EH-5): Key Performance Indicators

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 1: Reduce pollutant levels and human exposure to pollutants</b>			
EH-5/T-1/K-1	Percentage of water treatment facilities that produce finished water that meets required standards	100%	100%
EH-5/T-1/K-2	Percentage of water treatment facilities that comply with treatment technique standards each year	100%	100%

## Priority Area 5: Drinking Water

### Section Overview

# of Initiatives	# of KPIs	TOTAL
19	16	
11	10	Target 1
3	3	Target 2
1	0	Target 3
1	1	Target 4
1	1	Target 5
2	1	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative. They may include nonspecific entities as well as these specific entities:

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FEWA	Federal Electricity and Water Authority	MOH	Ministry of Health
HAAD	Health Authority—Abu Dhabi	RSB	Regulation and Supervision Bureau

KPI No.	Description	2014 Goal	2030 Goal
EH-5/T-1/K-3	Percentage of water samples taken from points of use (e.g., public buildings and fire stations) that comply with potable water quality standards each year	>95%	>99%
EH-5/T-1/K-4	Percentage of groundwater samples that exceed standards for nitrate, fertilizers, and pesticides	To be determined	To be determined
EH-5/T-1/K-5	Annual number of incidents of low pressure in water distribution system	To be determined	To be determined
EH-5/T-1/K-6	Percentage of water distribution systems with active programs for addressing the physical integrity of the system	95%	100%
EH-5/T-1/K-7	Percentage of treated water lost through leaks in the distribution system	<15%	<10%
EH-5/T-1/K-8	Percentage of bottled water companies that comply with standards for mineral, chemical, and microbial content	100%	100%
EH-5/T-1/K-9	Number of waterborne disease outbreaks per year	0	0
EH-5/T-1/K-10	Percentage of sampled storage tanks that are properly maintained	80%	95%

### Target 2: Improve data quantity and availability

EH-5/T-2/K-1	Percentage of water quality test results provided to oversight authority each year	>90%	To be determined
EH-5/T-2/K-2	Percentage of entities involved in potable water production and distribution that meet frequency requirements for water quality testing each year	>90%	100%
EH-5/T-2/K-3	Percentage of population aware of the composition of public and bottled drinking water	To be determined	To be determined

### Target 3: Improve scientific understanding of environmental health risks

	No pertinent KPIs		
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### Target 4: Build sustainable human and institutional capacity

EH-5/T-4/K-1	Capacity of drinking water quality labs to process samples (number of samples per unit time)	To be determined	To be determined
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### Target 5: Support urban development that promotes environmental health

EH-5/T-5/K-1	Percentage of development plans containing environmental impact assessments evaluating the effects of development on drinking water supply and source water quality	100%	100%
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### Target 6: Increase environmental awareness

EH-5/T-6/K-1	Percentage of farmers and others aware of effects of pesticides and fertilizers on groundwater quality	To be determined	To be determined
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# Coastal Water

## Problem Overview

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Coastal recreational activities, including swimming, fishing, and sailing, are popular in the UAE. Tourism related in part to these activities is a major industry, especially in Dubai and Abu Dhabi, attracting millions of foreign visitors annually (Dubai Department of Tourism and Commerce Marketing 2007).

Contamination of these coastal waters by sewage or other fecal pollution can result in the transmission of infectious diseases of various etiologies among swimmers and other users. Gastrointestinal diseases are the most common type of illness resulting from recreational exposure to contaminated waters, but skin diseases, respiratory illness, and fevers are also possible (Craun, Calderon, and Craun 2005; Wade et al. 2003; Pruss 1998).

Coastal waters can also threaten public health if recreational areas are contaminated by chemicals from industrial effluents, oil spills, and/or toxin-producing algal blooms ("red tides").

As industrial effluents appear to be sufficiently regulated with no recorded violations, and catastrophic single incidents such as oil spills or red tides would be highly visible and would be expected to deter any swimming/wading in affected areas, the primary focus of this section is microbiological contamination.

The phenomenon of algal blooms is also addressed in Priority Area 8: Produce and Seafood, page 82. •



## Main Achievements and Successes

Microbiological contamination of coastal water quality is generally considered a lesser concern in developed nations, such as the UAE, that require treatment of municipal wastewater prior to discharge. Past investigations of indicator organism concentrations in the Arabian Gulf generally support this assumption, reporting very low average concentrations of coliforms along the coast (Banat et al. 1998;

Banat et al. 1993; Abu Hilal et al. 1994).

EAD currently monitors two beach areas monthly within the city of Abu Dhabi: Al Raha beach and the public beach. Observed fecal streptococci (enterococcus subgroup) levels only occasionally exceeded WHO or U.S. EPA recommended bathing water standard levels at one beach during one of the two years for which monitoring data were available. •

## Main Unresolved and Emerging Issues

Unprecedented rapid development and rapid population growth throughout the nation appear to be straining available water treatment facilities. Chronic overloading of wastewater treatment plants results in decreased hydraulic retention times and reduces effluent quality, potentially discharging high concentrations of microorganisms to coastal tributaries. Additionally, a heavy reliance on tanker trucks to transport sewage from areas lacking sewers may result in some illegal dumping into storm drains or directly into the Arabian Gulf.

Although EAD has established water

quality standards for recreational areas within the emirate of Abu Dhabi, it is unclear whether all emirates have adopted similar standards or instituted monitoring programs. Anecdotal evidence suggests that a lack of public notice detailing existing water quality or necessary beach closures may be creating some concern among tourists and residents that swimming presents an elevated health risk due to fecal pollution (Setrakian 2009; *Telegraph* 2009). It is unclear whether these concerns are well-founded or simply the result of a lack of official information. •

## Recommendations

To reduce the health risks associated with exposure to pollutants in coastal water, the UAE should:

### Reduce pollutant levels and human exposure to pollutants.

Virtually immediate reductions in health risks related to recreational waters can be achieved through increased monitoring of fecal indicator bacteria concentrations at local beaches and closure of areas in violation of international recommended standards until adequate reductions in microbial concentrations are achieved.

National standards for coastal water quality monitoring and beach closures will prevent exposure to waterborne pathogens but will not reduce actual coastal contamination. In order to achieve this ultimate goal, the establishment of consistent national discharge standards for point-source effluents, including mandatory daily monitoring for pathogen indicators and chemical contaminants of concern (e.g. dioxins, PCBs, etc.), is needed to ensure consistently safe recreational areas throughout the nation.

Although some discharge recommendations currently exist, considerable confusion remains at the emirate level as to which government entities are responsible for monitoring and enforcement of standards. Without enforcement, including the levying of tangible fines or penalties in response to recorded violations, improvements in water quality will not be achieved. Clarification of the roles and responsibilities of each government entity in ensuring adherence to national discharge standards at the emirate level is therefore urgently required.

**Improve data quantity and availability.** Ideally, to provide consistent public health safeguards throughout the nation, a standardized coastal water monitoring program should be instituted at the federal level by the Ministry of Environment and Water and implemented by relevant emirate-level agencies. Beaches throughout the nation should be monitored frequently for enterococci bacteria (fecal streptococci), which have been identified as the most useful fecal indicator organism for regulation of marine water quality by WHO (Boehm et al. 2009).

Although the necessary frequency of sample collection may differ due to the specific popularity of a given location and the proximity of potential pollution sources, it is worth noting that currently proposed monthly sampling regimens will only be expected to record 5% of actual daily standard violations (i.e., days where swimming would pose an elevated risk of illness) (Leecaster and Weisberg 2001).

The establishment of a national database as a repository for required beach monitoring data is highly recommended to allow for continued examination of water quality trends over time and to en-



courage collaboration among all emirates to preserve the shared waters along the coast. Adherence to these recommendations should enable beaches throughout the UAE to join the international Blue Flag Programme, which certifies beaches as eco-conscious and swimmer friendly, currently a major goal of Dubai's tourism industry.

**Improve scientific understanding of environmental health risks.** Although the cities of both Abu Dhabi and Dubai are planning to expand their coastal water quality monitoring programs, these plans differ in targeted indicator organisms, analytical methods, and proposed sam-



pling frequencies. No information on similar existing or planned programs in other cities or emirates is currently available.

**Build sustainable human and institutional capacity.** Future planned expansions of major municipal wastewater treatment plants, which are point sources of particular concern, will undoubtedly reduce the overloading of current facilities and improve effluent quality, and should continue in order to minimize use of tanker trucks and illegal dumping.

**Support urban development that promotes environmental health.** Increased sewage treatment and improved effluent

quality will not only reduce pathogen concentrations and swimmer illness, but will also reduce nutrient loadings to the Gulf, which are likely at least partially responsible for increasing numbers of hazardous algal blooms (Anderson et al. 2002; Gilbert et al. 2002).

**Improve environmental awareness.** Consistent national guidelines for beach closures due to periodic high enterococci concentrations should be established, specifying concentration levels necessary to trigger closure, reductions in concentration required to permit reopening, and procedures for public notification. •

# Coastal Water (EH-6):

## Initiatives to Reduce the Burden of Disease Due to Coastal Water Pollution

Target 1: Reduce pollutant levels and human exposure to pollutants						Stakeholders
<b>EH-6 / T-1 / I-1</b> Identify priority pollutants, and establish national effluent standards (for bacteria, nutrients, and total suspended solids at a minimum) for industrial and municipal discharges.						Appropriate emirate agencies
2010	2011	2012	2013	2014	MOEW	
<b>EH-6 / T-1 / I-2</b> Establish standard laboratory procedures and quality-assurance and quality-control checks for monitoring discharges to coastal water. Establish national program for routine inspection of effluent monitoring reports.						MOEW ADFCA DCL
2010	2011	2012	2013	2014		
<b>EH-6 / T-1 / I-3</b> Increase current wastewater treatment plant design capacities to adequately meet established effluent discharge standards through sufficient treatment times.						ADWEA DED
2010	2011	2012	2013	2014		
<b>EH-6 / T-1 / I-4</b> Increase percentage of permanent homes and buildings connected to municipal sewage pipes, and simultaneously reduce required number of tanker trucks transporting sewage.						ADWEA DED
2010	2011	2012	2013	2014		
<b>EH-6 / T-1 / I-5</b> Include septic tank codes in rural and coastal building codes.						To be determined
2010	2011	2012	2013	2014		
Target 2: Improve data quantity and availability						Stakeholders
<b>EH-6 / T-2 / I-1</b> Clarify emirate and federal agencies' roles and responsibilities, especially with respect to enforcement of existing guidelines.						MOEW EAD
2010	2011	2012	2013	2014		
<b>EH-6 / T-2 / I-2</b> Strengthen programs for monitoring coastal water quality. <ul style="list-style-type: none"><li>• Institute national standards based on scientific literature.</li><li>• Identify priority areas (frequented beaches, fishing areas, etc.) and establish sampling regimen (ideally five samples per week).</li><li>• Develop central database for storage of historical coastal water quality data in all seven emirates.</li></ul>						MOEW EAD DED
2010	2011	2012	2013	2014		
Target 3: Improve scientific understanding of environmental health risks						Stakeholders
<b>EH-6 / T-3 / I-1</b> Continue to study the effects of development and resultant water quality contamination on marine ecology, especially red tides.						MOEW EAD DED
2010	ONGOING					
<b>EH-6 / T-3 / I-2</b> Monitor the new UAE unified disease-surveillance system for infectious diseases for waterborne disease outbreaks.						MOH
2010	ONGOING					

### Section Overview

# of Initiatives	# of KPIs
<b>12</b>	<b>16</b>
5	6
2	2
2	3
1	3
1	1
1	1

### TOTAL

Target 1  
Target 2  
Target 3  
Target 4  
Target 5  
Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative. They may include nonspecific entities as well as these specific entities:

ADFC	Abu Dhabi Food Control Authority	EAD	Environment Agency–Abu Dhabi
ADWEA	Abu Dhabi Water and Electricity Authority	MOEW	Ministry of Environment and Water
DCL	Dubai Central Laboratory	MOH	Ministry of Health
DED	Dubai Municipality Environment Department	UPC	Urban Planning Council

## Target 4: Build sustainable human and institutional capacity

### Stakeholders

### EH-6 / T-4 / I-1

Increase enrollment of undergraduate and graduate students in related programs at UAE universities.



Universities

MOEW

## Target 5: Support urban development that promotes environmental health

### Stakeholders

### EH-6 / T-5 / I-1

Require coastal water quality impact assessment for new development.



EAD UPC DED

## Target 6: Increase environmental awareness

### Stakeholders

### EH-6 / T-6 / I-1

Establish national programs for beach closures in the event that water quality standards are exceeded.

- Establish beach closure and reopening protocols.
- Develop public communications strategy and messages.
- Issue beach closure warnings when needed.



MOEW EAD DED

## Coastal Water (EH-6): Key Performance Indicators

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 1: Reduce pollutant levels and human exposure to pollutants</b>			
EH-6 / T-1 / K-1	Percentage of samples of wastewater discharges to the environment (coastal creeks, gulf, etc.) compliant with water quality standards	90%	95%
EH-6 / T-1 / K-2	Percentage of permanent homes and buildings on sewage system	90%	95%
EH-6 / T-1 / K-3	Percentage of point-source discharges in compliance with water discharge permits	90%	100%
EH-6 / T-1 / K-4	Percentage of coastal water samples with fecal coliform and enterococci concentrations that meet recommended standards	90%	95%
EH-6 / T-1 / K-5	Number of gastroenteritis outbreaks associated with coastal recreational water	To be determined	To be determined
EH-6 / T-1 / K-6	Number of fish kills per year	To be determined	To be determined







## Section Overview

## Priority Area 6: Coastal Water

# of Initiatives	# of KPIs	
<b>12</b>	<b>16</b>	<b>TOTAL</b>
5	6	Target 1
2	2	Target 2
2	3	Target 3
1	3	Target 4
1	1	Target 5
1	1	Target 6

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 2: Improve data quantity and availability</b>			
EH-6/T-2/K-1	Number of coastal water quality monitors in place and operating	To be determined	To be determined
EH-6/T-2/K-2	Average number of samples collected per coastal water quality monitor per unit time	To be determined	To be determined
<b>Target 3: Improve scientific understanding of environmental health risks</b>			
EH-6/T-3/K-1	Number of studies using intensive sampling (i.e., multiple samples per day) to investigate transport of microorganisms along coast (effects of tides, diurnal cycles, etc.)	To be determined	To be determined
EH-6/T-3/K-2	Number of studies determining typical chemical/metal concentrations in industrial effluents, particularly those associated with oil refineries	To be determined	To be determined
EH-6/T-3/K-3	Number of studies investigating effects of ambient nutrient concentrations, temperature, organics, etc., on development of "red tides" (hazardous algal blooms)	To be determined	To be determined
<b>Target 4: Build sustainable human and institutional capacity</b>			
EH-6/T-4/K-1	Number of students graduating from universities in the UAE with master's degrees related to water quality protection	To be determined	To be determined
EH-6/T-4/K-2	Number of students graduating from universities in the UAE with PhD degrees related to water quality protection	To be determined	To be determined
EH-6/T-4/K-3	Number of personnel from UAE government agencies completing training programs offered through the Arab Water Academy	To be determined	To be determined
<b>Target 5: Support urban development that promotes environmental health</b>			
EH-6/T-5/K-1	Percentage of environmental impact assessments addressing impact on coastal water quality	100%	100%
<b>Target 6: Increase environmental awareness</b>			
EH-6/T-6/K-1	Percentage of general public aware of causes and meanings of beach closure warnings	To be determined	To be determined

# Soil and Groundwater

## Problem Overview

Soil and groundwater can become contaminated through improper disposal of solid and hazardous wastes. Municipal solid waste, construction and demolition waste, hazardous waste, and medical waste all can carry components that are harmful to the environment and human health. Improper agricultural practices can also contribute to soil and groundwater contamination, but the focus of this section is proper waste-disposal practices. If wastes are not treated and disposed of appropriately, the soil and groundwater around disposal sites may be contaminated, providing potential pathways for human exposure to hazardous substances contained in the wastes.

It is clear that treatment and disposal facilities in the UAE must respond to the ever-growing amounts of waste generated by rapid urbanization, industrialization, and economic diversification. Some facilities seem inadequate to handle wastes according to current international best practices, both in terms of management and engineering. Reports exist of improper treatment and disposal practices, such as illegal dumping in the desert and disposal of liquid and hazardous wastes in unlined landfills (EAD 2009d).

At such uncontrolled and illegal disposal sites, the probability is high that hazardous substances in the wastes will accumulate in the soil surface layer or leak into groundwater. Although there are no reports yet on morbidity and mortality from exposure to contaminated soil and groundwater due to hazardous and

medical wastes in the UAE, people who live or use wells near disposal sites are potentially at risk. Moreover, new residential areas that will be developed due to rapid population growth might be at risk if they are placed near rehabilitated former dump sites or in the desert where illegal dumping has been reported.

In the absence of rigorous monitoring and control of waste disposal, the UAE might face problems of significant public exposure to contaminated soil and groundwater. Such exposures have occurred in other countries around the world. As an example, the best-known such case in the United States was the contamination of the neighborhood around a former waste disposal site in the Love Canal area of New York. After the landfill was closed, the surrounding area was extensively developed, including construction of a public elementary school and private homes. Subsequently, the school and many homes were contaminated by leakage of hazardous substances from the landfill site. In the late 1970s, the federal government evacuated approximately 950 families from a 10-square-block area surrounding the landfill and permanently closed their homes (U.S. EPA 2008).

To prevent similar incidents and problems, stakeholders across the UAE should minimize waste generation and improve waste management to prevent soil and groundwater pollution, as well as to prevent human exposure to contaminated soil and groundwater in the areas around disposal or rehabilitated sites. •

## Main Achievements and Successes

In the UAE, Dubai and Abu Dhabi emirates especially have considered adverse effects on the environment and public health from increasing waste generation and poor waste management. Examples of federal and emirate-wide laws created to improve waste management include Federal Law 24 of 1999 and its executive bylaws on the handling of hazardous materials, hazardous wastes, and medical wastes; Federal Law 1 of 2002 and its executive bylaws on protection from ionizing radiation hazards; and Law 21 of 2005 on solid waste management in Abu Dhabi emirate (EAD 2007b). In Abu Dhabi emirate, EAD has developed strategic plans and KPIs for improving waste management.

Dubai implemented its first comprehensive solid waste management system in 1992, and new industrial and medical hazardous waste treatment facilities were operational in 2001 (Al Qaydi 2006). In the city of Dubai, hazardous waste management is made easier by industrial zoning and regular workshops on industrial waste management. Soon after private-sector waste collection and transportation services

were introduced in the city of Dubai, the proper collection of hazardous wastes improved (Al Qaydi 2006). With continued population, commercial and industrial growth, however, pressure may be put on existing waste collection and treatment infrastructure and services.

An additional facility to process and store industrial hazardous waste will probably be needed by 2015, for which Dubai is making plans (Al Qaydi 2006).

Abu Dhabi has made similar strides. In 2008, the Center of Waste Management (CWM) Abu Dhabi was established to serve as the implementer of waste management policies at the operational level, while EAD is still responsible for legislation, regulation, and monitoring of waste management policies at the emirate level. Government authorities are accountable for regulating and monitoring their own sectors. For example, the Abu Dhabi National Oil Company is in charge of the oil and gas sector (EAD 2009d).

CWM is drafting a waste management strategy for Abu Dhabi emirate that focuses on four primary sectors: municipal solid

waste, construction and demolition waste, hazardous waste, and medical waste. The waste management strategy includes many principles from international best practices, including deposit-refund systems; award schemes; the “polluter pays” principle; financial incentives and new markets for recycling; tariffs; and educational awareness campaigns about waste reduction at the source. This strategy provides a framework for reformatting the waste management system in 2010 (EAD 2009d).

Abu Dhabi emirate has recognized its lack of waste treatment and disposal facilities as a problem. CWM plans to upgrade existing facilities or develop new ones and promote private-sector participation in waste management (EAD 2009d). It also plans to close and rehabilitate existing landfill sites (EAD 2008). In addition, EAD closed many incinerators used for disposing of infectious medical wastes due to unacceptable performance and now treats these wastes with nonincineration technologies that are more environmentally friendly (EAD 2007b). •

## Main Unresolved and Emerging Issues

Although the UAE has taken many steps to eliminate or reduce problems in the waste sector, a number of limitations and unresolved issues persist.

The 2007 Waste Locations Aerial Survey indicated that much illegal dumping of asbestos, concrete, garbage, metal, plastic, tire, and wood occurs in the nonurban areas of Abu Dhabi emirate, especially in the desert (EAD 2008). Further, compliance with and enforcement of existing or proposed policies and laws (e.g., Federal Law 24 of 1999 and its executive bylaws, Abu Dhabi Law 21, and others), is lacking (EAD 2009d).

The insufficiency of waste management requirements at the federal level is implicitly blamed for the problems.

No facilities are specifically designed

for the treatment and disposal of hazardous wastes from industries other than oil (EAD 2009d). These wastes are usually disposed of in existing facilities (mainly landfills) by Abu Dhabi Municipality, even though these landfills are not designed for liquid hazardous wastes.

Though the current disposal technique for medical waste (infectious waste) has shifted to nonincineration technologies (chemical and thermal treatment), these methods still leave some pathogens in the treated waste because of the nature of the technologies and an inability to handle the large amount of waste (EAD 2007b).

The UAE lacks reliable information about waste generation rates, waste characterization, waste flows, and the efficiency and safety of handling methods

(EAD 2009d). Data about contaminants in soil and groundwater are needed to support dump-site rehabilitation projects (EAD 2008).

Completing new, permanent waste-disposal facilities that the government plans to develop will take approximately 15 years. In the meantime, mobile treatment and disposal technologies will be developed as a temporarily solution; however, the efficiency of these solutions remains uncertain. Further, upcoming tariffs on landfills may increase the rate of dumping in the desert.

Little research by academic institutions on hazardous and medical waste management or on exposure to contaminated soil and groundwater exists. Most available information comes from governmental organizations’ annual or project reports. •

# Recommendations

To mitigate any existing or future soil or groundwater contamination from hazardous wastes or to reduce the burden of disease due to such contamination, the UAE should take action as follows:

**Reduce pollutant levels and human exposure to pollutants.** The federal government should develop minimum national waste-management standards. Each emirate should be required to develop waste-management policies that comply with the national standards. Emirate governments should also monitor illegal and improper disposal practices and the performance of each treatment and disposal site in meeting required standards or best practices.

The federal government should assess current guidelines and practice manuals for each waste stream and revise them to meet international best practices.

In addition, each emirate should list potential contaminated sites and develop guidelines and procedures for health risk estimation and rehabilitation. A system of fines and other punishments should be developed to discourage illegal/improper disposal practices.

**Improve data quantity and availability.** UAE environmental agencies should work together to develop centralized hazardous and medical waste databases that compile monthly or annual data about waste generation rates, characterization, waste flows, and the efficiency and safety of handling methods. Another database should be developed to collect information on properties of and contaminants in soil and groundwater, as well as other dump site data related to rehabilitation.

In addition, industrial and medical facilities should be required to report on waste generation and management.

**Improve scientific understanding of the environmental health risk.** UAE environmental agencies should work cooperatively on research related to the potential for exposure to hazardous and medical wastes. Academic institutions should be encouraged to participate.

**Build sustainable human and institutional capacity.** UAE environmental agencies should ensure that they have a sufficient number of staff with technical expertise in waste management to ensure implementation and enforcement of waste management policies. These agencies should hold workshops or trainings for licensed hazardous and medical waste handlers to enhance their knowledge of waste management.

**Support urban development that promotes environmental health.** UAE government agencies involved with waste management should cooperate to establish risk estimation methods and standards for residential soil based on international limits and develop guidelines for urban planning in potentially contaminated areas.

**Improve environmental awareness.** UAE agencies involved in waste management should work together to implement a public awareness campaign on household hazardous waste management and the risk of exposure to contaminated soil and groundwater due to improper disposal of hazardous and medical waste. •

## Soil and Groundwater (EH-7): Initiatives to Reduce the Burden of Disease from Soil and Groundwater Pollution Due to Hazardous and Solid Waste

Target 1: Reduce pollutant levels and human exposure to pollutants	Stakeholders
EH-7 / T-1 / I-1 Design policies to minimize waste production upstream of disposal.	Emirate environment agencies <div>MOEW</div> <div>EAD</div> <div>ADWEA</div> <div>ADNOC</div>
<div>2010</div> <div>?</div>	

## Section Overview

# of Initiatives	# of KPIs	TOTAL
21	17	
6	7	Target 1
2	3	Target 2
1	1	Target 3
4	2	Target 4
3	1	Target 5
5	3	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative.

They may include nonspecific entities as well as these specific entities:

ADNOC	Abu Dhabi National Oil Company	EAD	Environment Agency–Abu Dhabi
ADWEA	Abu Dhabi Water and Electricity Authority	HAAD	Health Authority–Abu Dhabi
CWM	Center of Waste Management Abu Dhabi	MOEW	Ministry of Environment and Water

### EH-7 / T-1 / I-2

Implement an integrated national system to regulate, manage, track, treat, and dispose of hazardous wastes.

- Draft law requiring compliance with new requirements for hazardous waste import/export, production, transport, handling, processing, treatment, and disposal.
- Identify and notify covered sources of the responsibility to report their hazardous waste operations under the new regulations. Consider allowing an amnesty period to allow companies time to comply.
- Publicize new regulations and hold seminars to train communities and companies on compliance.
- Create inspection guidelines for hazardous waste treatment, storage, and disposal facilities (by sector and facility).
- Research possible establishment of a federal or multiemirate compact for waste management facilities.
- Create a system to minimize redundancy and maximize compatibility of programs developed by various agencies, both within an emirate and across emirates.
- Establish enforcement mechanisms for solid and industrial wastes.

2010	2011	2012	2013	2014
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MOEW	EAD	HAAD
CWM		

### EH-7 / T-1 / I-3

Continue contract process in Abu Dhabi to design and build treatment and disposal facilities for industrial and medical wastes. Emulate this program in other emirates.

2010	?
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CWM
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### EH-7 / T-1 / I-4

Establish program to identify and classify sites where soil and/or groundwater are contaminated due to current and past waste disposal practices.

- Develop program for sampling soil and groundwater at such sites.
- Identify potential threats to the environment from waste disposal sites.
- Develop system for rating such sites and consequences of the rating system (e.g., limited access to area, revocation of license, etc.).
- Develop ranking system for prioritizing the most hazardous/highest risk sites in each emirate.
- Establish program to clean up sites and a mechanism to assess the success of cleanup efforts.

2010	2011	2012	2013	2014
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To be determined

### EH-7 / T-1 / I-5

Establish or refine existing emergency preparedness and response policies in all emirates for the accidental release of hazardous wastes and other hazardous substances.

- Verify that existing and new policies include hazardous waste in the definition of hazardous substances.
- Coordinate emergency response systems across all emirates.

2010	2011	2012	2013	2014
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To be determined

### EH-7 / T-1 / I-6

Develop programs and construct facilities to encourage recycling of both industrial waste and residential/commercial solid waste.

2010	ONGOING
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To be determined

Target 2: Improve data quantity and availability						Stakeholders
<b>EH-7 / T-2 / I-1</b> Complete national database for integrated hazardous waste management across all emirates. <ul style="list-style-type: none"> <li>• Inventory all waste sources.</li> <li>• Establish a mechanism for waste generators to report waste quantities accurately, subject to verification by inspection and penalties for false information.</li> <li>• Update and expand database as needed.</li> <li>• Make accessible to government agencies and public as appropriate.</li> </ul>						Appropriate emirate agencies MOEW CWM
2010	2011	2012	2013	2014		
<b>EH-7 / T-2 / I-2</b> Create national database of hazardous waste generators. <ul style="list-style-type: none"> <li>• Assign unique ID codes for each hauler, generator, and disposal facility.</li> <li>• Require manifesting of all hazardous waste and annual reports from each ID code.</li> </ul>						CWM
2010					ONGOING	
Target 3: Improve scientific understanding of human health risks						Stakeholders
<b>EH-7 / T-3 / I-1</b> Fund research to better understand the exposure pathways between hazardous and medical waste and human receptors in the UAE. Research potential threat from exposure to contaminants accumulated in soil and groundwater due to irrigation with treated wastewater.						To be determined
2010	2011	2012	2013	2014		
Target 4: Build sustainable human and institutional capacity						Stakeholders
<b>EH-7 / T-4 / I-1</b> Ensure that centralized database of information on hazardous waste treatment, storage, and disposal sites is available to all appropriate agencies across the UAE.						To be determined
2010	2011				ONGOING	
<b>EH-7 / T-4 / I-2</b> Identify priority work sectors for training in better hazardous waste practices. Establish education programs to raise awareness of hazardous waste management for workers in medical and industrial facilities.						To be determined
2010	2011	2012	2013	2014		
<b>EH-7 / T-4 / I-3</b> Create a system for publicizing waste management policies and sharing best practices across all emirates.						To be determined
2010	2011	2012	2013	2014		
<b>EH-7 / T-4 / I-4</b> Ensure that hazardous waste inspectors are adequately trained and that their number keeps pace with development. Inspectors should report results to central database.						To be decided
2010					ONGOING	
Target 5: Support urban development that promotes environmental health						Stakeholders
<b>EH-7 / T-5 / I-1</b> Establish standards for publicly accessible soil in urban or residential areas based on international limits. Develop regulations for the quality and acceptable uses of compost derived from waste materials.						To be determined
2010	2011	2012	2013	2014		



### Section Overview

# of Initiatives	# of KPIs	TOTAL
21	17	
6	7	Target 1
2	3	Target 2
1	1	Target 3
4	2	Target 4
3	1	Target 5
5	3	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative. They may include nonspecific entities as well as these specific entities:

ADNOC	Abu Dhabi National Oil Company	EAD	Environment Agency–Abu Dhabi
ADWEA	Abu Dhabi Water and Electricity Authority	HAAD	Health Authority–Abu Dhabi
CWM	Center of Waste Management Abu Dhabi	MOEW	Ministry of Environment and Water

### EH-7 / T-5 / I-2

Incorporate hazardous-waste inspection of soil into impact statements and criteria for the environmental review and permit process for any new construction or sale of property.

2010	2011	2012	2013	2014	To be determined
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### EH-7 / T-5 / I-3

Establish disclosure and public participation processes to inform and involve residents in potential urban plans that may result in hazardous wastes in their neighborhoods.

2010	2011	2012	2013	2014	To be determined
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## Target 6: Increase environmental awareness

### Stakeholders

### EH-7 / T-6 / I-1

Develop a program for labeling consumer products classified as hazardous household wastes.

- Develop a list of products that are classified as household hazardous wastes.
- Develop labels adequate to communicate risk of handling or improper use of product as well as proper disposal practices and how to treat humans if exposed.
- Establish mandate for application of label at point of manufacture.
- Inspect products deemed household hazardous wastes for labels.
- Develop procedures to enforce labeling requirements.

2010	2011	2012	2013	2014	To be determined
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### EH-7 / T-6 / I-2

Develop programs to educate residents on proper handling and disposal of household hazardous waste.

- Conduct survey to determine needs for public education.
- Create materials (written, Web-based), including a regulatory guide, for education on household hazardous waste (e.g., from batteries, mercury thermometers, antifreeze, etc.), for the end-user community.
- Create campaigns/methods to disseminate materials, possibly including public meetings.

2010	2011	2012	2013	2014	To be determined
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### EH-7 / T-6 / I-3

Perform trash analysis to see what people are throwing away.

2010	2011	2012	2013	2014	To be determined
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### EH-7 / T-6 / I-4

Organize and advertise household hazardous waste collection days.

2010	ONGOING				To be determined
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### EH-7 / T-6 / I-5

Require signs with health warnings for hazardous spills at contaminated sites.

- Create guidelines for signage.
- Create enforcement mechanisms for noncompliance.

2010	2011	2012	2013	2014	To be determined
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## Soil and Groundwater (EH-7): Key Performance Indicators

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 1: Reduce pollutant levels and human exposure to pollutants</b>			
EH-7/T-1/K-1	Waste generated per person per year, in these categories: 1. Hazardous 2. Medical 3. Household hazardous	To be determined	To be determined
EH-7/T-1/K-2	Percentage of hazardous waste that is processed, in these categories, by emirate: 1. Industrial 2. Medical	To be determined	To be determined
EH-7/T-1/K-3	Percent noncompliance of inspected licensed facilities, by industry (e.g., medical, industrial, etc.) and facility type (e.g., hazardous waste producers, processors, treatment or disposal sites)	To be determined	0%
EH-7/T-1/K-4	Number of contaminated sites (by emirate), measured as: 1. Number of sites identified and inspected 2. Percentage of sites rated, i.e., put on a national priority list or declared contaminated	To be determined	To be determined
EH-7/T-1/K-5	Number of sites declared contaminated that have been cleaned (by emirate), expressed according to level of cleanup	To be determined	To be determined
EH-7/T-1/K-6	Percentage of disposal sites in noncompliance with handling, treatment, and disposal standards	To be determined	To be determined
EH-7/T-1/K-7	Monetary value of property or health damage avoided through emergency response to release of toxic or hazardous wastes to soil and groundwater	To be determined	To be determined

## Section Overview

# of Initiatives	# of KPIs	
<b>21</b>	<b>17</b>	<b>TOTAL</b>
6	7	Target 1
2	3	Target 2
1	1	Target 3
4	2	Target 4
3	1	Target 5
5	3	Target 6

## Priority Area 7: Soil and Groundwater

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 2: Improve data quantity and availability</b>			
EH-7 / T-2 / K-1	Percent completion of centralized hazardous waste database including: 1. All regulated wastes 2. Sources (perhaps classified as large and small quantity generator, and exempted) 3. Manifest tracking records 4. Licensed treatment / disposal site operators and haulers 5. Priority list for contaminated sites 6. Sites undergoing hazardous waste remediation 7. List of laws, guidelines, etc., for sources	To be determined	To be determined
EH-7 / T-2 / K-2	Percentage of licensed hazardous waste facilities that comply with annual submission of reports to centralized database	To be determined	To be determined
EH-7 / T-2 / K-3	Percent completion of database for contaminated soil and groundwater around landfill sites, including: 1. Physical properties 2. Chemical properties 3. Characteristics, quantity, toxicity, and exposure pathway of contaminants	To be determined	To be determined
<b>Target 3: Improve scientific understanding of environmental health risks</b>			
EH-7 / T-3 / K-1	Funding for one or more research projects on potential exposures to hazardous and medical waste	To be determined	To be determined
<b>Target 4: Build sustainable human and institutional capacity</b>			
EH-7 / T-4 / K-1	Percentage of licensed hazardous waste handlers (in each emirate and relevant industrial sector) who have attended training workshops	To be determined	To be determined
EH-7 / T-4 / K-2	Percentage of workers who are aware of proper segregation, collection, and disposal practices for hazardous waste: 1. Health-care workers 2. Industrial workers (by size and type of operation)	To be determined	To be determined
<b>Target 5: Support urban development that promotes environmental health</b>			
EH-7 / T-5 / K-1	In the future, as construction sites move into the desert where there is reported illegal dumping, the percentage of new construction sites (in these categories) with hazardous substances in soil that exceed existing standards: 1. Residential 2. Public / open space 3. Commercial 4. Other	To be determined	To be determined
<b>Target 6: Increase environmental awareness</b>			
EH-7 / T-6 / K-1	Percentage of inspected hazardous waste products that meet labeling requirements	To be determined	To be determined
EH-7 / T-6 / K-2	Percentage of the population who can demonstrate awareness of household hazardous products and how and where to properly dispose of such waste after use	To be determined	To be determined
EH-7 / T-6 / K-3	Percentage of overall household hazardous waste that is improperly disposed of with municipal solid waste	To be determined	To be determined

# Produce and Seafood

## Problem Overview

Eating fruits and vegetables has documented health benefits, but it also exposes people to risk if the produce contains hazardous contaminants. Two potential contaminants are human pathogens (e.g., salmonella, *Escherichia coli*) and agricultural pesticides (e.g., organophosphates, carbamates), both of which can be reduced with proper food handling and preparation.

Food-borne pathogens cause and contribute to an array of human illnesses, from acute illnesses—including gastrointestinal distress and nausea—to chronic conditions such as organ failure, arthritis, and heart disease. Exposure to two commonly used classes of pesticides, organophosphates and carbamates, potentially could cause subtle neurological effects. However, such effects have been documented only for high doses of pesticides that can occur through occupational exposures or accidental ingestion. Very limited data on clinical effects of chronic, low-level exposure to pesticides (at levels that typically might be found as residues on food) are available, and research is ongoing to estimate the occurrence of subtle effects.

Limited pesticide residue data from Abu Dhabi and worst-case assumptions of both (1) low pesticide removal during food preparation and (2) high consumption of a

single vegetable (i.e., high exposure to a single pesticide type) suggest virtually no acute risk and minimal chronic risk from pesticide exposure via consumption of fruits and vegetables in the UAE. Large percentages of fruits, vegetables, grains, and legumes consumed in the UAE are produced abroad. Pesticide use in countries exporting to the UAE will also affect pesticide residues consumed in the UAE.

Appropriate handling of food can minimize food-borne environmental hazards. Properly cooking produce contaminated with pathogens can eliminate risk of food-to-human microbial pathogen transmission. But recent outbreaks of illness in the United States show that peeling and washing alone may not eliminate and may even increase pathogen hazard in raw food products.

Seafood is a primary staple of the UAE diet, as it is in many coastal countries. More than 90% of residents consume fish at least once a week (Badrinath et al. 2002). Consumption of seafood provides many health benefits; however, fish can also serve as vectors for pathogenic microorganisms (e.g., *Vibrio* spp.) or heavy metals and toxins (e.g., dioxin, mercury) if contaminated by polluted coastal waters.

While the risk from pathogenic microorganisms can be minimized by good food

handling procedures and proper cooking, the risk from toxins and heavy metals cannot. Prevention of exposure to heavy metals and toxins in seafood depends on limiting consumption (particularly by sensitive groups such as pregnant women or small children) and reducing pollutant levels in the coastal environment.

Toxin-producing algal blooms (“red tides”) can also be a source of seafood contamination. The number of red tide incidents has increased in UAE coastal waters in recent years. EAD recorded only one incident in 2002 but eight in 2008. Red tides have forced recent temporary closures of the Sharjah desalination plant (Sambidge 2008) and Dubai beaches (Menon 2009).

Red tides appear to be associated with elevated nutrient levels that can come from human sewage, agricultural runoff, and elevated water temperature. Evidence suggests that consumption of fish exposed to red tide toxins can result in serious health effects, though there is also a good deal of uncertainty about the resultant rates of human illness (Graneli and Turner 2006).

Although this discussion primarily considers food as encompassing fruit and vegetable produce and seafood, the accompanying key performance indicators chart (page 88) broadens this scope to include general food safety. •

## Main Achievements and Successes

The federal government has passed several regulations to combat inappropriate pesticide use. At least 88 pesticides have been banned as a result of the federal Pesticides, Agricultural Additives, and Fertilizers law (Decision 37, 2001) and regulations of the Ministry of Agriculture and Fisheries (Decision 193, 2004). Additionally, the manufacture and formulation of any pesticide is prohibited in the UAE, and only pesticides registered by MOEW can be imported or used legally in the UAE (Al Ashram 2005).

Pathogen and pesticide monitoring activities are conducted by the food control departments of individual emirates. In 2002, for example, the Pesticide Residue Analysis Section at the Food and Environment Control Center of Abu Dhabi (now the Abu Dhabi Food Control Authority) found that 5% of tested samples of locally grown vegetables (and 0% of locally grown fruits) exceeded maximum legally allowable residue levels (*Khaleej Times* 2002).

Numerous scientific studies have investigated toxin and heavy metal concentrations in fish harvested along the UAE coast. The majority of observed concentrations were below WHO tolerable weekly doses or toxic levels for the general population, and so consumption would not be expected to result in adverse health outcomes. Initial monitoring of coastal waters by EAD has determined that mercury is not detectable and dioxin levels were lower than 0.4 ppm at all sites except one with a concentration of 1 ppm (EAD 2007).

The UAE has instituted several relevant pieces of legislation to continue to preserve coastal water and seafood quality, including Federal Law 24 of 1999, which aims to protect the marine environment from pollution (UAE Federal Government 1999).

Experimental studies are in progress to determine the potential effects of oil/fuel on fish, and regional conventions aimed at preventing contamination of the Arabian Gulf—particularly by oil spills—have been ratified.

Another innovative policy being adopted in the UAE is the encouragement of the use of Good Agricultural Practices (GAP), as classified by the Food and Agricultural Organization (FAO) of the United Nations. This provides a more holistic means of preventing contamination of food whether with pesticides or pathogens. Good Agricultural Practices stress the importance of adopting integrated pest management strategies—pest-resistant cultivar selection, crop rotation sequences, beneficial insects—in an effort to reduce the need for pesticides (Poisot, Speedy, and Kueneman 2004).

Initial analysis suggests some overlap between the authority and duties of farmer/resident outreach and education activities conducted by MOEW and the jointly staffed UAE-AGRICENT Agricultural Information Center, including manure management practices that can help prevent food from becoming contaminated with pathogens. The UAE should also consider requiring use of GAP by those who export foods to the UAE.

Despite significant efforts to increase agricultural production, the UAE is heavily dependent on imported foods and is likely to remain so for the foreseeable future. Import safety policy will also remain critical to assuring UAE food safety. Little information is available on sampling and testing results of foods imported to the UAE. From 2001 to 2003, 6–7% of imported shipments into the UAE were rejected for violation of local food safety standards (FAO and WHO 2005). •







## Main Unresolved and Emerging Issues

When pesticides are restricted, farmers must generally substitute other means of pest control. In addition, pesticide-use restriction or cancellation can also increase the cost of particular foods, leading consumers to substitute other foods or food from other sources. Either action can have an effect on the risk consumers actually experience and should be considered in policy decisions (Gray and Hammit 2000).

The UAE is also still in the process of examining issues related to the inadvertent or unwanted introduction of genetically

modified organisms (GMOs) into UAE farm crops or imported food supplies. The long-term health effects of GMOs are still under-going study (Croucher 2009). UAE food labeling laws do not require GMOs to be identified.

Although the majority of scientific studies have confirmed that toxin and heavy metal concentrations in fish tissue were below levels posing a health risk to consumers, mercury levels in some fish exceed WHO recommended levels for pregnant women. Arsenic levels may exceed recommended levels for the general population

if compared with standards for inorganic arsenic in drinking water; however, the vast majority of arsenic in fish tissue is organic and may be less completely metabolized and more rapidly excreted (i.e., inorganic arsenic standards may be inappropriately conservative).

Of greater general concern, comparison of fish tissue studies completed over the past 20 years reveals a distinct increasing trend in heavy metal concentrations over time. Continuation of this trend could render local seafood unsafe for regular human consumption. •

## Recommendations

To reduce the burden of disease due to exposure to contaminated fruits, vegetables, and seafood, the UAE should take action as follows:

**Reduce pollutant levels and human exposure to pollutants.** Emirate-wide Farmers Services Centers and similar UAE agencies should draft and implement GAP as defined by FAO. Pesticide-residue standards, codes of practice, and auditing and enforcement procedures need to be developed and coordinated across all seven emirates. A standardized, risk-based, food-imports inspection protocol, based on international norms, should be adopted by all emirates.

**Improve data quantity and availability.** Agencies from all seven emirates must continue efforts toward establishing a national medical-records surveillance system and ensure that all medical centers report cases of disease suspected as or consistent with food-borne illness. The UAE must include adequate funding for staff to analyze food-borne disease incidence based on this national database. Periodic screenings must be carried out across all emirate coastal zones to determine heavy metal concentrations in domestically produced fish. Appropriate contingency strategies need to be developed.

**Build sustainable human and institutional capacity.** The

Ministry of Environment and Water, emirate food-control authorities, and similar agencies must continue to provide leadership on efforts to improve food safety policy and practices, especially via the UAE Codex Committee (operating in conjunction with WHO and FAO). Public health-authority staff must improve capacity for conducting outreach activities for farmers, physicians, and residents. The need for additional food testing capacity via additional laboratories must be assessed.

**Support urban development that promotes environmental health.** Communication procedures between emirate-wide food control authorities and urban planning offices must be implemented and expanded to ensure that environmental impact statements consider food contamination issues (such as effects of additional waste discharges into the coastal environment).

**Improve environmental awareness.** Pertinent agencies within the UAE should design and conduct proactive public safety information campaigns on food-related issues (pesticides, pathogens, seafood heavy metals, etc.). UAE-wide organic farming standards should be adopted, with provisions for proper labeling. Seafood consumption advisories related to red tide conditions (offshore algal bloom events) and persistent seafood pollutants must be adopted and extended across all seven emirates. •

## Initiatives to Reduce the Burden of Disease Due to Contamination of Food

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## Priority Area 8: Produce and Seafood

### Section Overview

# of Initiatives	# of KPIs	TOTAL
16	19	
4	6	Target 1
3	3	Target 2
0	0	Target 3
5	7	Target 4
1	1	Target 5
3	2	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative. They may include nonspecific entities as well as these specific entities:

EAD	Environment Agency—Abu Dhabi	MOEW	Ministry of Environment and Water
ESMA	Emirates Authority for Standardization and Metrology	MOH	Ministry of Health
FSC	Abu Dhabi Farmers Services Centers	UAE CG	UAE Coast Guard

#### EH-8 / T-2 / I-3

Conduct periodic screening studies of heavy metal concentrations in domestically produced fish to determine if further action is required. Coordinate screening studies across emirates to avoid duplication of effort. Develop strategy for response contingent on need.

2010	2011	2012	2013	2014	Emirate food-control agencies
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### Target 3: Improve scientific understanding of environmental health risks

No recommendations at this time.

### Target 4: Build sustainable human and institutional capacity

#### Stakeholders

#### EH-8 / T-4 / I-1

Continue to provide regional leadership in efforts to improve food-safety policy practices through the UAE Codex committee that was established in February 2009.

2010	2011	2012	2013	2014	Emirate food-control agencies
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#### EH-8 / T-4 / I-2

Increase staff to conduct outreach activities to UAE farmers for purposes of preventing and reporting of illnesses that may be food-borne.

2010	2011	2012	2013	2014	FSC
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#### EH-8 / T-4 / I-3

Increase public-health agency staff to conduct outreach activities and train physicians on reporting of illnesses that may be food-borne.

2010	2011	2012	2013	2014	MOH
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#### EH-8 / T-4 / I-4

Improve coordination between emirate public-health and food-control agencies.

2010	2011	2012	2013	2014	Emirate food-control agencies
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#### EH-8 / T-4 / I-5

Assess need for additional accredited food-testing laboratories and accredited testing capacity.

2010	2011	2012	2013	2014	Emirate food-control agencies
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Target 5: Support urban development that promotes environmental health						Stakeholders
<b>EH-8 / T-5 / I-1</b> Establish a procedure for communication between emirate food-control agencies and urban-planning offices to ensure that environmental impact statements consider food-safety issues (such as effects of additional waste discharges into the coastal environment).						<div>MOEW</div> <div>EAD</div>
2010	2011	2012	2013	2014		
Target 6: Increase environmental awareness						Stakeholders
<b>EH-8 / T-6 / I-1</b> Design and conduct public information campaigns on food safety.						Emirate food-control agencies
2010	2011	2012	2013	2014		
<b>EH-8 / T-6 / I-2</b> Adopt UAE-wide organic labeling. Extend MOEW food-labeling program across all emirates.						<div>MOEW</div>
2010	2011	2012	2013	2014		
<b>EH-8 / T-6 / I-3</b> Establish consumption advisory related to red tides and to persistent pollutants in fish and seafood.						Emirate food-control agencies <div>MOEW</div> <div>EAD</div> <div>UAE CG</div>
2010	2011	2012	2013	2014		

## Produce and Seafood (EH-8): Key Performance Indicators

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 1: Reduce pollutant levels and human exposure to pollutants</b>			
EH-8/T-1/K-1	Monthly percentage of food product shipments imported into the UAE that comply with UAE technical rules and applicable regulations	100%	100%
EH-8/T-1/K-2	Percentage of food produced in the UAE every year that complies with UAE pesticide residue levels	To be determined	To be determined
EH-8/T-1/K-3	Percentage of domestic fish and seafood samples that comply with established heavy-metal standards each year	To be determined	To be determined
EH-8/T-1/K-4	Percentage of imported fish and seafood samples that comply with established heavy-metal standards each year	To be determined	To be determined
EH-8/T-1/K-5	Number of food-borne outbreaks per year	To be determined	To be determined
EH-8/T-1/K-6	Incidence of childhood neurological impairment	To be determined	To be determined
<b>Target 2: Improve data quantity and availability</b>			
EH-8/T-2/K-1	Percentage of suspected food-borne illness outbreaks that are investigated annually (e.g., epidemiologic outbreak investigation)	To be determined	To be determined
EH-8/T-2/K-2	The extent to which a national electronic medical record system is operational, prevalent and used for food-borne illness surveillance: <ol style="list-style-type: none"> <li>Percentage of physicians participating in the system in a given year</li> <li>Percentage of emergency rooms participating in the system in a given year</li> <li>Percentage of hospitals participating in the system in a given year</li> </ol>	To be determined	To be determined
EH-8/T-2/K-3	Percentage of health laboratories in UAE that participate in electronic laboratory reporting system	80%	100%

## Section Overview

# of Initiatives	# of KPIs	TOTAL
16	19	
4	6	Target 1
3	3	Target 2
0	0	Target 3
5	7	Target 4
1	1	Target 5
3	2	Target 6

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative. They may include nonspecific entities as well as these specific entities:

EAD	Environment Agency—Abu Dhabi	MOEW	Ministry of Environment and Water
ESMA	Emirates Authority for Standardization and Metrology	MOH	Ministry of Health
FSC	Abu Dhabi Farmers Services Centers	UAE CG	UAE Coast Guard

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 3: Improve scientific understanding of environmental health risks</b>			
	No pertinent KPIs		
<b>Target 4: Build sustainable human and institutional capacity</b>			
EH-8/T-4/K-1	Percentage of UAE food manufacturers, hotels, and caterers that implement food safety management systems based on Hazard Analysis and Critical Control Points on a continual basis	70%	100%
EH-8/T-4/K-2	Percentage of farms in the UAE that implement GAP on a continual basis	70%	100%
EH-8/T-4/K-3	Percentage of pesticide applicators who are certified	40–60%	100%
EH-8/T-4/K-4	Percentage of physicians who receive outreach information every year related to required surveillance reporting requirements for specified illnesses or pathogens isolated from cases	To be determined	To be determined
EH-8/T-4/K-5	Percentage of providers from whom reports are expected (e.g., sentinel) who submit at least 90% of expected annual reports on specified illnesses (e.g., diarrheal disease or specified pathogens)	To be determined	To be determined
EH-8/T-4/K-6	Percentage of need for accredited food-safety laboratories met	80%	100%
EH-8/T-4/K-7	Percentage of providers in the national electronic medical record system who receive annual training on the system, specifically: <ol style="list-style-type: none"> <li>Percentage of physicians who receive annual training</li> <li>Percentage of emergency room administrators who receive annual training</li> <li>Percentage of hospitals with a medical records officer who receives annual training</li> </ol>	100%	100%
<b>Target 5: Support urban development that promotes environmental health</b>			
EH-8/T-5/K-1	Percentage of emirates with procedures implemented to liaise between food and planning authorities	90%	100%
<b>Target 6: Increase environmental awareness</b>			
EH-8/T-6/K-1	Percentage of UAE consumers aware of risks associated with pesticide residues on foods	85%	To be determined
EH-8/T-6/K-2	Percentage of fishermen aware of water quality issues affecting fish	To be determined	To be determined

# Conclusions

## Overarching Objectives

The vision and ambitious directions encompassed within this plan call for harmony with other strategic efforts in the country, sound management and coordination in implementation, responsible enforcement, ongoing monitoring and vigilance, research to advance the knowledge base, and country leadership that can extend to the entire region and beyond. Overarching objectives in these areas are described below, and related initiatives and KPIs are provided in the charts that follow.

**1 Connect relevant elements of this plan with other strategic plans.** The science team has identified a number of strategic plans and relevant guidance documents at the federal and emirate level that are pertinent to this environmental health strategy and action plan. To the extent possible, we have incorporated and documented indicators from such documents so that plans across emirates and sectors are harmonized and compatible with one another. This will help avoid both unnecessary creation of new indicators and conflicting or contradictory indicators across plans.

**2 Coordinate implementation and promote communication across emirates and agencies.** While the aspiration to achieve an environment that poses minimal burden on human health across the UAE is clear in the recommendations for the eight priority areas, it is equally clear that stakeholders must coordinate implementation of these recommendations across agencies and across emirates. Two possible mechanisms with which to do so would be the establishment of one or more new coordinating committees or the development of additional tasks for relevant existing committees. Committee members should be aware of one another, and committees should meet in person and/or virtually as often as stakeholders deem appropriate to keep one another informed, monitor progress, address operational decisions, etc. For example, a committee that brings together representatives from environmental agencies or local environmental authorities from each emirate could share information about effective policies, coordinate actions to implement the strategy, and help build capacity.

**3 Build local human resource capacity.** As noted across all eight priority areas, the establishment or further development of graduate professional education programs, certificate training, and in-service (on-the-job) training across the UAE is the foundation for the development of a UAE environmental health workforce that is well qualified and of sufficient size to manage environmental health policies and programs at all levels. A coherent approach to the development of such educational and training programs should transcend all priority areas.



**4 Promote sound policy enforcement mechanisms.** Policies are only valuable if they are implemented; enforcement is a critical early step to effective policy implementation, before more distal downstream health effects occur. Thematically across the eight priority areas, environmental health enforcement mechanisms in this strategic plan address compliance with required reporting of environmental and health monitoring; compliance with regulations to avoid or reduce pollution or contamination (e.g., related to generation of outdoor air emissions, hazardous waste or occupational exposures, hazard analysis, and critical point-control monitoring for food safety); and inspections and audits (e.g., indoor air quality, energy). Across all of these areas, relevant authorities should continually assess enforcement activities and ensure that the policies in place are actively being enforced.

**5 Monitor health outcomes and risk on an ongoing basis to detect emerging threats.** The ultimate goal of the UAE environmental health strategy is to reduce the burden of disease associated with environmental pollution. The strategy describes two major ways to assess this burden over time: (1) burden of disease modeling for specific environmental risks and (2) routine monitoring of health outcomes of interest, e.g., through public health surveillance, disease registries, or data mining from electronic medical records. The modeling is described in detail in a companion report on the state of the environment and public health in the UAE. Routine monitoring is addressed here, as it reflects assessment of the ultimate outcome of interest along the pathway from pollution to exposure to disease. Monitoring diseases and other health outcomes associated with specific environmental pollutants will allow policy makers to track the characteristics of disease occurrence (e.g., in terms of who is affected, locations where disease is concentrated, and trends over time). As effective environmental policies are implemented, health outcomes should improve. In the meantime, routine monitoring will allow tracking of trends and detection of outbreaks or clusters of disease that should be investigated to help target further interventions.

In the context of a rapidly developing and ever-changing country, it is important to recognize that tomorrow's environmental health threats may not be the same as those of today—new threats may emerge. Similarly, threats that are currently relatively unimportant may become more important over time. Therefore, an environmental health strategic plan must remain dynamic and policy makers vigilant to the emergence of new and evolving environmental factors or new types of exposures that negatively impact human health. Such vigilance will rely upon established monitoring systems and astute observation of unexpected or unusual events and patterns that arise. UAE policy makers may wish to consider both periodically repeating risk assessments—such as that undertaken for this strategic plan—and also ad hoc investigations of new risks as they arise. Effective monitoring will also require enhancing current systems to ensure they are robust and provide information that is useful to decision makers.

**6 Invest in a sound environmental health research agenda.** Proposed research priorities across the eight priority areas range from the fundamental understanding of the pathways from environmental exposure to disease (and the corresponding unique environmental health risks in the UAE) to the development of new technologies and more in-depth economic analyses of alternative policies to reduce the environmental burden of disease. A coherent research agenda will help the country make sound investments in improving the scientific understanding of environmental health in the country and ways to improve it.

**7 Provide national and regional leadership.** UAE policy makers are ambitious and confident about their vision for improving environmental health across the country. Leadership across emirates and across sectors must be developed and nurtured as an explicit element of building human resource capacity, e.g., through leadership training, development, and mentorship. Moreover, leadership can also apply to the exemplary environmental health policies and practices in the country. For example, policy makers may wish to consider establishment of one or more environmental health centers of excellence, including the possibility of attaining designation as a WHO Collaborating Center for environmental health. Such designation by the WHO reflects regional and international stature, with such centers serving as a model or reference center for other countries. •

A large, powerful water fountain spraying upwards in a park setting. The water is white and frothy, creating a tall column that reaches high into the sky. In the background, there are green trees, a blue sky with some clouds, and a wooden fence. The ground is paved with light-colored stones.

## Implementation and Refinement of the Strategy and Action Plan

This strategy and action plan document is but the first of many steps toward improving the protection of public health from environmental risks in the UAE. Collection of additional data and further quantitative analyses will strengthen future versions of the strategy and action plan.

As the UAE moves forward with the strategy and action plan, it should establish a regular process for refining the KPIs and recommended initiatives. The KPIs and initiatives presented here are based on the collective input of a wide variety of stakeholders in environmental health from the UAE and the science team. They represent a strong starting point for making progress in environmental health, but the KPIs and initiatives should be refined based on future data collection and quantitative analysis.

Future work to improve the strategy and action plan should include (1) gathering baseline information on the KPIs, (2) conducting quantitative analyses to determine what levels of improvement along the KPIs are technically feasible, (3) prioritizing KPIs based on analyses of the strength of association of the KPIs to environmental health, and (4) prioritizing initiatives based on their potential to improve public health and on cost-benefit analysis.

UNC has developed an integrated tool for estimating the environmental burden of disease in the UAE that can provide a foundation for carrying out some of these steps: the *United Arab Emirates Environmental Burden of Disease Model*, which can be used to prioritize data collection so that data collection efforts are focused on information with the greatest potential to inform decisions to protect environmental health. The model can help identify the factors with the greatest influence on the environmental burden of disease and which of these factors contribute the greatest uncertainty to estimates of the effects of environmental pollutants on public health. It can be used to provide input to future cost-benefit analyses. The results of the cost-benefit analyses could inform decisions about which actions or initiatives may have the greatest net benefit for public health.

The companion report on the state of the environment and public health in the UAE describes the structure of the UAE environmental burden of disease model in detail. The model itself is available from UNC or through EAD. It is supported by the software package *Analytica*.

Through implementation of this strategy and action plan, the UAE can continue to realize the vision of its first president, H. H. Sheikh Zayed bin Sultan Al Nahyan. Sheikh Zayed long recognized the connections between the environment and human health. He observed,

*We cherish our environment because it is an integral part of our country, our history and our heritage. On land and in the sea, our forefathers lived and survived in this environment. They were able to do so only because they recognized the need to conserve it, to take from it only what they needed to live and to preserve it for succeeding generations.*

This strategy and action plan is designed to help guide the UAE in its stewardship of the environment for the health of current and future generations, consistent with Sheikh Zayed's vision. The cooperation of many agencies and organizations across the UAE will ensure the success of this effort. •

## Section Overview

# of Initiatives	# of KPIs	
<b>10</b>	<b>14</b>	<b>TOTAL</b>
1	1	Target 1
1	2	Target 2
0	2	Target 3
0	1	Target 4
4	5	Target 5
1	1	Target 6
3	2	Target 7

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative. They may include nonspecific entities as well as these specific entities:

DHA	Dubai Health Authority	MOH	Ministry of Health
EAD	Environment Agency—Abu Dhabi	NRF	National Research Foundation
HAAD	Health Authority—Abu Dhabi	UAEU	UAE University
MOEW	Ministry of Environment and Water		

## Overarching Objectives (EH-9): Initiatives to Reduce the Burden of Disease Across Multiple Areas

### Target 1: Connect relevant elements of this plan with other strategic plans

#### EH-9 / T-1 / I-1

Collect all strategic planning documents pertinent to reducing environmental impacts on public health in the UAE from all agencies with missions relevant to the environment and public health. Review the strategic plans, and identify common elements.



### Target 2: Coordinate implementation and promote communication across emirates and agencies

#### EH-9 / T-2 / I-1

Establish an interagency committee to devise an approach for coordinating implementation of existing strategic plans with the UAE *National Strategy and Action Plan for Environmental Health*.



### Target 3: Build local human resource capacity

See pertinent initiatives recommended for each priority area.

### Target 4: Promote sound policy enforcement mechanisms

See pertinent initiatives recommended for each priority area.

### Target 5: Monitor health outcomes and risk on an ongoing basis

#### Stakeholders

#### EH-9 / T-5 / I-1

Review and update the *United Arab Emirates Environmental Burden of Disease Model* at least every two years.



#### EH-9 / T-5 / I-2

Establish a biological monitoring program that would provide serial cross-sectional or longitudinal data on the human body burden of environmental contaminants and of environmentally related health conditions, such as asthma or neurological disorders.



#### EH-9 / T-5 / I-3

Consider behavioral risk factor surveillance.



**EH-9 / T-5 / I-4**

Establish a list of health outcomes of interest for purposes of monitoring health effects associated with the eight priority areas, and ensure that routine data are collected throughout the country for these outcomes, e.g., through surveillance, case registries, analysis of electronic medical records.

2010	2011	2012	2013	2014	MOH	HAAD	DHA
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**Target 6: Invest in a sound environmental health research agenda****Stakeholders****EH-9 / T-6 / I-1**

Develop a national environmental health research agenda consistent with the needs of the UAE national research agenda, and review it annually. Note also that MOH is working on a national health research agenda.

2010	2011	2012	2013	2014	Environmental and health authorities, occupational health authorities	UAEU
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**Target 7: Provide national and regional leadership****Stakeholders****EH-9 / T-7 / I-1**

Continue to support centers of excellence related to environmental health in the UAE. Note that 10 such centers already exist or are planned.

2010	?	NRF
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**EH-9 / T-7 / I-2**

Establish a WHO Collaborating Centre for Environmental Health in the UAE. Begin with annual assessments of readiness to apply for such designation.

2010	ONGOING	Environmental and health authorities	UAEU
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**EH-9 / T-7 / I-3**

Support study tours in environmental health in the UAE.

2010	?	To be determined
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**Overarching Objectives (EH-9): Key Performance Indicators**

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 1: Connect relevant elements of this plan with other strategic plans</b>			
EH-9/T-1/K-1	Percentage of revised KPIs that are compatible with other relevant strategic plans (federal and emirate level)	100%	100%
<b>Target 2: Coordinate implementation and promote communication across emirates and agencies</b>			
EH-9/T-2/K-1	Number of sectors or entities represented in committees and meetings to coordinate plan implementation	To be determined	To be determined
EH-9/T-2/K-2	Number of coordinating committee meetings in the preceding six months	To be determined	To be determined
<b>Target 3: Build local human resource capacity</b>			
EH-9/T-3/K-1	Number of accredited programs offering graduate-level degrees in specified disciplines relevant to environmental health, e.g., environmental sciences and engineering, occupational medicine, epidemiology, toxicology	To be determined	To be determined
EH-9/T-3/K-2	Number of graduates per year with master's and PhD degrees in specified disciplines relevant to environmental health	To be determined	To be determined
<b>Target 4: Promote sound policy enforcement mechanisms</b>			
EH-9/T-4/K-1	Number of emirates with policies, laws and/or regulations in place to provide for adequate enforcement of all requirements for each priority area	3-4 emirates for each priority area	All emirates, all priority areas



## Section Overview

# of Initiatives	# of KPIs	
<b>10</b>	<b>14</b>	<b>TOTAL</b>
1	1	Target 1
1	2	Target 2
0	2	Target 3
0	1	Target 4
4	5	Target 5
1	1	Target 6
3	2	Target 7

Stakeholders are organizations that should cooperate in the planning and achievement of each initiative. They may include nonspecific entities as well as these specific entities:

DHA	Dubai Health Authority	MOH	Ministry of Health
EAD	Environment Agency—Abu Dhabi	NRF	National Research Foundation
HAAD	Health Authority—Abu Dhabi	UAEU	UAE University
MOEW	Ministry of Environment and Water		

KPI No.	Description	2014 Goal	2030 Goal
<b>Target 5: Monitor health outcomes and risk on an ongoing basis</b>			
EH-9/T-5/K-1	Total estimated environmental burden of disease (expressed as disability-adjusted life years) in the UAE	To be determined	To be determined
EH-9/T-5/K-2	Number of emirates monitoring at least 90% of health outcomes of interest on a routine basis	3-4	All emirates
EH-9/T-5/K-3	Percentage of required surveillance reports for one year that are submitted within one week of due date (by emirate)	50%	100%
EH-9/T-5/K-4	Number of outbreaks or case clusters of health outcomes of interest detected per year by each emirate	Not applicable	Not applicable
EH-9/T-5/K-5	Number of input parameters in environmental burden of disease model updated per year	To be determined	To be determined
<b>Target 6: Invest in a sound environmental health research agenda</b>			
EH-9/T-6/K-1	Number of research findings concretely applied to environmental health policy or programming per year	To be determined	To be determined
<b>Target 7: Provide national and regional leadership</b>			
EH-9/T-7/K-1	Number of designated environmental health centers of excellence in the UAE	To be determined	To be determined
EH-9/T-7/K-2	Number of environmental health study tours hosted per year: 1. From region 2. From elsewhere	To be determined	To be determined



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## Appendix A

# Workshop Participants

January 25-26, 2009, Abu Dhabi

<b>Hazem Abuahmad</b>	Abu Dhabi National Oil Company, Supreme Petroleum Council
<b>Ayesha Abushahab</b>	Environment Agency—Abu Dhabi
<b>Faisal Al Hammadi</b>	Environment Agency—Abu Dhabi
<b>Taha Nagy Al Hosary</b>	National Center for Meteorology
<b>Salha Al Humairi</b>	Environment Agency—Abu Dhabi
<b>Mohammad Al Hosani</b>	Abu Dhabi Municipality
<b>Yousif Al Husani</b>	Armed Forces, UAE Defense, Medical Services
<b>Ahmed Saeed Al Junaibi</b>	
<b>Amer Al Kindi</b>	Abu Dhabi Education Council
<b>Mohammad Al Marzouqi</b>	Abu Dhabi Municipality
<b>Khawla Al Muhairi</b>	Family Environment Foundation
<b>Muthana Al Omar</b>	Abu Dhabi Water and Electricity Authority
<b>Abdulla Al Rumaiti</b>	Environment Agency—Abu Dhabi
<b>Ayesha Al Suweidi</b>	Environment Agency—Abu Dhabi
<b>Shirina Al Suweidi</b>	UAE University
<b>Salem Al Sueiki</b>	Environment Agency—Abu Dhabi
<b>Mariam H. Al Yousuf</b>	Abu Dhabi Food Control Authority
<b>Wafa Eissa Al Zaabi</b>	General Women Union
<b>Mohammed Hag Ali</b>	Armed Forces, UAE Defense, Medical Services
<b>Ahmed Ali Roshdy</b>	
<b>Joseph Bularzik</b>	Abu Dhabi University
<b>Holley Chant</b>	Urban Planning Council
<b>Lutfi Desougi</b>	Federal Environment Agency
<b>Ibrahim El Labadidi</b>	Abu Dhabi Council for Heritage and Culture
<b>Olabode Esan</b>	Abu Dhabi Municipality
<b>Khalid A. Gelle</b>	Environment Agency—Abu Dhabi
<b>Abdul Salam Husain</b>	Environment Agency—Abu Dhabi
<b>Darren Joubert</b>	Health Authority—Abu Dhabi
<b>Walid Abdel Kader</b>	Environment Agency—Abu Dhabi
<b>Zainab Khazaal</b>	Abu Dhabi Health Services Company (SEHA)
<b>Huden Kunz</b>	United Nations Development Programme
<b>Gabrielle Z. Mailloux</b>	Abu Dhabi University
<b>Neil Mallen</b>	Urban Planning Council
<b>Ruqaya Mohamed</b>	Environment Agency—Abu Dhabi

<b>Ahmed Nabeel</b>	Ministry of Health
<b>Annemarie Neubecker</b>	Abu Dhabi Education Council
<b>Alena Pristiskayah</b>	Al Noor Hospital
<b>Dhirajal Radadiya</b>	Abu Dhabi National Oil Company, Supreme Petroleum Council
<b>Khamis Raddad</b>	Ministry of Economy, Census
<b>Kevin Reid</b>	Urban Planning Council, Environment
<b>Yasmin Saddah</b>	Masdar City Initiative
<b>Abdurrahman Saleh</b>	Armed Forces, UAE Defense, Chemical Defense
<b>Fareed Saleh</b>	Abu Dhabi Health Services Company (SEHA)
<b>Humeid Said</b>	Ministry of Interior, Civil Defense
<b>Doa'a Hamdy Sorour</b>	Federal Environment Agency
<b>Rex Taylor</b>	Zayed University
<b>Alan Thomson</b>	Abu Dhabi Sewage Services Company
<b>Mark Vine</b>	Department of Transport
<b>Sanaa Omair Bin Yousef</b>	Family Environment Foundation
<b>Amin Mohamed Yousif</b>	Abu Dhabi Municipality

## January 28-29, 2009, Dubai

<b>Mohammed A. Abdullah</b>	Ajman Municipality
<b>Thowaibi Ahli</b>	Ministry of Environment and Water
<b>Badir Al Ali</b>	Emirates National Oil Company
<b>Saber Al Ammar</b>	Emirates National Oil Company
<b>Raed Al Marzouq</b>	Dubai Municipality
<b>Ali Al Marzouqi</b>	Dubai Health Authority
<b>Ahmad S. Al Nagaz</b>	Dubai Municipality
<b>Hareth Al Omary</b>	Dubai Municipality
<b>Asma S. Al Suweidi</b>	Sharjah Municipality
<b>Kaltham Al Shaibani</b>	Um Almomine Association
<b>Saeed Al Shamsi</b>	Department of Health
<b>Nasser Ali</b>	Emirates National Oil Company
<b>Alia Ali Busamra</b>	Emirates Environment Group
<b>Shareifa Ali Saeed</b>	Fujairah Municipality
<b>Khadija A. Alloghani</b>	Sharjah Municipality, Food Lab
<b>Shereen Besiso</b>	Emirates Environment Group
<b>Rashed Karkain</b>	Dubai Municipality
<b>Abdulsalem Mohmd</b>	Dubai Municipality Environment Department
<b>Hafiz Omar</b>	University of Sharjah
<b>Redha H. Salman</b>	Dubai Municipality
<b>Moayad Yacoub</b>	Emirates Environment Group

## April 15, 2009, Abu Dhabi

<b>Abdullah Al Aameri</b>	Environment Agency—Abu Dhabi
<b>Omar Al Ashram</b>	Environment Agency—Abu Dhabi
<b>Salem Al Braiki</b>	Environment Agency—Abu Dhabi
<b>Huda Mohamed Ajaraj Al Dhafar</b>	Abu Dhabi Food Control Authority
<b>Manal Al Hashemi</b>	Abu Dhabi Food Control Authority
<b>Awatif Al Hosani</b>	Environment Agency—Abu Dhabi
<b>Ahmed Awad Ali Al Kathery</b>	Armed Forces
<b>Abdul Rahman Al Marzouqi</b>	Environment Agency—Abu Dhabi
<b>Ali Al Marzouqi</b>	Dubai Health Authority
<b>Khaled Ateeq Al Mazrouki</b>	Environment Agency—Abu Dhabi
<b>Nabeel Saleh Al Olaqi</b>	Environment Agency—Abu Dhabi
<b>Abdulla Al Rumaithi</b>	Environment Agency—Abu Dhabi
<b>Ayesha Al Suweidi</b>	Environment Agency—Abu Dhabi
<b>Mariam H. Al Yousuf</b>	Abu Dhabi Food Control Authority
<b>Abdul Salam BaAqeel</b>	Environment Agency—Abu Dhabi
<b>Dhabia Bhakhit</b>	Department of Transport
<b>Ahmed Bashir</b>	Environment Agency—Abu Dhabi
<b>Khalid A. Gelle</b>	Environment Agency—Abu Dhabi
<b>Qasem Hilles</b>	Abu Dhabi Food Control Authority
<b>Darren Joubert</b>	Health Authority—Abu Dhabi
<b>Mustafa Lotfi</b>	Environment Agency—Abu Dhabi
<b>Salah Moussa</b>	Abu Dhabi National Oil Company, Supreme Petroleum Council
<b>Asma Abdi Mohamed</b>	Abu Dhabi Food Control Authority
<b>Ruqaya Mohamed</b>	Environment Agency—Abu Dhabi
<b>Hazem H. Qawasmeh</b>	Environment Agency—Abu Dhabi
<b>Katherine Rain</b>	Health Authority—Abu Dhabi
<b>Zuleykha Rasolova</b>	Department of Transport
<b>Pritpal Soorae</b>	Environment Agency—Abu Dhabi
<b>Jens Thomsen</b>	Health Authority—Abu Dhabi
<b>Mark Vine</b>	Department of Transport

## June 3, 2009, Abu Dhabi

<b>Mahmoud Abdelfattah</b>	Environment Agency—Abu Dhabi
<b>Ayesha Abushahab</b>	Environment Agency—Abu Dhabi
<b>Shakeel Ahmad</b>	Abu Dhabi Food Control Authority
<b>Abdulla Al Aameri</b>	Environment Agency—Abu Dhabi
<b>Omar Al Ashram</b>	Environment Agency—Abu Dhabi
<b>Abdulnaser Al Faihan</b>	Dubai Municipality
<b>Saif Al Ghais</b>	UAE University

<b>Manal Al Hashemi</b>	Abu Dhabi Food Control Authority
<b>Khaled Al Junadi</b>	Environment Agency–Abu Dhabi
<b>Saif Rateb Al Kubaisy</b>	Dubai Municipality
<b>Nabil Al Madalal</b>	Center of Waste Management Abu Dhabi
<b>Saif Al Qaydi</b>	UAE University
<b>Buthaina Salem Al Qubaisi</b>	Abu Dhabi Food Control Authority
<b>Abdulla Al Rumaithi</b>	Environment Agency–Abu Dhabi
<b>Ayesha Al Suweidi</b>	Environment Agency–Abu Dhabi
<b>Husein Ghani Ali</b>	Environment Agency–Abu Dhabi
<b>Muhammad Altaf</b>	Dubai Municipality Food Control Department
<b>Tar-Ching Aw</b>	UAE University
<b>Gregorio B. Balerite</b>	Dubai Municipality Environment Department
<b>Dhabia Bhakhit</b>	Department of Transport
<b>Iain Blair</b>	UAE University
<b>Trond Bohler</b>	Norwegian Institute for Air Research
<b>Victoria Brown</b>	Urban Planning Council
<b>Housam Chahin</b>	Environment Agency–Abu Dhabi
<b>Mohamed El Sadig</b>	UAE University
<b>Stanley Falconer</b>	ICAD Industrial Waste Treatment Services
<b>Khalid A. Gelle</b>	Environment Agency–Abu Dhabi
<b>Husein Hamed</b>	Norwegian Institute for Air Research
<b>Mohamed Hasan</b>	Dubai Municipality
<b>Qasem Hilles</b>	Abu Dhabi Food Control Authority
<b>Darren Joubert</b>	Health Authority–Abu Dhabi
<b>Mona Kazwah</b>	Environment Agency–Abu Dhabi
<b>Shadab Alem Khan</b>	Dubai Municipality
<b>Mustafa Lotfi</b>	Environment Agency–Abu Dhabi
<b>Asma Abdi Mohamed</b>	Abu Dhabi Food Control Authority
<b>Ruqaya Mohamed</b>	Environment Agency–Abu Dhabi
<b>Nasir Ahmed Ali Mohammed</b>	Ministry of Health
<b>Ahmed Nabil</b>	Ministry of Health
<b>Hafiz Omar</b>	University of Sharjah
<b>Hazem Qawasmeh</b>	Environment Agency–Abu Dhabi
<b>Katherine Rain</b>	Health Authority–Abu Dhabi
<b>Anbiah Rajan</b>	Environment Agency–Abu Dhabi
<b>Zuleykha Rasulova</b>	Department of Transport
<b>Saeed Yousef A. Abdel Razeq</b>	UAE University
<b>Kevin Reid</b>	Urban Planning Council
<b>Sufyan Sabri</b>	UAE University
<b>John Schneider</b>	UAE University
<b>Pritpal Soorae</b>	Environment Agency–Abu Dhabi
<b>Jens Thomsen</b>	Health Authority–Abu Dhabi
<b>Mark Vine</b>	Department of Transport
<b>Andy Wheatley</b>	UAE University

## Appendix B

# Science and Editorial Team

### Team Leadership

<b>Dr. Jacqueline MacDonald Gibson</b>	University of North Carolina—Chapel Hill
<b>Dr. Zeinab Farah</b>	University of North Carolina—Chapel Hill
<b>Dr. Melinda Moore</b>	RAND Corporation
<b>Dr. Henry Willis</b>	RAND Corporation
<b>Hanine Salem</b>	RAND Corporation

#### Priority Area 1:

### Outdoor Air

<b>Dr. William Vizuet</b>	University of North Carolina—Chapel Hill
<b>Dr. J. Jason West</b>	University of North Carolina—Chapel Hill
<b>Dr. Alan Krupnick</b>	Resources for the Future
<b>Dr. Kenneth G. Sexton</b>	University of North Carolina—Chapel Hill
<b>Dr. Zuber Farooqui</b>	University of North Carolina—Chapel Hill
<b>Dr. Regina Shih</b>	RAND Corporation
<b>Dr. Ying Li</b>	University of North Carolina—Chapel Hill

#### Priority Area 2:

### Indoor Air

<b>Chris Trent</b>	University of North Carolina—Chapel Hill
<b>Dr. Michael Flynn</b>	University of North Carolina—Chapel Hill
<b>Dr. Regina Shih</b>	RAND Corporation

#### Priority Area 3:

### Occupational Exposures

<b>Dr. Leena Nylander-French</b>	University of North Carolina—Chapel Hill
<b>Tiina Folley</b>	University of North Carolina—Chapel Hill
<b>Dr. Melinda Moore</b>	RAND Corporation
<b>Dr. Regina Shih</b>	RAND Corporation



**Priority Area 4:**

## Climate Change

<b>Dr. J. Jason West</b>	University of North Carolina—Chapel Hill
<b>Dr. Richard Andrews</b>	University of North Carolina—Chapel Hill
<b>Dr. Nicholas Burger</b>	RAND Corporation
<b>Leslie Chinery</b>	University of North Carolina—Chapel Hill
<b>Elizabeth S. Harder</b>	University of North Carolina—Chapel Hill
<b>Dr. Sandra Geschwind</b>	RAND Corporation

**Priority Area 5:**

## Drinking Water

<b>Dr. Greg Characklis</b>	University of North Carolina—Chapel Hill
<b>Joseph Lobuglio</b>	University of North Carolina—Chapel Hill
<b>Dr. Gary Cecchine</b>	RAND Corporation

**Priority Area 6:**

## Coastal Water

<b>Dr. Greg Characklis</b>	University of North Carolina—Chapel Hill
<b>Dr. Leigh-Anne Krometis</b>	University of North Carolina—Chapel Hill
<b>Dr. Gary Cecchine</b>	RAND Corporation

**Priority Area 7:**

## Soil and Groundwater

<b>Dr. Michael Aitken</b>	University of North Carolina—Chapel Hill
<b>Dr. Ying Li</b>	University of North Carolina—Chapel Hill
<b>Chidsanuphong Chart-asa</b>	University of North Carolina—Chapel Hill
<b>Sarah Szambelan</b>	Resources for the Future
<b>Dr. Sandra Geschwind</b>	RAND Corporation
<b>Dr. Nicholas Burger</b>	RAND Corporation

**Priority Area 8:**

## Produce and Seafood

<b>Dr. Sandra Hoffmann</b>	Resources for the Future
<b>Christopher Davidson</b>	University of North Carolina—Chapel Hill
<b>Dr. Leigh-Anne Krometis</b>	University of North Carolina—Chapel Hill
<b>Dr. Aimee Cartwright</b>	RAND Corporation

## Editing and Design

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## Appendix C

# Key to Common Acronyms

<b>ACGIH</b>	American Conference of Governmental Industrial Hygienists
<b>ADACI</b>	Abu Dhabi Air and Climate Institute
<b>ADFCA</b>	Abu Dhabi Food Control Authority
<b>ADNOC</b>	Abu Dhabi National Oil Company
<b>ADPD</b>	Abu Dhabi Police Department
<b>ADWEA</b>	Abu Dhabi Water and Electricity Authority
<b>AGEDI</b>	Abu Dhabi Global Environmental Data Initiative
<b>CCS</b>	carbon capture and sequestration
<b>CWM</b>	Center of Waste Management Abu Dhabi
<b>DED</b>	Dubai Municipality Environment Department
<b>DFG</b>	German Research Foundation ( <i>Deutsche Forschungsgemeinschaft</i> )
<b>DHA</b>	Dubai Health Authority
<b>DOT</b>	Department of Transport (Abu Dhabi)
<b>EAD</b>	Environment Agency—Abu Dhabi
<b>EHSMS</b>	Environment, Health and Safety Management System (Abu Dhabi)
<b>EPA</b>	Environmental Protection Agency (U.S.)
<b>ESMA</b>	Emirates Authority for Standardization and Metrology
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FEWA</b>	Federal Electricity and Water Authority (UAE)
<b>GAP</b>	Good Agricultural Practices
<b>GDP</b>	gross domestic product
<b>GHG</b>	greenhouse gas
<b>GMO</b>	genetically modified organism
<b>HAAD</b>	Health Authority—Abu Dhabi
<b>ISO</b>	International Organization for Standardization
<b>KPI</b>	key performance indicator
<b>MHESR</b>	Ministry of Higher Education and Scientific Research (UAE)
<b>MOE</b>	Ministry of Education (UAE)
<b>MOEcon</b>	Ministry of Economy (UAE)
<b>MOEW</b>	Ministry of Environment and Water (UAE)
<b>MOF</b>	Ministry of Finance (UAE)
<b>MOH</b>	Ministry of Health (UAE)
<b>MOI</b>	Ministry of Interior (UAE)
<b>MOL</b>	Ministry of Labor (UAE)
<b>NILU</b>	Norwegian Institute for Air Research
<b>NRF</b>	National Research Foundation (UAE)
<b>NTA</b>	National Transport Authority (UAE)
<b>OHS</b>	occupational health and safety
<b>PM</b>	particulate matter
<b>ppm</b>	parts per million
<b>RAND</b>	RAND Corporation
<b>RFF</b>	Resources for the Future
<b>RSB</b>	Regulation and Supervision Bureau for the water, wastewater, and electricity sectors in Abu Dhabi emirate
<b>SDI</b>	Spatial Data Infrastructure database
<b>VOC</b>	volatile organic compound
<b>UAEU</b>	UAE University
<b>UNC</b>	University of North Carolina—Chapel Hill
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>UPC</b>	Urban Planning Council (Abu Dhabi)
<b>WHO</b>	World Health Organization



