



UNITED ARAB EMIRATES
MINISTRY OF CLIMATE CHANGE
& ENVIRONMENT

National Climate Change Adaptation Program

Sectoral Climate Risk Assessment Framework

2019

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Background and Objectives

The National Climate Change Plan of the United Arab Emirates 2017-2050 (hereafter referred to as Climate Plan) defines climate change adaptation as one of the three pillars, along with greenhouse gas (GHG) accounting and private sector-driven green diversification. The Climate Plan highlights the development of a national climate change adaptation policy with the following expected outcomes and timeline:

- **By 2020:** Climate change risk and vulnerability assessments performed and immediate measures put in place.
- **By 2025:** Adaptation planning mainstreamed in development policy.
- **By 2030-2050:** Continuous monitoring and evaluation to ensure evidence-based adaptation measures.

Since understanding risks is a prerequisite to develop response measures,^(a) the Climate Plan identified climate risk assessment completed by 2020 as the initial outcome. In the context of climate change, the Intergovernmental Panel on Climate Change (IPCC) defined risk as “the potential for consequences (i.e., impacts) where something of value (i.e., assets, people, ecosystem, culture) is at stake and where the outcome is uncertain.”^(b) To fulfill the climate change risk assessment, the UAE Ministry of Climate Change and Environment (MOCCA) assesses climate change risks in the following four key sectors, which are significant in realizing the country’s green economy transformation outlined in the UAE Green Agenda 2030:

- a. Public health: Medical symptoms, diseases, injuries, and deaths of the population;
- b. Energy: Generation, transmission, distribution, and end use of electricity & heat;

- c. Infrastructure: Structural elements of transportation, buildings, water supply, sanitation and waste management, and coastal and offshore infrastructure; and
- d. Environment: Terrestrial, coastal, ocean, and freshwater ecosystems, with associated ecosystem services including agriculture and fisheries.

This document provides a common framework for conducting national-level climate risk assessments for the key sectors of the country. The outcomes from the assessments will support the development of specific policies and initiatives of the National Climate Change Adaptation Program under the aegis of the Climate Plan.

Global Practices of Climate Risk Assessment

In the development of a sectoral climate risk assessment framework, relevant practices from Australia, Canada, Germany, Japan, the Netherlands, New Zealand, Singapore, United Kingdom, and United States were considered (Annex 1). These countries conducted national and/or sectoral climate risk assessments in various periods. For example, the UK released the most recent assessment through the UK Climate Change Risk Assessment 2017.^(c)

A review of those countries’ approaches shows common steps taken in the risk assessment processes, which includes: 1) establish the context; 2) identify risks; 3) analyze the risks; 4) evaluate the risks; and 5) treat the risks. To help identify and evaluate risks, those countries generally use information from global and regional climate scenarios and modelling studies, and refer to local research upon availability to complement findings. The countries also consult with stakeholders from various sectors to confirm the findings from literature, obtain insights not provided by scientific research, and help prioritize the risks and response measures.

(a) Noble, I. R., et al. 2014. “Adaptation needs and options”, In: Field, C.B., et al. (eds.). Climate Change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, pp. 833-868. Cambridge: Cambridge University Press.

(b) Intergovernmental Panel on Climate Change (IPCC). 2014. Annex II: Glossary. In Pachauri, R., et al. (eds.). Climate Change 2014: Synthesis report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, pp.117-130 (quote in p.127). Geneva: IPCC.

(c) Committee on Climate Change, United Kingdom. 2016. UK Climate Change Risk Assessment 2017 (Synthesis Report & Evidence Report), London: CCC, available at <https://www.theccc.org.uk/publication/uk-climate-change-risk-assessment-2017>.

Climate Risk Assessment Framework for the UAE

The UAE's sectoral climate risk assessment framework incorporates the basic elements present in the reviewed global practices as well as the national standard for risk assessment of occupational health and safety that the National Crisis Emergency and Disasters Management Authority (NCEMA) developed.^(d) This ensures the framework's methodological integrity while adapting it to the national contexts (Figure 1).

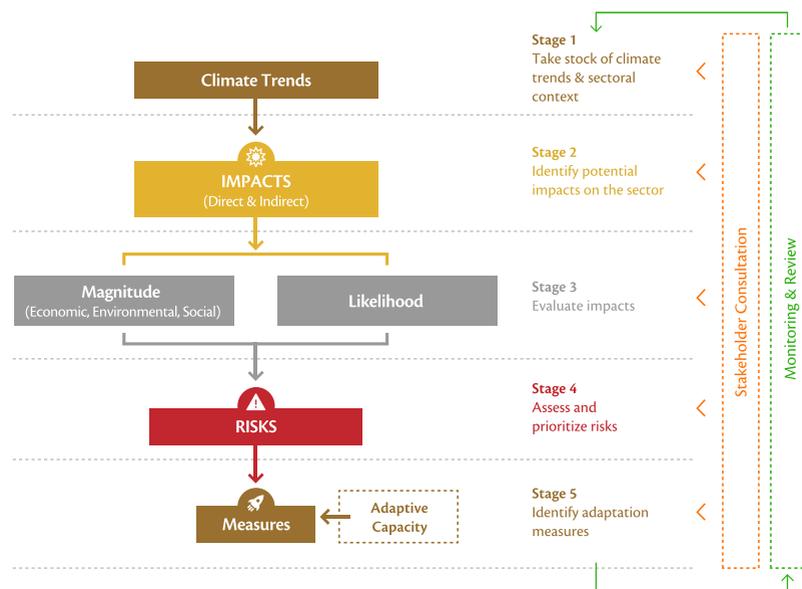


Figure 1. UAE sectoral climate risk assessment framework

The framework has five stages. The assessment starts with taking stock of existing knowledge on local climate conditions and projections, including national climate modeling studies as far as available. Secondly, based on global climate knowledge, the assessment identifies a range of potential climate change impacts specific to the sector and relevant to the national context.

The third stage evaluates the magnitude and the likelihood of occurrence of the relevant impacts identified in the previous stage. The results from this evaluation synthesizes the risks of those impacts in the fourth stage, which sheds light to the most significant risks. Lastly, by analyzing gaps in existing actions and institutional capacity surrounding the sector, the final stage elaborates on the climate change adaptation measures to tackle the priority risks. Below are more details on each stage:

Stage 1: Take stock of climate trends and sectoral context

The climate risk assessment begins with an appraisal of climate trends at various levels as a foundation for all sectoral assessments. This stage considers historical patterns and future trends (short- to long- term) of atmospheric temperature, humidity, precipitation, sea level rise, drought, and extreme weather events in the country. By taking stock of available research findings from global, regional, and national climate modelling studies and other relevant literature, this stage involves the collection and examination of relevant information screened or classified according to presented level of confidence and margin of error.

This first stage also requires contextualizing the climate trends for the sector according to who or what may be affected. This stage also identifies where, when, and how the trends may affect the sector. In addition, this stage reviews the current national and local systems surrounding the sector (i.e., institutions, policies, governance, industrial structures, etc.) to identify key stakeholders to engage in the risk assessment exercises as well as to elaborate adaptation measures in the final stage.

(d) For the risk assessment for occupational health and safety in the UAE, refer to: Occupational Health and Safety Management System (OHSMS) National Standard, AE/NSCS/NCEMA 71000 2016, available at www.ncema.gov.ae.

Stage 2: Identify potential impacts on the sector

This framework considers climate change impacts as effects of extreme climatic events on natural and human systems occurring within a specific period, and affected by the vulnerability of an exposed society or system.^(e)

Such impacts may take place in varying degrees of scale, complexity, and exposure – either directly or indirectly to the sector. Impacts may arise when the exposure to climatic factors or events directly affects the elements essential to the sector's operation or functioning. The effects of climate change on other environmental, economic or social parameters (e.g., degraded ecosystems, rising cost of materials, displacement of communities) may also indirectly cause noticeable impacts on the sector. The scope of sectoral climate risk assessments considers both the direct and indirect impacts.

This second stage initially develops a list of potential climate change impacts relevant to the sector based on the potential impacts outlined in different chapters of the IPCC's fourth and fifth assessment reports (AR4; AR5).^(f) The list is then examined from the country's specific context including natural resources, demographics, and economic and social development to narrow it down. In addition to the IPCC reports,

Examples of climate change impacts in the UAE context:

- Mortality increases for vulnerable population due to rising temperature and humidity
- Increased disruption in energy supply due to extreme weather events
- Damages to public infrastructure (e.g., roads and ports) due to sea level rise
- Natural habitat and species losses due to extreme temperature and sea level rise

this stage considers the information on climate change impacts from various international organizations with sectoral expertise such as the World Health Organization (health), the International Energy Agency (energy), and the UN Environment (the environment).

Stage 3: Evaluate impacts

Climate risk, in this framework, refers to the risk of a particular climate change impact occurring in a given timescale.^(g) In line with the reviewed international practices, each climate risk is defined as a synthesis of the magnitude and the likelihood of occurrence of the impact identified in the previous stage.

$$\text{Risk} = \text{Magnitude} \times \text{Likelihood (of impact)}$$

Consistent with the NCEMA's national standard for occupational health and safety risk assessment, the magnitude of impacts considers three dimensions: economic (monetary value of damages to property, livelihood, and infrastructure), social (size, segments and vulnerability of population affected), and environmental (effects on species, habitats, or landscapes). Each dimension uses five assessment scales of Very Small (1), Small (2), Moderate (3), Large (4), and Very Large (5).

(e) Intergovernmental Panel on Climate Change (IPCC). 2014. Annex II: Glossary. In Pachauri, R., et al. (eds.). Climate Change 2014: Synthesis report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, pp.117-130 (quote in p.127). Geneva: IPCC

(f) The IPCC Working Group II (WG II) is the group of experts designated to examine and evaluate the sectoral risks, impacts, vulnerability, and adaptation. This risk assessment framework largely relies on the reports that WG II produced for the third to the fifth assessment reports of the IPCC. The sectors that the WG II considered at both the global and regional levels include: natural and managed resources and systems (e.g., freshwater, terrestrial systems, coastal systems, ocean systems, food production systems); human settlements, industry, and infrastructure (e.g., urban areas, rural areas); human health and well-being (e.g., public health, human security, livelihoods). All the reports of the WGII are available at www.ipcc.ch.

(g) The definition of both climate change impacts and risks is consistent with the UK's climate risk assessment methodology.

As presented in Table 1, there is an equal aggregation of the scores of the three dimensions with scaling up to a maximum of 100. This stage classifies the synthesized score into five levels (Very Small, Small, Moderate, Large, and Very Large). Table 2 presents the process of scoring, synthesizing, and classifying the magnitude of impacts using three hypothetical examples.

Table 1. Magnitude scoring and classification

Dimension of magnitude	Score	Formula to synthesize scores (max = 100)		
Economic (MEco)	Very Small = 1 Small = 2	$\text{Magnitude} = \frac{\text{MEco} + \text{MEnv} + \text{MSoc}}{15} \times 100$		
Environmental (MEnv)	Moderate = 3 Large = 4			
Social (MSoc)	Very Large = 5			
Classification of magnitude				
0 - 20	20 - 40	41 - 60	61 - 80	81 - 100
Very Small	Small	Moderate	Large	Very Large

Table 2. Examples of magnitude scoring and classification

Sample impact	Scores of magnitude			Synthesized score	Classification
	Economic	Environmental	Social		
A	2	2	1	→ 33	→ Small
B	4	2	2	→ 53	→ Moderate
C	3	5	3	→ 73	→ Large

As the estimated chance of a specific outcome occurring under a future scenario in a given period, likelihood^(h) of impacts examined in this stage may fall into any of the five levels of Very Unlikely, Unlikely, Likely, Very Likely, and Almost Certain. Annex 2 provides the criteria for each scaling of magnitude and likelihood, which used globally-accepted definitions with some modification to fit the country context.

Stage 4: Assess and prioritize risks

To determine the level of climate risks, the fourth stage synthesizes the assessed magnitude and likelihood of impacts using a “risk matrix” presented in Figure 2. For example, in the case of the likelihood levels of Sample Impact A in Table 2, which is Likely, that of B as Very Likely, and that of C as Almost Certain, the risks of A, B, and C then fall into Low, Medium, and High, respectively, as presented below. Thus, it is concluded that the risk of C is of higher priority compared to that of A and B, and the risk of B is of higher priority than that of A. The assessment assumes equal weights between magnitude and likelihood to preclude subjective judgements of significance.

With the graphical representation of the impacts in the matrix, the relevant sector can identify the next step on whether it is necessary to respond to certain risks proactively or continue further investigations. Annex 2 includes details on the interpretation of the results of risk classifications and sectoral responses required for addressing the risks.

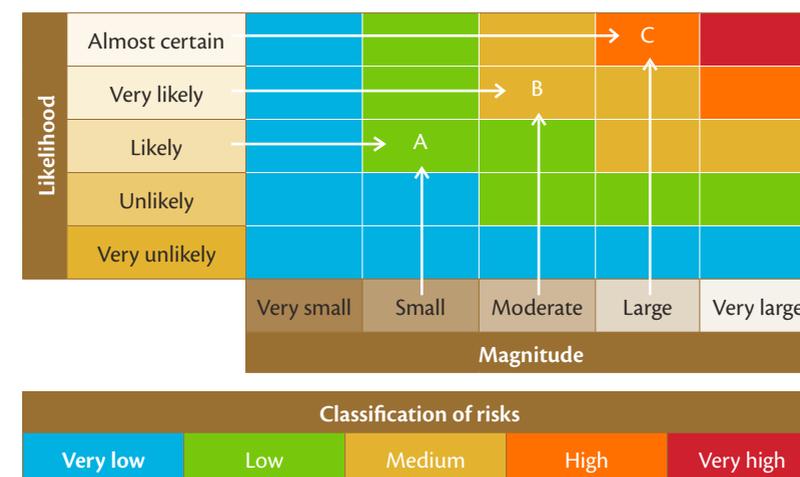


Figure 2. Climate risk matrix

(h) Department for Environment, Food, and Rural Affairs (Defra), United Kingdom. 2014. UK Climate Change Risk Assessment Evidence Report 2016, Method document, Version 1.0. London: Defra.

Stage 5: Identify adaptation measures

The final stage elaborates the measures to tackle the risks prioritized at the previous stage. It is important to take stock of existing efforts for adaptation to build on the current institutional capacity of the country. As such, it is critical to consider and compile existing sectoral policies and measures of both national and local relevance.

Here, adaptation-relevant measures can be of hard or soft approaches. Hard measures involve infrastructure (e.g., construction of sea walls), whereas the soft approach comes in the form of laws, programs or initiatives such as early warning systems, awareness programs, and zoning rules. This stage of the assessment may consider using the IPCC's standard classification of adaptation measures, which are structured into four categories – physical safeguards, risk management, knowledge, and enablers:⁽ⁱ⁾

- Physical safeguards refer to engineered structures, technological systems, and services, as well as ecosystem-based infrastructure, that support adaptation objectives.
- Risk management covers the regulations, incentives, and financial mechanisms, as well as early warning systems and emergency plans, that directly address climate risks.
- Knowledge encompasses climate data and research, risk assessment, and awareness campaigns and communication.
- Enablers are foundational policies not directly targeting adaptation but providing an enabling condition for improving resilience.

It is important to note that many policies and measures may not be primarily targeted for adaptation but can be considered to directly or indirectly support adaptation if carefully examined. As such, a review of existing policies and measures is vital to identify whether they can directly or indirectly address the prioritized risks to identify the “adaptive capacity” of the country as well as the gaps where relevant measures are missing or insufficient, and additional actions are necessary.

Lastly, based on the above analysis, this stage must also elaborate a set of additional measures required to address and manage the prioritized risks. Two distinct perspectives may influence these measures. Where several adaptation-relevant measures are already in place for the particular risk, there is an opportunity to refocus the measures toward adaptation or to implement further actions based on existing capacity with relatively small cost. On the other hand, where there are significant action gaps to address the particular risk, substantial efforts may be necessary to establish a new initiative or mechanism. It is, therefore, important to develop diverse adaptation measures to complement each other and to help other sustainable development objectives. One type of initiative or action may be relevant to more than one category of the measures.



(i) This typology of adaptation measures is consistent with IPCC categories (structural/physical, social, and institutional adaptation) and the World Health Organization adaptation measure taxonomy (risk management, information, foundations).

Stakeholder Engagement and Continuous Improvement

Given the limited availability of the research and data specific to the country and the region, the UAE's sectoral climate risk assessments need to rely heavily on information and insights from local experts and professionals through surveys, interviews, and multi-stakeholder workshops, as well as desk reviews of global knowledge such as the IPCC reports as well as the academic and gray literature.^(j) The benefit of this approach is that the risk assessment process is participatory and facilitates collective implementation of the required measures. Therefore, it is imperative to conduct active consultation and communications with relevant stakeholders at each stage of the assessment process.

After completing the first round of the risk assessments, it is critical to continue to engage relevant stakeholders to prioritize the measures identified in the above final stage in terms of its importance, cost, feasibility, practicality, and impact. The identification of task leader(s), who will further elaborate each prioritized measure with a roadmap and subsequently coordinate its implementation must be part of the prioritization of measures.

Regular monitoring and evaluation of the climate risk status and the implementation of adaptation measures are essential for continuous improvement. To allow new knowledge to be taken into account and to ensure that risk prioritization and measures continue to be relevant (e.g., UK conducts climate risk assessment every five years), periodic risk assessment updates are necessary. Meanwhile, it is important for the country to invest in advancing climate research to gain improved knowledge for planning and implementing more effective and efficient adaptation actions.

(j) Academic literature refers to peer-reviewed documents published in scholarly journals. Gray literature consists of diverse types of non-scholarly documents with a certain level of acceptable quality produced on all levels of governments, businesses, industries, and non-governmental entities.

Annex A: Reviewed Climate Change Adaptation Plans & Climate Risk Assessments

	National Adaptation Plan/ Strategy	National Risk Assessment	Local Adaptation Plan/ Strategy
Australia	National Climate Resilience and Adaptation Strategy (2015)	Climate Change Impacts & Risk Management: A guide for business and government (2006)	Adapting for Climate Change: A long-term strategy for the City of Sydney (2017)
Canada	Pan-Canadian Framework on Clean Growth and Climate Change (2016)	Canadian Climate Change Risk Assessment Guide: A strategic overview of climate risks and their impacts on organizations (2014)	2020-2013 Quebec Government Strategy for Climate Change Adaptation (2013)
European Union (regional)	EU Adaptation Strategy (2013)	Climate Change, Impacts and Vulnerability in Europe: An indicator-based report (2012 - 2016)	—
Germany	Adaptation Action Plan of the German Strategy for Adaptation to Climate Change (2011)	Climate Change in Germany: Vulnerability and adaptation strategies of climate-sensitive sectors (2005)	Adapting to the Impacts of Climate Change in Berlin (2016)
Japan	National Plan for Adaptation to the Impacts of Climate Change (2015)	Report on Assessment of Impacts of Climate Change in Japan and Future Challenges (2015)	Yokohama City Climate Change Adaptation Strategy (2016)
Netherlands	National Climate Adaptation Strategy (2016)	Adaptation to Climate Change in the Netherlands: Studying related risks and opportunities (2015)	Rotterdam Adaptation Strategy (2013)
New Zealand	New Zealand's Framework for Adapting to Climate Change (2014)	Climate Change Adaptation in New Zealand: Future scenarios and some sectoral perspectives (2010)	Christchurch City Council Climate Smart Strategy (2010-2025) 2010
Singapore	Climate Adaptation Action (2016)	Second National Climate Change Study (2015)	—
United Kingdom	National Adaptation Programme (2013)	UK Climate Change Risk Assessment (2012-2017)	Managing Risks and Increasing Resilience: London Climate Change Strategy (2011)
United States	U.S. Environment Protection Agency Climate Change Adaptation Plan (2014)	3rd National Climate Assessment (2014)	New York City Climate Resiliency Design Guidelines (2017)

Annex B: Criteria for Scaling & Interpretation of Results of the UAE Sectoral Climate Risk Assessment

Magnitude			
Scale (Score)	Economic	Environmental	Social
Very Small (1)	The value of damages to property, infrastructure, and livelihood is below AED 100,000.	Impacts are very limited and effects on species, habitats, landscapes, ecosystem services, or sites of national or international significance are reversible in less than 6 months.	Very small number affected (0.0001% of population) by injuries and fatalities and/or no lost labor-day per worker per year.
Small (2)	Damages to property, infrastructure, and livelihood are limited and localized. The value of damages is AED 100,000 - 1 million.	Impacts are limited and localized and effects on species, habitats, landscapes, ecosystem services, or sites of national or international significance are reversible in 6-12 months.	Small number affected (0.001% of population) by injuries and fatalities and/or 1 lost labor-day per worker per year.
Moderate (3)	Damages to property, infrastructure, and livelihood are localized. The value of damages is AED 1-5 million.	Impacts are localized and effects on species, habitats, landscapes, ecosystem services, or sites of national or international significance are reversible in 1-5 years.	Substantial number affected (0.01% of population) by injuries and fatalities and/or 2-5 lost labor-days per worker per year.
Large (4)	Damages to property, infrastructure, and livelihood are spread. The value of damages is AED 5-10 million.	Impacts are spread and effects on species, habitats, landscapes, ecosystem services, or sites of national or international significance are reversible in more than 5 years.	Considerable number affected (0.1% of population) by injuries and fatalities and/or 6-10 lost labor-days per worker per year.
Very Large (5)	Damages to property, infrastructure, and livelihood are widespread. The value of damages exceeds AED 10 million.	Impacts are widespread and effects on species, habitats, landscapes, ecosystem services, or sites of national or international significance are irreversible.	Tremendous number affected (1% of population) by injuries and fatalities and/or more than 10 lost labor-day per worker per year.

	Likelihood		Risk	
	Scale	Frequency & Timing	Result	Required response
X	Very Unlikely	Impact has not been observed and will never arise within this century under normal circumstances but may occur under very exceptional circumstances.	Very Low	Monitor Occasionally: Risks are largely negligible but sporadic monitoring is necessary to determine changes in situation which may affect the risk level.
	Unlikely	Impact has not been observed but possible to arise within this century and/or may occur once or more every five years.	Low	Monitor Periodically: Risks are largely acceptable but regular monitoring is necessary to determine changes in situation which may affect the risk level.
	Likely	Impact was previously observed to occur intermittently and may arise within this century and/or may occur once annually.	Medium	Investigate Thoroughly: Risks are somewhat acceptable for the short term, but it is necessary to conduct thorough investigation on whether control measures are required to minimize the risk in the longer term.
	Very Likely	Impact is currently observed to occur and may arise occasionally within this century and/or may occur once semi-annually.	High	Act Proactively: Risks are acceptable to some extent for a very short term but need to be managed and monitored rigorously combined with proactive control measures.
	Almost Certain	Impact is currently observed to occur frequently and may arise more regularly within this century and/or may occur at least twice semi-annually.	Very High	Act Aggressively: Risks are unacceptable, and it is necessary to respond immediately and implement aggressive actions to substantially reduce the risk level.

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