الهيئة العامة للبيئة دولة الكويت
ENVIRONMENT PUBLIC AUTHORITY KUWAIT

كويت جديدة
NEWKUWAIT

دولة الكويت
STATE OF KUWAIT

FIRST BIENNIAL UPDATE REPORT OF THE STATE OF KUWAIT

SUBMITTED TO
THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE
BY ENVIRONMENT PUBLIC AUTHORITY - SEPTEMBER 2019

FOREWORD

On behalf of Kuwait's government, it is my pleasure to submit Kuwait's First Biennial Update Report to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC). This report was prepared according to the guidelines approved by the parties and the methodologies of the Intergovernmental Panel on Climate Change (IPCC).

Kuwait already experiences high temperatures of up to 48 degrees Celsius in the summer, with a reading of 54 degrees Celsius in July 2016 north of Kuwait City. Notably, this was the highest temperature in the Eastern Hemisphere and Asia in recorded history. With climate projections showing even higher future temperatures and a decrease in the already low annual rainfall of Kuwait, the negative impacts of climate change on the country, especially those related to food security, water resources, public health, marine ecosystems, and coastal zones, have come in to focus.

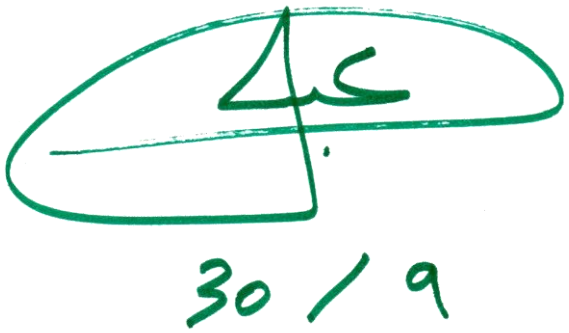
Kuwait's First Biennial Update Report presents the results of a series of studies that reveal how changes in local temperature and rainfall patterns, as well as rising seas, are expected to adversely affect vital sectors of the country. This report also includes an inventory of greenhouse gases from key sectors for year 2016, with an analysis of the emission reduction potential of a set of voluntary mitigation efforts through 2035.

In order to address climate change, the Kuwait Environment Public Authority established the Environmental Protection Law in 2014 and completed its bylaws in 2018. This represents an important pivot point for Kuwait, as there is now legislative and regulatory authority for monitoring and documenting greenhouse gas emissions. Both the public and private sectors are being engaged to ensure that future greenhouse gas emission inventories are complete, consistent, and accurate.

Sheikh Abdullah Ahmad Al Hamoud Al-Sabah

Chairman of the Board & Director General of Kuwait

Environment Public Authority



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ACKNOWLEDGMENTS

This document was the result of a fruitful partnership and cooperation between the Kuwait Environment Public Authority (KEPA) and the Regional Office for West Asia of the United Nations Environment Programme (UNEP), which oversaw the preparation of the First Biennial Updated Report project and provided training and technical support to national experts. In addition, the Global Environment Facility (GEF) provided financial support during all stages of the preparation of the document. Finally, thankful to all those who participated in the preparation of this work, particularly all ministries, governmental agencies, nongovernmental organizations, and the private sector for their support and assistance with the various working groups during the preparation of this document. Hopefully, this document will become a useful reference for policymakers, researchers, and all those interested in climate change and its negative impacts on the State of Kuwait.

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ACRONYMS AND ABBREVIATIONS:

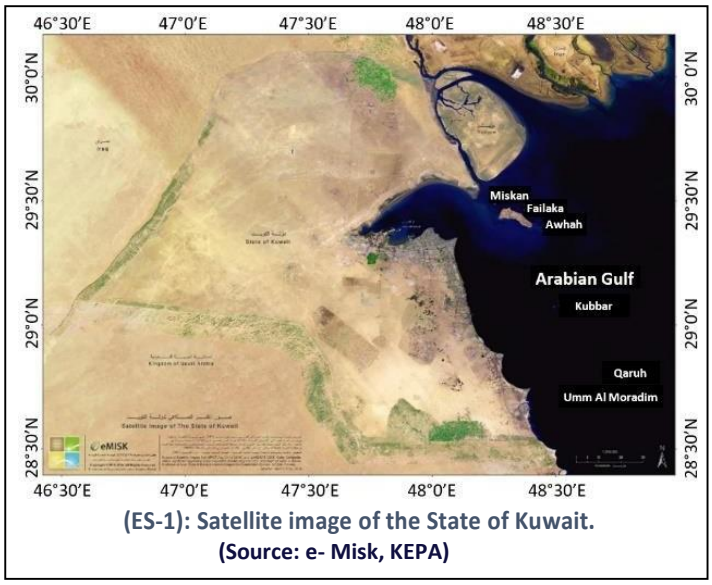
AFOLU	Agriculture, Forestry, and Other Land Use
°C	Degrees Centigrade
BCM	Billion Cubic Meters
CH_4	Methane
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
eMISK	Environmental Monitoring Information System of Kuwait
GEF	Global Environment Facility
GDP	Gross Domestic Product
Gg	Gigagrams (i.e., one billion grams)
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GW	Gigawatt (billion watts)
GWh	Gigawatt-hour (billion watt-hours)
HFC	Hydrofluorocarbons
INC	Initial National Communication
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
KEPA	Kuwait Environment Public Authority
KEPS	Kuwait Environment Protection Society
KFAS	Kuwait Foundation for the Advancement of Sciences
Kg	kilogram
KISR	Kuwait Institute for Scientific Research
Km	Kilometers
Km^2	Square Kilometers
KMA	Kuwait Medical Association
KPC	Kuwait Petroleum Corporation
KU	Kuwait University
kWh	Thousand Watt-hours
l/cap/day	Liters Per Capita Per Day
LPG	Liquid Petroleum Gas
m	Meters
MEW	Ministry of Electricity and Water
Mm^3	Million Cubic Meters
MRV	Measurement, Reporting and Verification
MSW	Municipal Solid Waste
N_2O	Nitrous Oxide
NC	National Communications
NDC	Nationally Determined Contribution
NGCC	Natural Gas Combined Cycle (Power Station)
NGO	Non-governmental Organization
NHA	National Housing Authority
NMVOC	Non-methane Volatile Organic Compounds
NO_x	Nitrogen Oxides
NTF	National Circumstances & Other Information Task Force

O3	Ground-level Ozone
PAAET	Public Authority for Applied Education and Training
PAAF	Public Authority for Agriculture and Fisheries
PACI	Public Authority for Civil Information
PFC	Perfluorocarbons
PM10	Particulate latter less than 10 microns in diameter
PSC	Project Steering Committee
PV	Photovoltaic (solar)
ROWA/UNEP	The Regional Office for West Asia of the United Nations Environment Programme
SEI-US	Stockholm Environment Institute – US Center
SLR	Sea Level Rise
SNC	Second National Communication
SO_2	Sulfur Dioxide
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

National Circumstances

The State of Kuwait is located at the north eastern corner of the Arabian Peninsula and has borders with the Republic of Iraq and the Kingdom of Saudi Arabia. It covers a total land area of nearly 18 thousand square kms and is roughly 170 kms across from East to West and 200 kms across from North to South. Kuwait shares a 495 kms border with Saudi Arabia to the south and 195 kms with Iraq to the north and west (see Figure ES-1).



(ES-1): Satellite image of the State of Kuwait.
(Source: e- Misk, KEPA)

Kuwait has a hyper-arid desert climate that is highly variable with recurrent extremes. Maximum daily temperatures can reach 45°C during the summer during which there is no rainfall. Much of Kuwait is characterized by loose, mobile surface sediments that have very low levels of nutrients and organic matter. While rich in terrestrial and marine biodiversity, these systems are fragile and highly vulnerable to climate change. Kuwait is also one of the world's most water-stressed countries, with the lowest per capita renewable internal freshwater availability of any country, requiring extensive seawater desalination to meet water demand. The population is overwhelmingly urban and has grown rapidly since the discovery of oil in the late 1930s, with over 98% of the population currently living in urban areas which are mostly located along the coast. A modern country with an extensive, modern and well-maintained network of road infrastructure, Kuwait also has a modern healthcare system and a healthy populace; recent trends show a decrease in the incidence of communicable diseases and an increase in life expectancy. Kuwait is one of the world's leading oil producers, possessing the world's fifth largest crude oil reserves and has one of the wealthiest economies in the Arabian Gulf region. Throughout its modern history, Kuwait has heavily relied on food imports since only a negligible fraction of food demand can be met by local agriculture.

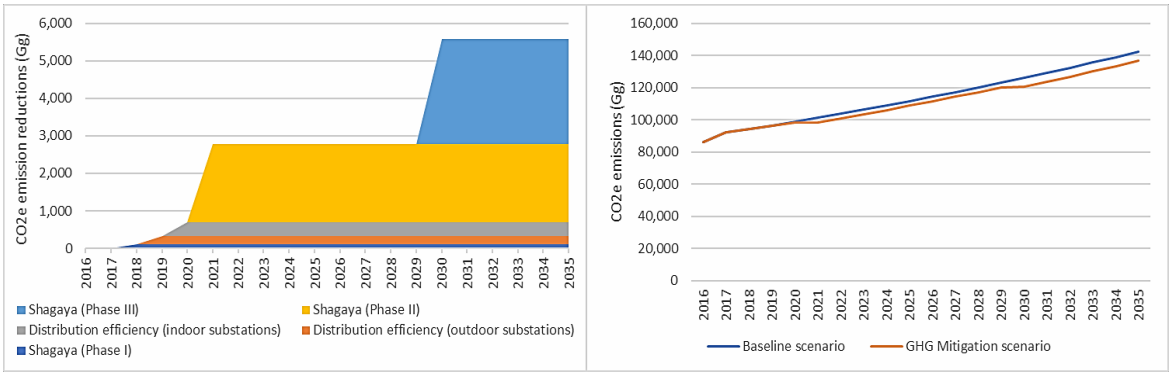
Greenhouse Gas Inventory and Mitigation Action

Kuwait compiled an update to its inventory of greenhouse gas emissions for the year 2016 (see Table ES-2). Total and net GHG emissions in 2016 were 86,336.448 Gg CO2-equivalent, which includes 82,556.572 Gg from energy; 1,932.156 Gg from industrial processes and product use; 154.371 Gg from agriculture, -13.932 Gg from forestry and other land use and 1,706.539 Gg from waste. Emissions from perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulfur hexafluoride (SF6) in Kuwait are negligible as the products containing these gases are not produced in the country. The Tier-1 approach of the IPCC guidelines was utilized in the calculations for all reporting categories, since State of Kuwait does not have national emission factors and does not have detailed data to calculate the inventory.

	GHG Sources & Sinks	CO2-equiv	CO2	CH4	N2O
1	Energy	82556.572	81985.033	10.919	1.104
2	Industrial processes and product use	1932.156	1932.156	0.0	0.0
3	Agriculture	154.371	2.761	6.570	0.044
4	Forestry & other Land Use	-13.190	-13.190	0.0	0.0
5	Waste	1706.539	4.172	77.847	0.218
Total National Emissions		**86349.638**	**83924.122**	**95.336**	**1.366**
Net National Emissions		**86336.448**	**83910.932**	**95.336**	**1.366**

(ES-2): Kuwait Greenhouse Gas emissions for 2016

Kuwait is committed to efforts that harmonize economic growth with a low-carbon, climate-resilient development. Domestically, it has already undertaken several strategic projects to reduce its carbon footprint by promoting clean energy initiatives, introducing new low-carbon technologies, and developing long-term partnerships to exploit sustainable energy opportunities (see Figure ES-3). Progress toward such actions is already underway, and when fully implemented by 2035 will result in total annual emission reductions of about 5,600 Gg, with cumulative emission reductions of nearly 60,000 Gg of CO2-equivalent.

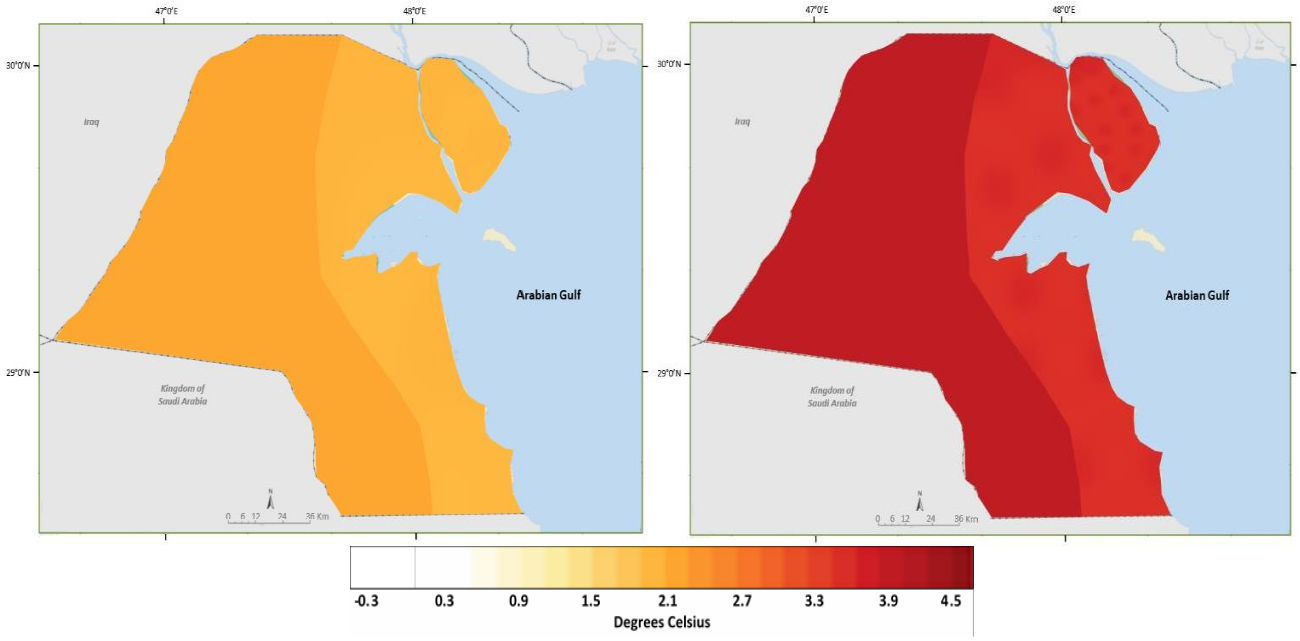


(ES-3): Left: Projected CO2e emission reductions in the GHG Mitigation Scenario; Right: Projected CO2e emissions in the Baseline and GHG Mitigation Scenarios

Vulnerability Assessments

All land areas of Kuwait will become warmer in the future, with the greatest change projected to occur during the winter months. Across the entire country, annual average temperatures show the greatest rise under RCP8.5, between 4.3° to 4.5°C by the 2071-2100 period (see Figure ES-4), compared to the historical average. Kuwait will also become drier in the future, with average annual rainfall in the western part of the country showing the greatest decrease under RCP8.5, roughly between 15% and 18% lower than the historical average. The Arabian Gulf water will also experience change. Historical monthly sea surface temperatures in the Arabian Gulf have steadily increased at a rate of 0.6 (±0.3) °C per decade, a trend three times greater than the concurrent global average.

Many sectors are vulnerable to these climatic changes, with potentially grave environmental and social effects, compounded by the country's adaptation challenges. A summary of the key findings of the vulnerability assessments is contained in the bullets below.



ES-4: Annual average projected change in temperature under RCP4.5 (left) and RCP8.5 (right) for the 2071-2100 period (Sources: CORDEX-MENA; ICBA)

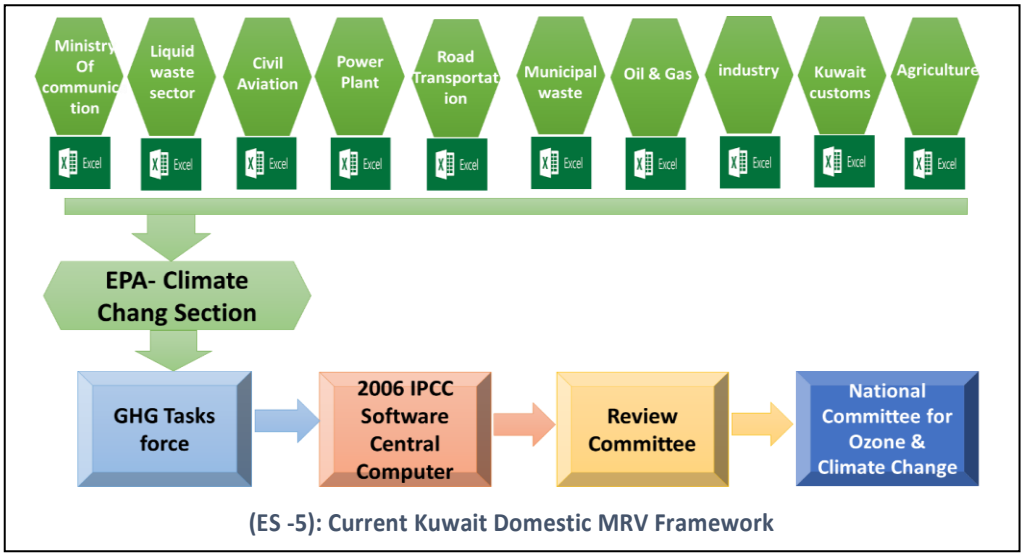
- **Coastal zones:** Rising sea levels pose threats of wetland flooding, aquifer and agricultural soil contamination, destructive erosion and lost habitat for fish, birds, and plants. Sea level rise also poses a threat to the built environment in the form of Arabian Gulf waters reaching further inland, particularly under high tide conditions and especially when combined with storm surge associated with extreme storm events. Boubyan Island would be highly impacted under by sea level rise, with roughly half the island inundated in the highest sea level rise scenario. Only the relatively higher land in the interior of the island would be visible by the end of this century. Coastal areas along Kuwait Bay are also projected to be adversely impacts by rising seas, especially the western coast near Doha Port and densely populated neighborhoods around Kuwait City.

- **Water resources:** Population growth, urbanization, industrial growth, and agricultural development are key drivers underlying Kuwait's high per capita water consumption. Coupled with a hyper-arid environment, low annual rainfall, no permanent lakes or rivers, and limited fresh groundwater resources, sustainable water resource management is a key national priority. A number of potential adaptation policies were analyzed (i.e., water tariffs, improved water efficiency, leak reduction, and improved irrigation efficiency) with each showing significant water savings and associated carbon dioxide emissions.

- **Public health:** With climate change, increased heat stress from higher temperatures and increased cardiovascular and respiratory diseases associated with more frequent dust storms, represent looming health threats to the population. These additional risks could exacerbate current major health problems such as ischemic heart disease, stroke, road injury and lower respiratory infections, whilst potentially undermining Kuwait's social protection systems.

Domestic measurement, reporting and verification (MRV) arrangements

Since the State of Kuwait signed the United Nations Framework Convention on Climate Change (UNFCCC), as the national focal point for this agreement, the Environment Public Authority has sought to develop an administrative and technical system (see Figure ES-5) to deal with the requirements of the UNFCCC through the Environmental Protection Law (Law No. 42 of 2014) and the amendments thereto that were promulgated under Law No. 99 of 2015. These legislations regulate the general policy framework for environmental protection in the State of Kuwait. The current national system for measurement, reporting and verification outlined in Figure ES-5 below will be improved in 2020 with a new MRV system that fulfills the requirements of the Convention.



(ES -5): Current Kuwait Domestic MRV Framework

Economic and Social Consequences of the Impacts of Response Measures

Climate change response measures instituted to minimize emissions of greenhouse gases often exert profound adverse effects on sustainable development plans and programs of many developing countries. These effects are particularly severe on those countries whose economies are heavily dependent on a single sector such as hydrocarbons and tourism. The State of Kuwait will have its own evaluation system for the adverse effects of climate change and the impact of response measures on the country, with work going on to enhance the modeling activities and data sets for assessing the impacts of implemented response measures on the national circumstances of State of Kuwait. To do so, Kuwait needs to be provided with support such as financial support, technology need assessments and national capacity building.

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ES-6: 2035 vision New Kuwait logo

The State of Kuwait is working on maintaining public life and continuing all services and developing facilities in all aspects based on the 2035 Vision "New Kuwait"(see Figure ES-6). Pursuing economic diversification in the State of Kuwait requires the professional development of Kuwait's human resources sector. The country suffers from a shortfall of professional human resources. To start building human resource capacity, the country needs to invest in the infrastructure of its education, research and technology development sectors. Strong levels of domestic investment and financing in the country's human resources to develop skills and expertise are necessary.

Constraints, gaps, needs, and support received

- ***Constraints, gaps, and needs to be addressed in relation to the undertaking of climate change-related actions:*** Inadequate capacity (technical, financial and institutional) remains one of Kuwait's significant challenges as it confronts climate change. Enhancing capacity will depend on overcoming serious institutional, financial and technical constraints and gaps that currently interfere with affective action. With adequate support, Kuwait can build climate change resilience and explore the viability of low-emission development trajectories.

- ***Support received for the implementation of climate change-related actions and for the preparation of the BUR:*** The state of Kuwait received financial support from Global Environment Facility (GEF) for preparing and communicating Initial National Communication of the State of Kuwait, Second National Communication of the State of Kuwait and the biannual updated report. The technical support for these reports was provided by the Regional Office for West Asia of the United Nations Environment Programme (UNEP-ROWA).

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CHAPTER ONE

National Circumstances and Institutional Arrangements

1. National Circumstances

1.1 Geography

The State of Kuwait is located at the northeastern corner of the Arabian Peninsula (see Figure 1-1) and has borders with Saudi Arabia to the south and Iraq to the north and west. Kuwait lies between latitudes 28°30'and 30°5' North and longitudes 46°33' and 48°30' East, covering a total land area of 17,818 km2 that includes nine uninhabited islands. Kuwait is roughly 170 km across from East to West and 200 km across from North to South. Kuwait shares a 495 km border with Saudi Arabia to the south and 195 km with Iraq to the north and west. The capital of Kuwait is Kuwait City. The country is divided into 6 administrative governorates; and the governorates are further subdivided into administrative areas. The country's topography is predominantly flat sandy desert, and is characterized by two distinct areas, as follows:

- *Northern zone.* This area includes Kuwait Bay and five islands: Boubyan, Warba, Maskan, Failaka, and Ouha. Kuwait Bay is a shallow but very important coastal and marine habitat with high productivity and diversity. Its coastal zone accounts for nearly half of the country shoreline. The two largest islands (Boubyan, 863 km^2, and Warba, 212 km^2) remain in an undisturbed condition and are home to migratory birds and rich marine biodiversity. Boubyan is the second largest island in the Arabian Gulf and is home to pristine marine and terrestrial ecosystems of regional and international importance. The northern half of the island is a designated marine protected area named Mubarak Al Kabeer Marine Reserve (MKMMR) - recently designated as a RAMSAR Convention Site.[1]
- *Southern zone.* The area extends from Ras Al-Ardh to the border with Saudi Arabia. Its coastal stretches include sandy and mixed shores, as well as the coral reef islands of Kubbar, Qaruh and Um Al-Maradim. Many intertidal marshes, known as *sabkhas*, are also found in this zone; the largest being Al-Khiran Sabkha that was transformed into a large waterfront city. The southern region of this zone is a monotonous plain covered by sand. Al-Ahmadi hill, 125-m high, is the sole exception to the flat terrain, while the Wadi Al- Batin and Ash-Shaqq are the only major valleys, portions of which lie within the western and southern reaches of the country, respectively. Rocks ranging in age from early Miocene (less than 24 million years) to recent are exposed within the boundaries of Kuwait.

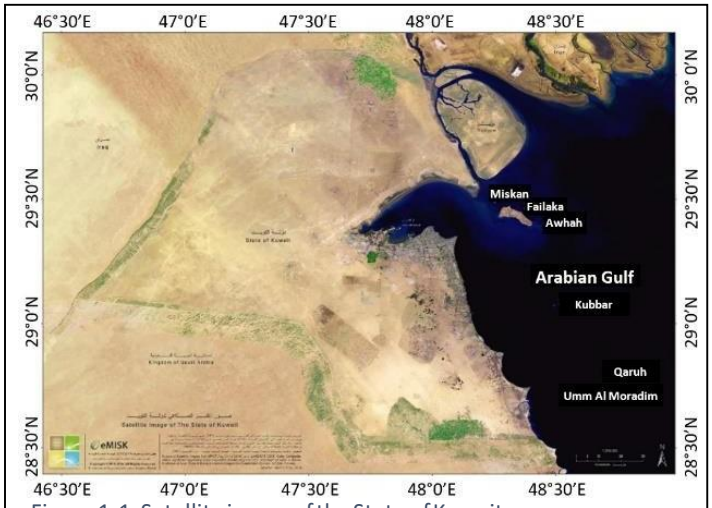

Figure 1-1: Satellite image of the State of Kuwait.
(Source: eMISK, KEPA)

[1] In 2015 Kuwait became the 169th Contracting Party of the Ramsar Convention on Wetlands; and on 17 May 2017 announced the designation of Mubarak Al-Kabeer Marine Reserve.

1.2 Land and Vegetation

Much of Kuwait is characterized by loose, mobile surface sediments. Soils are divided into ten groups, all of which have very low levels of nutrients and organic matter (see Figure 1-2). Soil moisture content is also very low because of high evaporation rates but also due to widespread hard pans (locally known as *gutch*) that reduce water permeability. Less than 1% of Kuwait's land area is considered arable.

The vegetation of Kuwait is broadly classified as an open scrub of the Saharo - Arabian floristic region, which is contiguous with that of the Northern Plains of eastern Saudi Arabia (Royal Botanical Gardens-Kew, 2010). Kuwait occupies part of the large, low-lying desert plain covering most of Eastern Arabia and is mostly characterized by desert and coastal plains (see Figure 1- 3). Coastal areas comprise important marine habitats, many with high productivity and diversity, including salt marshes and tidal mudflats.

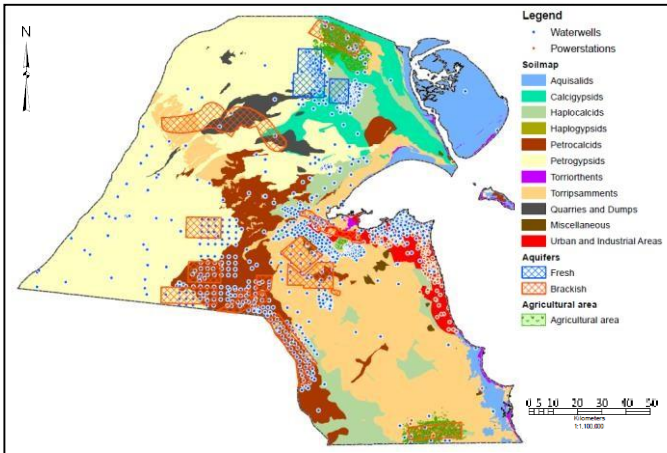

Figure 1-2: Soils, aquifers and groundwater-irrigated agricultural areas of Kuwait.
(Source: PAAF, KISR)

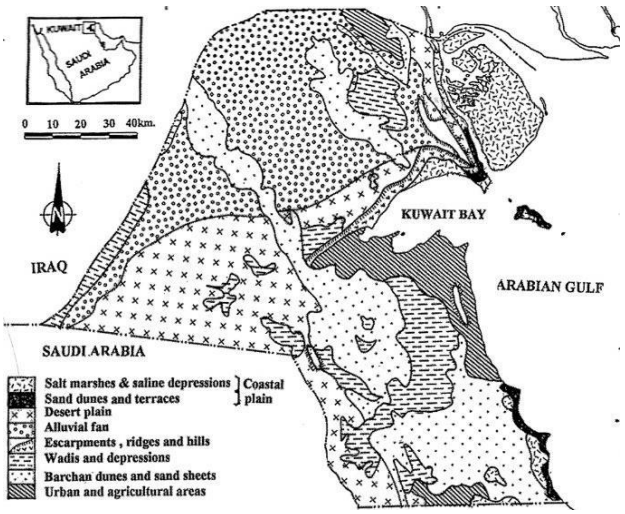

Figure 1-3: Ecosystems of Kuwait.
(Source : Samira AS Omar, Raafat Misak ;2007, KISR)

1.3 Desertification

Several studies have assessed desertification in parts of Kuwait (Shahid *et al.,* 1999; Al-Dousari *et al.,* 2000; Omar *et al.,* 2001; Misak *et al.,* 2002; Al-Awadhi *et al.*, 2005). Seven processes or indicators of land degradation have been recognized, with a general agreement that these processes affect about 70% of Kuwait's land area. They are deterioration of vegetation cover; soil crusting and sealing; soil erosion by wind; soil erosion by water; soil compaction; soil contamination by oil; and soil salinization. These indicators are mapped in Figure 1-4.

Deterioration of vegetation cover and a decline in the alpha diversity of plant species is one the most obvious indicators of desertification in Kuwait's desert ecosystem. Overgrazing is considered the prime driver of this vegetation degradation on rangelands, a conclusion supported by several studies that document much greater vegetation cover in areas fenced off and unavailable to livestock (Omar, 1991; Zaman, 1997; Shahid *et al.*, 1999). This form of desertification is particularly severe around watering points where it is exacerbated by soil trampling and compaction due to the congregation of animals (Al-Awadhi et al., 2005).

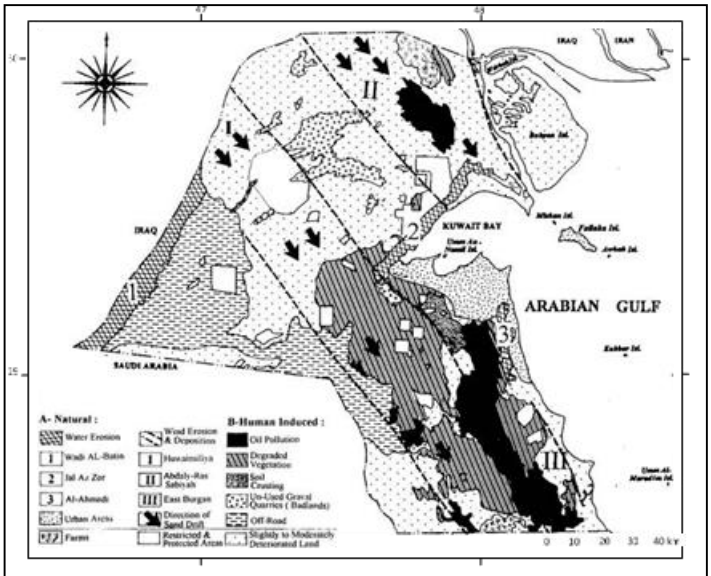

Figure 1-4: Preliminary land degradation map of Kuwait.
(Source : Al-Dousari et al., 2000)

Other important localized causes of vegetation deterioration are spring camping, the uprooting of woody shrubs to use as fuel and military maneuvers. One survey indicates that at least 65% of Kuwaiti soils are affected by some degree of compaction, inhibiting the infiltration capacity of soils by 40–100% and increasing their bulk density by up to 50% (Misak et al., 2001).

Wind erosion occurs naturally on many of Kuwait's desert surfaces: those consisting of active sand sheets and sand dune fields. Elsewhere, some vegetated sand sheets have also been mobilized where their stabilizing cover of vegetation has suffered from degradation and trampling. These mobile sediments represent a serious hazard to human activities. The annual costs of clearing sand encroachment from oil installations in Kuwait is more than US$1 million. The annual expenditure needed to remove sand from Ali As-Salem airbase is similar (Ramadan & Al-Dousari, 2013). Local sources of fine particulates contribute to the numerous dust storms that affect Kuwait, although the country is also affected by desert dust transported from neighboring countries and further afield.

Associated impacts include hazards to aircraft and maritime traffic, effects on oil operations and green energy production, and serious human health problems due to the low air quality.

1.4 Biodiversity

Kuwait is committed to its international obligations regarding the conservation of its native biodiversity. On 5 June 2017, Kuwait ratified the Nagoya Protocol, which is a supplementary agreement to the Convention on Biological Diversity that sets forth obligations on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. With this ratification Kuwait became the 100th Party to such Protocol. On the same date, Kuwait also ratified the Cartagena Protocol on Biosafety to the Convention on Biological Diversity and became its 171st Party.

The Worldwide Fund for Nature (WWF) classifies Kuwait's terrestrial ecosystem as a desert and xerophytic (Greek xero dry, phuton plant) scrub. This classification is based on the high variability in intra-annual annual rain fall (see earlier Figure 1-2), and the high evaporation rate exceeding rainfall.

About 375 plant species have been recorded in Kuwait of which about two thirds (256 species) are annuals. Low shrubs and herbaceous perennials form the main constituents of the perennial vegetation with only a few large shrubs, and a single tree species present (Halwagy & Halwagy 1974, Halwagy et al. 1982, Mandaville 1990, Omar et al. 2001, Ghazanfar 2006).

Kuwait has a colorful terrestrial and marine biodiversity (see Figure 1-5). This diversity is fragile and vulnerable to the impacts of climate change; desertification and other threat resulting from anthropogenic activities, including habitat destruction, overgrazing, pollution, and illegal hunting and overfishing. The last inventory of wild animal species in Kuwait documented the presence of more than 300 bird species, more than 20 mammalian species, and 40 reptile species. In Kuwait, 648 species of insects have been recorded, belonging to 414 genera and 22 orders. The largest order is that of beetles Coleoptera with 230 known species, then butterflies and moths Lepidoptera with 76 recorded species, followed by bees, wasps and ants Hymenoptera with 71 species, then flies Diptera with 69 species, and finally the locusts Orthoptera with 34 known species (Al-Houty,1989).

The native flora of Kuwait consists of 374 plant species including dwarf perennial bushes, annual grasses, and herbs. This includes 256 annuals, 83 herbaceous perennials, 34 under shrubs and 1 tree. The native plants have designed their own mechanisms to survive in the country's extreme environmental conditions. The perennials in particular have to face the harsh climate more than the annuals, which propagate only after the seasonal rainfall (Shamal Azzour: https://www.aznoula.com). Important plant communities in this floristic region in Kuwait are briefly described in the bullets below (Halwagy & Halwagy, 1974; Halwagy *et al.*, 1982; Mandaville, 1990; Omar *et al.*, 2001; Ghazanfar, 2006).

Figure 1-5: Examples of biodiversity in Kuwait.
Top left: Lizard; Top right: Al-Sheriab (shore Crab); Bottom right: Arabian red fox (Vulpes arabica); Bottom left: Black-winged Stilt (Credits: Faisal Al-Nomas; KEPA)

- *Haloxylone salicornicum community* extends from Iraq in the northeast down to the northern edge of the Rub' al Khali in Saudi Arabia. Found predominantly on sandy and sandy-gravelly soils, this is the largest community in northeast Arabia and is composed of the dominant shrub *Haloxylon salicornicum*. In Kuwait, it is present in the north and north- eastern parts. Associates are *Astragalus spinosus* and *Chrozophora spp.*
- *Rhanterium epapposum community.* Extends from eastern Saudi Arabia and south to the United Arab Emirates. It is present on deep and shallow sand. The dominant species is *Rhanterium epapposum* with associates *Convolvulus oxyphyllus* and *Moltkiopsis cilata*. Other species such as *Gynandriris, Anthemis*, *Cornulaca* form associates in specific soil and topography. *Rhanterium epapposum* is very palatable to livestock, and overgrazing has greatly affected its occurrence. It is not common in Kuwait, presently found only in protected area.
- *Stipagrostis plumosa community*. Found mostly in the west and south west of Kuwait with the dominant grass, *Stipagrostis plumosa* is a result of degradation and disturbance. Under proper management this community develops into the *Rhanterium epapposum* community, or on saline soils, into the *Haloxylon salicornicum* community. In the south- west *Centropodia forsskalii*, a perennial grass, is dominant with *Stipagrostis plumosa* as the chief associate (recognized as a separate community by Omar *et al.* 2001).
- *Cyperus conglomeratus community*. Found throughout the Arabian Peninsula, being a community on sand, both on mobile and stable dunes and sand sheets, forming hummocks. In Kuwait found in the southern part the country. An excellent sand binder, and not readily eaten by livestock, it can thrive with moisture from dew. Associates are usually annual species (*Astragalus annularis*, *Brassica tournefortii*, *Plantago albicans*).
- *Halophytic communities*. Three halophytic communities – *Zygophyllum*, *Panicetum* and *Halophyletum* from coast inland are composed primarily of halophytic shrubs. *Salicornia europaea* grows on low, frequently inundated mud banks or along creeks, sometimes associated with *Aeluropus lagopoides* and *Bienertia cycloptera*, or with *Juncus rigidus* on the fringes of creeks. A *Halocnemum strobilaceum* community occupies the lower marshes along the shoreline with the seaward edge inundated very frequently by tides. A *Seidlitzia rosmarinus* community occurs further inland, followed by Nitraria retusa above the high tide mark dominating the middle marshes, and

finally, the *Tetraena qatarensis* (syn. *Zygophyllum qatarense*) community occurs on elevated, coarse sandy sites on the landward edge of the marsh.

The salt marshes are fringed by nonhalophytic communities such as the *Cyperus conglomeratus* community, the *Rhanterium epapposum-Convolvulus oxyphyllus-Stipagrostis* plumose community and the *Haloxylon salicornicum* community, the latter covering most of the territory of Kuwait.

Kuwait has a rich profile of invertebrate and vertebrate fauna. The intertidal zone is colonized by many species of Ocypode crabs, of which *leptochryseus kuwaitnese* is endemic. The blue-spotted Mudskipper *Boleophthalmus boddarti* is also another inhabitant of the intertidal zone. The most common is the black scorpion *Androctonus crassicayda*, while the most common spiders are the wolf spiders *Pardosa sp.*, the crab spiders *Thomisus sp*, the sun spiders *Galeodes sp.*, the velvet mites *Dinothrombium sp*, and *Tarantula sp* (KEPA, Fifth National Report, 2014).

One of the most common insects in Kuwait is the ground beetle (Tenebrionidae). The most famous species is probably Trachyderma hispida. This black beetle is omnipresent in houses and in the desert. Active during daytime, this beetle burrow the larvae and pupae beneath soil cover.

The reptile fauna of Kuwait is depauparate with no endemic species, although 40 species have been recorded. The common reptiles of Kuwait include the dhub *Uramastyx microlepis*, the Agma lizard and the wirral *Varanus griseus*. There are several species of snakes in Kuwait such as the sand boa *Eryx jayakari*, the Arabian boa *Malpolon moilensis* and the sand the sand viper *Cerastes cerastes*.

Twenty-eight mammalian species live in Kuwait. Sadly, four large mammal species have been exterminated; the dorcas gazelle, the mountain gazelle (Idmi), the Arabian sand gazelle and the Asiatic cheetah (fahd). Other large carnivores such as the wolf, caracal and jackal are now extremely rare. Habitat destruction and extensive and unregulated hunting are driving endangered mammalian species, such the fennec fox, the red fox, the honey badger, the Indian grey mongoose and the wild cat, to extinction.

Due to ecological and anthropogenic activities, most large mammals that were native to Kuwait were wiped out or have disappeared. (Kuwait Times, 11 March 2017). Over the past decades, the desert of Kuwait has witnessed a dramatic decline in its biodiversity, as many species have disappeared, such as Arabian oryx Oryx leucoryx, Arabian wolf Canis lupus arabs, striped hyena Hyaena hyaena, the golden jackal Canis aureus, mellivora capensis, dorcas gazelle Gazella dorcas, sand gazelle Gazella subgutturosa, fox Ruppell Vulpes rueppellii, and others. (https://www.aznoula.com) In addition, several species of birds such as houbara bustard Chlamydotis undulate, and lanner falcon Falco biarmicus feldeggi were also wiped out. Concerning reptiles, there are over 40 species of reptiles and amphibians recorded in the dry areas of Kuwait.

However, no specific studies can be found about their current status, but as with the other native fauna, their distribution is limited and restricted to remote areas with minimum human interference. In general, the fate of desert reptiles is not expected to be better than the fate of extinct birds and other species. The loss and fragmentation of habitat, the human impact and overcrowding are the main causes of extinction. Fragmentation of habitats continues to threaten wildlife in Kuwait.

Genetic clustering, species isolation, and the intensification of genetic mutations that may lead to population breakdown in isolated groups are some of the threats that habitat fragmentation poses. (https://www.aznoula.com).

The Kuwaiti government strives to preserve the national biodiversity through several policies and procedures. Environmental police are enforcing the implementation of the environment protection law on violators hunting or polluting the environment or fishing in restricted areas. Article 100 of Kuwait's Environmental Act, in force since 2014, bans hunting, collecting or destruction of nests in the areas where wild species live. The article states that native fauna, including all mammals, birds and reptiles, cannot be killed, collected, hunted, have their nests destroyed, or be harmed by any activity.

Kuwait has also allocated 11.65% of its terrestrial and coastline as nature reserve and protected parks. At the present there are twelve reserve areas across the country (see Figure 1-6). The largest and most significant reserves are as follows:

- ***Sabah Al-Ahmad Nature Reserve.*** Located at the north- east of Kuwait, it covers 325 km^2 and is where threatened animals and plants are reintroduced, and natural characteristics of the native ecosystem is preserved.
- ***Mubarak Al-Kabeer Reserve.*** Located in the north of Boubyan Island and the entire territory of Warba Island, it covers 510.2 km^2 and consists of low sandy and muddy surfaces, numerous channels and bays with rapid currents and tides rich in food abundance, which contributes to a richness in marine organisms. The reserve accommodates dolphins during the summer and migratory birds coming from Europe, such as flamingos, watercress and small derricks in winter.

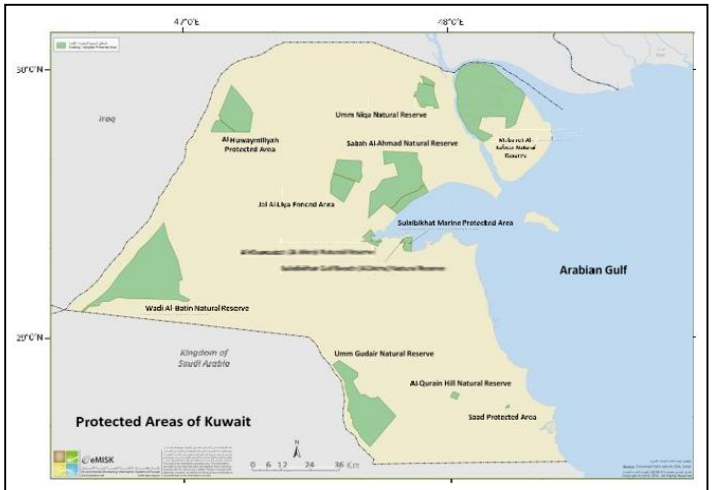

Figure 1-6: Protected Areas of Kuwait.
(Source : EPA eMISK – Kuwait)

Migratory birds use Kuwait as transit base in different times of the year. The Al-Jahra Pool Nature Reserve located in northern Kuwait is a wet and green sanctuary area that attracts a wide variety of birds, both migrant and wintering species. To date, 220 bird species have been recorded in the Reserve (Bird Life International, 2012). Another site for migratory birds is Kubbar Island, located roughly 30 kilometers off the southern coast of Kuwait, and a breeding ground for three migratory species of terns, nesting in Kubbar from early May to August.

However, the vegetation of Kuwait is under threat of extinction due to many factors including the setting up extensive recreational camps, gravel quarrying, oil exploration and the destructive activities during the 1990/1991 war; all have increased pressure on Kuwait's vegetation. Decades of low enforcement and compliance of ecosystem protection laws is another major cause of the destruction of the native biodiversity. A study conducted in protected and unprotected areas has shown that the plant cover in the unprotected areas is 80% less than that of the protected areas. (Shamal Azzour: https://www.aznoula.com).

1.5 Land Use Change and Forestry Sector (LULUCF):

The State of Kuwait has an area of 17818 km2, and with the development, renaissance, implementation of its development plans, the State of Kuwait utilized its territory to expand urban areas, establish development and recreational projects, develop the state infrastructure and establish reserves in large areas to provide a suitable environment for the growth of animals, plants and biodiversity (see Figure 1-6). Accordingly, the land areas of the State of Kuwait are classified as follows:

- Forest Land (FL): Defined as tree plantations acting as wind breaks managed by the government agencies located around the residential areas.
- Cropland (CL): Government owned lands, long term leased to growers for food production.
- Wetlands (WL): Wet areas where land is covered with water for periods of time.
- Settlements (SL): Residential areas where housing projects and other urban areas facilities are located.
- Other Land (OL): These areas are other lands outside urban and cropped areas and in this report considered as grazing areas.

Land use changes between 1994 and 2016 were determined from satellite images, see Table (1-1). Land conversions were determined for the following categories:

- Other land converted to forest land.
- Other land converted to cropped land.
- Other land converted to residential areas.
- Forest land converted to residential areas.

Year	FL	CL	WL	SL	OL	Total
	hectare	hectare	hectare	hectare	hectare	hectare
1994	3201	14850	33206	19920	1710623	1781800
1995	3201	27277	33206	19920	1698196	1781800
1996	3227	33375	33206	20320	1691672	1781800
1997	3227	33900	33206	20320	1691147	1781800
1998	3227	34960	33206	20720	1689687	1781800
1999	3227	36700	33206	20720	1687947	1781800
2000	3227	38000	33206	21520	1685847	1781800
2001	3227	38000	33206	21590	1685777	1781800
2002	3227	38700	33206	25151	1681516	1781800
2003	3397	38800	33206	24291	1682106	1781800
2004	3367	39500	33266	24951	1680716	1781800
2005	3367	39500	33266	24951	1680716	1781800
2006	3317	39500	33266	25357	1680360	1781800
2007	3296	40800	33266	25656	1678782	1781800
2008	3399	40800	33266	26026	1678309	1781800
2009	3399	41100	33266	27156	1676879	1781800
2010	4143	42600	33266	27406	1674385	1781800
2011	4325	43200	33266	28251	1672758	1781800
2012	4325	43400	33266	30008	1670801	1781800
2013	4325	43700	33266	34483	1666026	1781800
2014	4314	47000	33266	36483	1660737	1781800
2015	4314	48300	33266	36483	1659437	1781800
2016	3854	54600	33266	36933	1653147	1781800

Table 1-1: Land use change between the years 1994 and 2016.

(Source: Mohammad Jamal, (PAAF), 2018).

1.6 Water Resources

Due to its climate, Kuwait suffers from a scarcity of conventional fresh water. Endogenous precipitation is 121 mm/year (long-term average), which amounts to 2.156k 109 m3/year in 2014, which is respectively low. It increases to 39.18 mm in December 2017 from 13.26 mm in November of 2015 as shown in Figure 1-7 (Y. Villacampa, 2008).

With the increasing growth of population, water from wells is no longer enough, and so the government built a desalination plant in Kuwait in 1953, followed by others, two in Doha with capacity reaching 138 M gallons per day. A third plant was built for desalination by reverse osmosis nearby. There are three main water sources for urban and agricultural uses in Kuwait, desalinated water groundwater and treated wastewater (Y. Villacampa, 2008).

There are no permanent rivers in the country and the high level of evaporation means that streams and runoff water only last a few hours after rain. Groundwater replenishment is even scarcer due to the dryness of the soil and the high evaporation rate. The groundwater produced internally amounts to virtually nothing, as is the surface water, meaning that there is no overlap between the ground and surface water. The accounted groundwater inflow from Saudi Arabia through lateral underflow is estimated to be 20 MCM/year (Aquastat, 2016), and groundwater in Kuwait does not flow into neighboring countries' groundwater basins. The total renewable water resources per capita are 5.139k m3/year in 2014 (Aquastat, 2016).

Groundwater in Kuwait can be categorized into three classifications according to the salinity level in the water. Fresh groundwater has less than 1 g/L of a soluble salt, and it is mainly considered a freshwater reservoir from drinking water rather than used for irrigation. Due to the precipitation patterns, which include intense rainfall in a short period of time, and the soil types that allow filtration, fresh groundwater can be found in the fields of Raudhatain and Umm

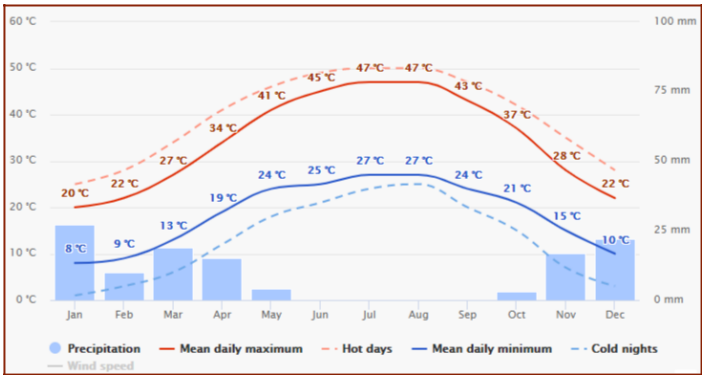

Figure 1-7 AVERAGE ANNUAL TEMPERATURES AND PRECIPITATION

(Source: meteoblue: https://www.meteoblue.com/en/weather/forecast/week/kuwait-city_kuwait_285787)

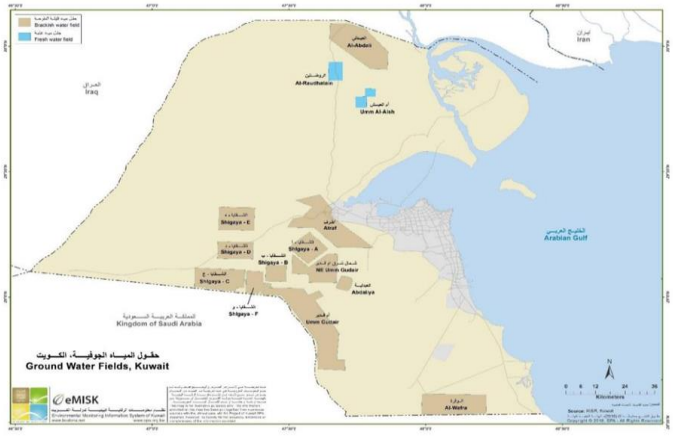

Figure 1-8 KUWAIT'S GROUNDWATER RESOURCES

(Source: eMISK, EPA)

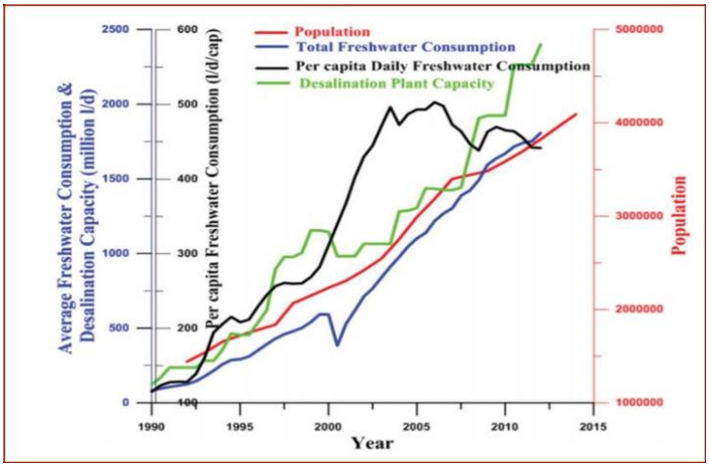

Figure 1-9 VARIATION OF FRESHWATER WATER CONSUMPTION, POPULATION GROWTH, AND DESALINATION PLANT CAPACITY IN KUWAIT 1990 -2015

(Mukhopadhyay & A. Akber, 2018)

Al Eish. Water extraction at these aquifers is 5,500 and 3,500 m3/day respectively.

Another type of groundwater is the Saline groundwater. The content of soluble salts in this type of groundwater is between 7 g/L to 20 g/L. It cannot be used for either agriculture or domestic use. The brackish groundwater is another type of groundwater present in Kuwait. It contains higher amounts of soluble salts than the fresh groundwater coming at an amount of 1 to 7 g/L. This type of water is used domestically, for agriculture and drinking water for animals, namely cattle. The source of this water is the Al Shaya, Al Qadeer, Al Solaybeia, Al Wafra, and the Al Abdali fields. The distribution of groundwater fields in Kuwait is shown in Figure 1-8. The outtake from these fields is estimated at 545,000 m3/day (Y. Villacampa, 2008), which is significantly higher than the fresh groundwater outtake.

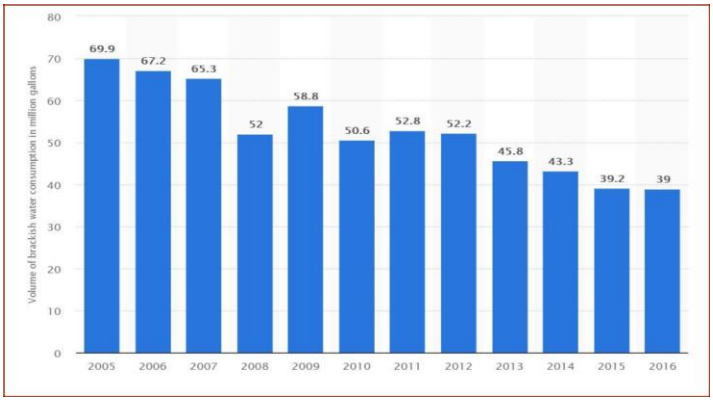

Figure 1-10 BRACKISH WATER CONSUMPTION IN KUWAIT

(Statista 2019 https://www.statista.com/statistics/648858/kuwait-average-daily-consumption-ofbrackish-water/)

In 1993 the water withdrawal was calculated to be 538 MCM; however, in 2002 it has increased to 913 MCM and that is due to the increasing water consumption by the Kuwaiti individual (Figure 1-9) and (Figure 1-10). 44% of the water withdrawn is being used for domestic uses, 2% for industrial purposes and the rest is for irrigation, which amounts to 492 MCM; 80% of it is for productive agriculture, 300 MCM is brackish water from the Al Abdali and Al Wafra private wells, 66 MCM is treated wastewater.

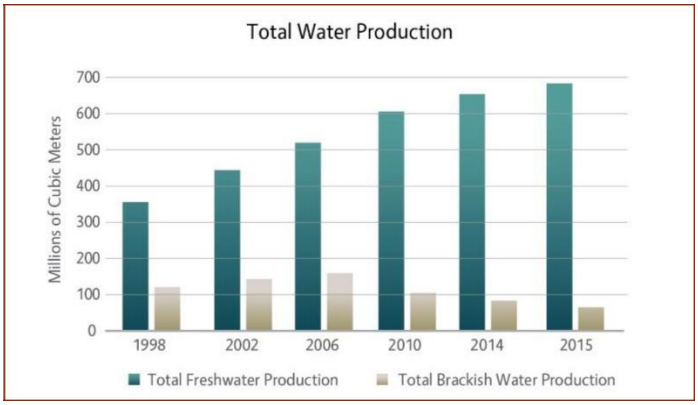

Figure 1-11: Total Freshwater and brackish water

(Source: KEPA, GIS portal, eMISK.)

The quality of the groundwater is deteriorating due to the excessive withdrawal which reached its peak in 2006 at 164.7 MCM. At which point the Ministry of Electricity and Water (MEW) realized that water preservation was necessary for future prosperity. Thus, the fresh and brackish water consumption started gradually decreasing as of 2007-2008 (Figure 1-11). The current groundwater withdrawal rate from each of the Wafra and the Adbali wells is estimated to be 300,000 - 400,000 m3/d.

Raudhatain, which is a freshwater field in the north, started with a production rate of above 9090 m3/d in the years 1963-1967, now pumping about only 4545 m3/d. The decrease of outtake is due to the increasing relativity of the total dissolved solids in the water acquired. By the year 1989, the water produced from the two water wells decreased to about 300 m3/d (Mukhopadhyay & A. Akber, 2018).

Producing groundwater, be it fresh, brackish or saline water has the accompanying costs of pumping and desalination treatment, which includes the multi-stage flash evaporation

Figure 1-12: WASTEWATER TREATMENT PLANTS

(Source: eMISK, EPA)

process, Figure 1-12. The cost of the thermal process is largely dependent on the consumption of energy during the operation accounting to about 50% of the water unit cost. In 2014, desalination capacity was recorded to have reached 2.4 M m3/d. Wastewater treatment has similar cost priorities; over 90% of the population of Kuwait has access to a central sewage system collecting both domestic and industrial wastewater. The total length of pipelines stretches over 650 km.

In 2004 a municipal wastewater treatment plant was constructed by a private consortium on Build – Operate – Transfer (BOT) formula in Sulaibiya, the plant uses Reverse Osmosis Process (RO) and has the capacity of 375,000 m3/d. In 2006 the efficiency of the plant was at 94.7%, producing 355,102 m3/d of treated wastewater from a 375,000 m3/d influent (Abdel-Jawad et al.).

Future demand for water is increasing and does not show any signs of stabilizing. The availability of desalinization capacity will depend on the economic growth in the country. Burney et al. carried out a study projecting the water demand in Kuwait by 2025, and results show that it will rise to 2 M m3/d to 8.3 M m3/d. There seem to be several available options for rationalizing water demand, one of many is to reduce the gap between the increase of income and the government-fixed price of water, another is the used of reclaimed municipal wastewater. In 2007, 76% of the treated wastewater was used for landscaping and agriculture (Mukhopadhyay & A. Akber, 2018).

1.7 Climate

Kuwait has a hyper-arid desert climate that is highly variable with recurrent extremes. Maximum daily temperatures can reach 45°C during the summer during which there is no rainfall (see Figure 1-13). The climate is marked by four distinct seasons, with long, hot and dry summers and short winters, as briefly described in the bullets below.

- *Winter.* The winter season occurs over a 2-month period between 6 December and 15 February. These months are cooler, often with a cold northwesterly wind. The lowest temperature recorded was −4°C recorded at Kuwait International Airport in January 1964. Low temperatures, clouds, rain and a cold northwesterly wind called (*Shamal*) characterize this season. Two distinct climatic periods within the winter season are evident.

Spring. The spring season is a 3-month period from 16 February to 20 May and is characterized by moderate temperatures, rain, cloudy conditions and hot southerly winds. The climate during the spring is divided into two distinct climatic periods, as briefly described in the bullets below. Two distinct climatic periods within the spring season are evident.

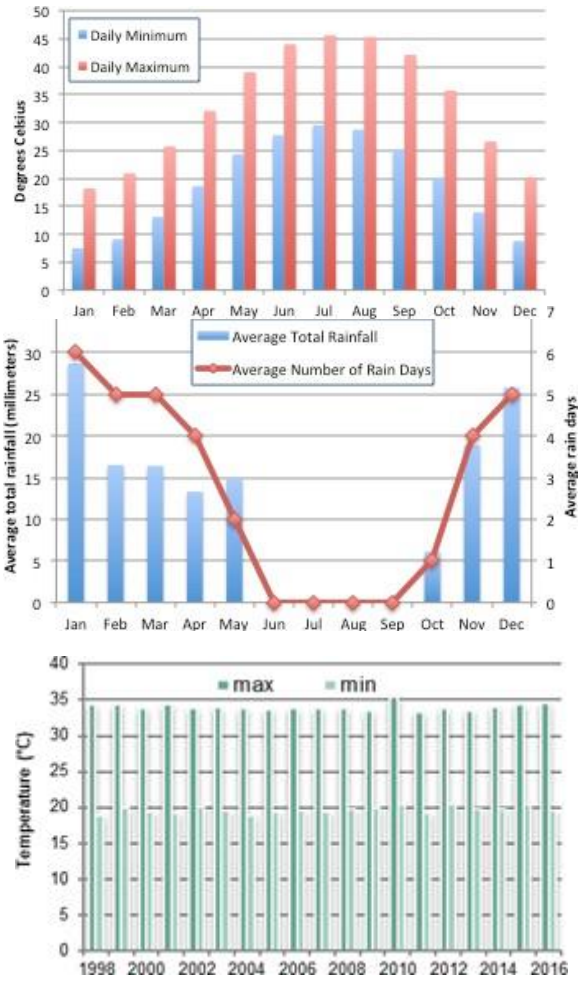

Figure 1-13: Top: Daily minimum and maximum temperatures in each month, averaged over 1962- 2016; Middle: Total rainfall in each month, averaged over 1962- 2016; Bottom: Highest and lowest average annual temperature recorded over the period 1998- 2016.
(Source: Kuwait Civil Aviation - Metrological Department)

- ***Summer.*** The summer season occurs over a roughly 5-month period from 21 May to 4 November and is characterized by a significant increase in both humidity and temperature. Summer is typically hot, dry and humid, with daily maximum temperatures ranging from range from 43°C to 48°C, with the highest-ever recorded temperature of 54.0 °C at Mitribah in northwest of Kuwait on July 21, 2016 (Kuwait Civil Aviation Metrological Department). This was the highest-ever temperature reliably recorded on the planet in last 76 years, as documented by the World Meteorological Organization (WMO). The prior highest temperature (52.9°C) was also recorded at Mitribah. The climate during the summer is divided into three distinct periods.
- ***Autumn.*** The autumn season is considered to occur over a single month- long period from 5 November through 5 December and is characterized by moderate temperatures, greater cloud cover, more frequent rain showers, and increasingly cold nights.

The climate of Kuwait is further characterized as follows:

- ***Rainfall.*** Figure 1-14 summarizes annual rainfall over the period 1998 to 2016. Rainfall is concentrated in the winter and spring months, totals are highly variable from year to year, and drought is a recurrent phenomenon. Average annual rainfall is typically around 112 millimeters (mm) per year, varying from 75 to 150 mm/yr. Annual levels at Kuwait International Airport have been recorded as low as 34.4 mm and as high as 218 mm, while 319.5 mm was recorded in Umm Almaradim Island in October 2013.

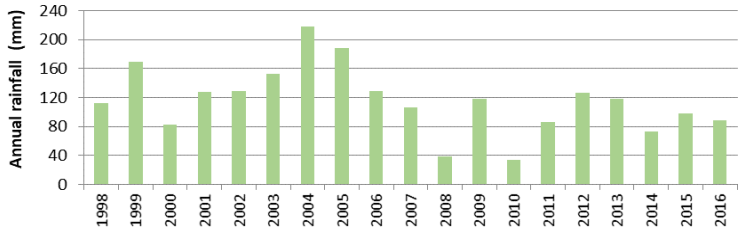

Figure 1-14: Average annual rainfall over the period 1998-2016.
(Source: Kuwait Civil Aviation - Metrological Department)

- ***Humidity:*** From mid-August through September, humidity can exceed 95% in coastal areas. This is due to high seawater temperatures coinciding with tropospheric temperature inversions. Over the period 1987 through 2017, average relative humidity was 57%.

Figure 1-15: Recent severe dust storms over Kuwait City.
Left: Storm on 17 June 2018. (Photo: Sarah Al-Sayegh); Right: Storm on 18 February 2018 (Photo: Kuwait Times, 19 February 2018)

- ***Dust storms:*** Given the geographical location, dust storms are regular phenomena in Kuwait. While they can occur in any season, dust storms are particularly frequent in summer and can reach speeds up to 150 km per hour (see Figure 1-15). Dust sources are the Mesopotamian region that includes Syria, Iraq, western Iran, and the north-eastern portion of the Arabian Peninsula. Dust activity in the Tigris- Euphrates basin begins around May, reaches a maximum in July and is much reduced by September–November. In spring, the region is affected by north- westerly Shamal winds that transport dust down to the Gulf. Dust storms are aggravated by practices of overgrazing and camping practices. They are known to contribute to serious health impacts in Kuwait such as asthma attack incidence rates of 175 per day, as well as increasing road traffic accident rates that are over three times the normal rates.

1.8 Population

Kuwait has an overwhelmingly urban population that has grown rapidly since the discovery of oil in the late 1930s, with over 98% of the population living in urban areas. Between 1996 and 2018 the total population increased from 1.6 million to 4.8 million, at an average annual rate of 4.0% (see Figure 1-16). Over this time, the Kuwaiti population as a share of the overall population has declined from nearly 37.2% to nearly 30.4%. In contrast, the expatriate population has grown more rapidly over the same period - about 5% per year on average - while their ratio of total population rose from nearly 62.8% to 69.6% (PACI, 2018).

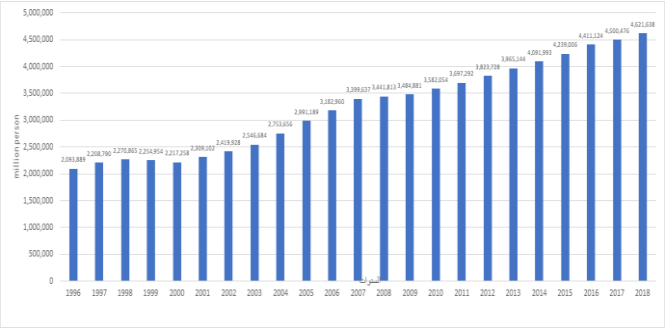

Figure 1-16: Population composition

(Source: The Public Authority for Civil Information,

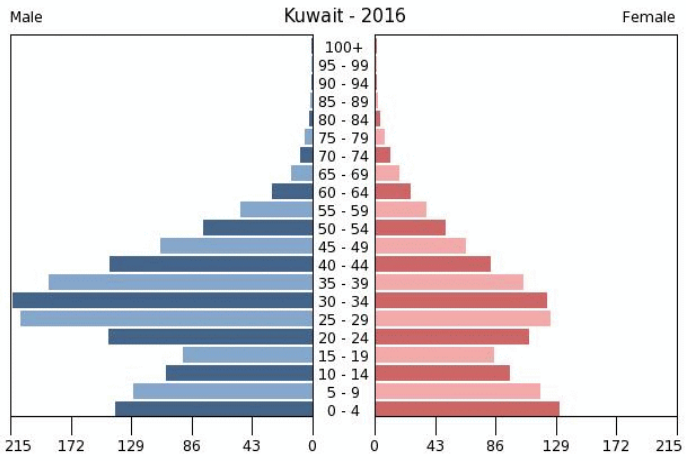

Figure 1-17: Population pyramid, 2016.

(Source: Public Authority for Civil Information, paci.gov.kw)

Kuwait's population is, like those of its Gulf neighbors, heavily skewed relative to age and gender (see Figure 1-17). By the end of 2017, most of the total population (about 78%) was between 16 and 64 years of age and males roughly comprised 63%. This is in large part due to the presence of a large number of expatriate workers in the country in that age bracket (about 86%) that are mostly male (nearly 69%).

In contrast, Kuwaitis under the age of 20 accounted for the majority, about 45.2 percent, of the Kuwaiti national population in 2016. On the other hand, the gender distribution in the case of Kuwaiti national population is modestly biased towards females (51%).

Regarding educational levels, illiteracy rate among the total population during the last 10 years was about 3 percent, while those who just read and write stood at 27 percent, and holders of school certificates ranging from primary to secondary represented 45.4% of the population (see Figure 1-18).

1.9 Public Health

Due to a modern healthcare system, there has been a decrease in the incidence of communicable diseases and an increase in life expectancy over the recent past. Today, the burden of disease has shifted towards non-communicable diseases and injuries. Trends are showing steady increases in the incidence of coronary heart disease, cancer and accidents and injuries (mainly road traffic accidents). In addition, the incidence of diabetes and obesity is on the rise. Various NGOs have begun to focus attention on these conditions.

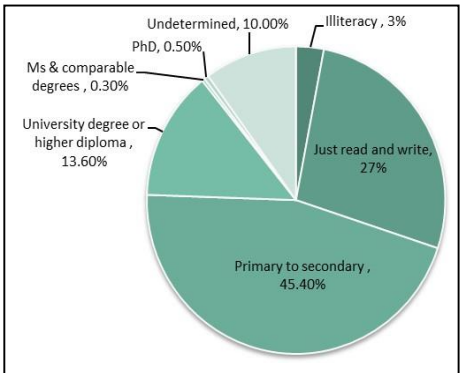

Figure 1-18: Educational profile.

(Source: Alghais and Pullar, 2016)

In recent decades e.g. 1990s to 2010s, the number of motorized vehicles has grown significantly lead to increased air pollutant emissions (PM10, CO, NOx, O3, SO2 and VOCs) and poor urbans; quality (Al Bassam; and Khan, 2004). Many studies have shown strong associations between particulate matter (PM) levels and a variety of adverse health outcomes, with particulate matter (PM) levels are high enough in Kuwait to impose substantial health risks (Ward Brown et al., 2008).

1.10 National and Regional Development Priorities and Objectives

Since 2010, the national development plan has been implemented with objectives and programs based on the vision of His Highness Sheikh Sabah Al-Ahmad Al-Sabah to transform the state of Kuwait into a financial, cultural and institutional leader in the region by 2035, attracting investors, creating a competitive economy led by private sector and promoting production efficiency.

The Kuwait National Development Plan sets the nation's long-term development priorities. It is organized around five themes, or desired outcomes, and seven pillars, or areas of focus for investment and improvement. Each pillar has a number of strategic programs that are designed to have the most impact on achieving the vision of a New Kuwait and some projects have a direct relation to mitigation of GHG emissions of the business as usual scenario and adaptation to the negative impact of climate change as follows:

In the development of infrastructure, Kuwait seeks to develop and modernize the national infrastructure to improve the quality of life for all citizens. For example, in the land transportation system -- The Sheikh Jaber Al-Ahmed Causeway project and the development project of the 4th ring road; in the marine transportation system -- The Mubarak Al-kabeer Port project and the development projects for Shuwaikh, Shuaibah and Doha Ports; in the air transport system -- The Kuwait Airport Expansion project - Terminal II and the development of east and west runways at the international airport project; In the development and increase of production capacity of electrical and water energy -- The construction project of the Doha Reverse-Osmosis Seawater Desalination Plant-Phase I, the supply, installation, operation and maintenance project of gas turbine units with composite cycle system to increase electrical power at al-Sabiya power station and water distillation by 750 MW-Phase III, the supply, installation, operation and maintenance of the gas turbine project (Phase I) at al-Sabiya station to the combined cycle system, and the supply, installation, operation and maintenance of the gas turbine project (Phase III) at the al-Zour Southern station site to the Combined Cycle system.

In the utilization of renewable energy, Kuwait is embarking on the Al Sheqaya Renewable Energy Complex project; the supply, installation, operation and maintenance project of PV panels on the Sebiyyah's ground water tanks; and the Water Desalination Center project using renewable energy. To improve the efficiency of waste management, projects include the development and rehabilitation of landfill sites in different areas, and the municipal solid waste treatment project (Kabad).

In order to develop a prosperous and diversified economy to reduce the country's dependence on oil revenues there are three main projects to be implemented in the oil sector -- The Al-Zour Refinery project, The Bio-fuel project and The Olefins III and Aromatics II integrated with al-Zour Refinery project.

1.11 Economy

Kuwait's economy is fairly small, comparatively rich, semi-highly dependent on oil exports. Petroleum accounts for the majority of gross domestic product (GDP), export revenues and government income. Crude oil & natural gas sector dominates the economy. On average, it represents nearly 50% of the country's real GDP.

Other sectors are not actually fully independent of the oil and gas sector as they are heavily dependent on oil and gas revenues. Social services, for example, are entirely funded by public oil revenues. The largest manufacturing industries are oil-based, and most other activities are heavily subsidized with oil income. Figure 1-19 (left) shows the percentage contribution of oil and non-oil sectors to real GDP (at constant prices of 2010) between 2006 and 2015. Figure 1-19 (right) shows the growth trend of these two sources of real GDP during the same period. Because of such a reliance on oil income, Kuwait's economy continues to be highly vulnerable to changes in global oil demand, as well as international oil market price volatility.

Over the period 2006–2015, nominal GDP per capita has shown a decline of 12.6% from nearly 30.7 thousand U.S. dollars in 2006 to nearly 26.7 thousand U.S. dollars in 2015. However, during the same period of time, real GDP per capita has shown a strong growth of 63.6% from 18.6 thousand U.S. dollars in 2006 to 30.2 thousand U.S. dollars in 2015 (see Figure 1-20, left). Over the same period of time, the GDP per capita using the purchasing power parity (PPP) basis has averaged 80.4 thousand U.S. dollars, which is one of the world highest levels. However, PPP-GDP per capita has declined by 6.4 percent. Figure 1-20 (right) shows the decline in GDP per capita at PPP basis over the period 2006 – 2015.

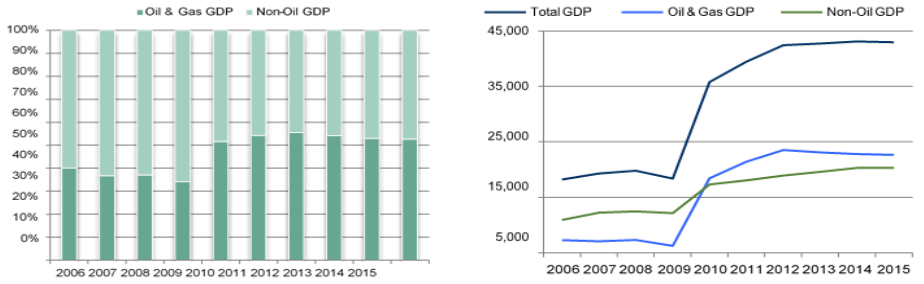

Figure 1-19: Shares of oil and gas sector and non-oil sectors of total real GDP, 2006-2015 (left); Trends in the contribution to total real GDP from oil and non-oil sectors,2006-2015(right). **(Source: A. Al-Mejren-2018)**

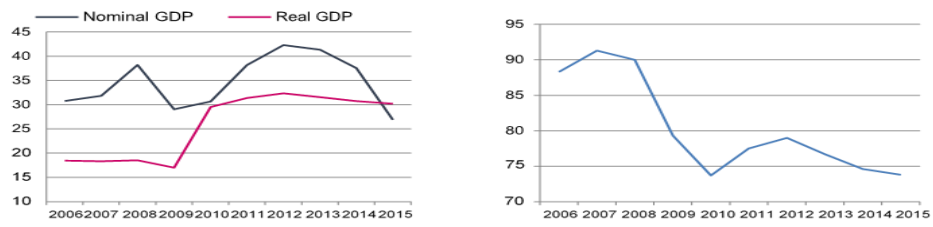

Figure 1-20: Nominal GDP per capita versus real GDP per capita, 2006-2015 (left); GDP per capita at purchasing power parity, 2006-2015(right).
(Source: A. Al-Mejren-2018)

In addition to the oil and gas sector, there are four other activities with large GDP shares. They include social services, financial services, transport and manufacturing. Together, these sectors account for about 90% of the non-oil sector's contribution to real GDP and 42% of the entire real GDP, with the remaining 5% of non-oil GDP accounted for by agriculture, utility, construction, and trade sectors. An overview of the major sectors is provided in the bullets below. Figure 1-21 presents their relative contribution to GDP in 2015.

- *Social services:* The contribution of this sector to real GDP is in the form of government expenditures on basic services (e.g., health care). The overall contribution to overall real GDP in 2015 was about 17%.
- *Financial services:* This sector, which includes banking, insurance, real estate and other financial and business services, plays a substantial role in the nation's economy where its contribution to real GDP was about 14%.
- *Transport:* This sector includes road and ports development, storage and communication services. Its contribution to real GDP in 2015 was about 6%.
- *Manufacturing:* This sector consists primarily of petrochemical industries, building materials, metal and steel production. Its overall contribution to real GDP was about 5%.

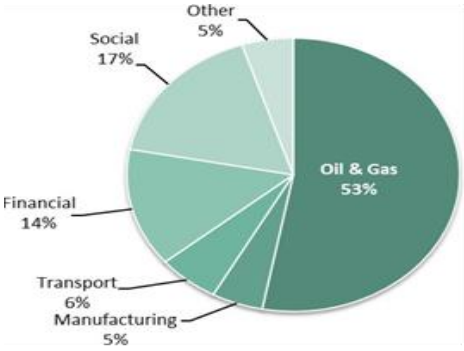

Figure 1-21: Sectoral contribution to Kuwait's real GDP 2015.
(Source: Central statistical Bureau, Kuwait)

1.11.1 Key Economic Sectors

- ***Oil***

Kuwait, a member of the Organization of Petroleum Exporting Countries (OPEC), is one of the world's leading oil producers. It has the world's fifth largest crude oil reserves and is one of the ten largest global exporters of crude oil and oil products. As result of Kuwait having a strong economy, it had a per capita Gross Domestic Product (GDP) in 2015 of 30.2 thousand U.S. dollars. The country enjoys macroeconomic and financial stability and has a very solid financial position with accumulation of considerable public and external accounts surpluses.

Kuwait Petroleum Corporation (KPC), the Ministry of Oil, and the Supreme Petroleum Council are the government institutions that are responsible for the petroleum sector in Kuwait. KPC is an umbrella establishment with multi subsidiaries including Kuwait Oil Company (KOC), which manages crude oil and natural gas production; Kuwait Gulf Oil Company, which manages offshore crude oil and natural gas operations in the Partitioned Neutral Zone between Kuwait and Saudi

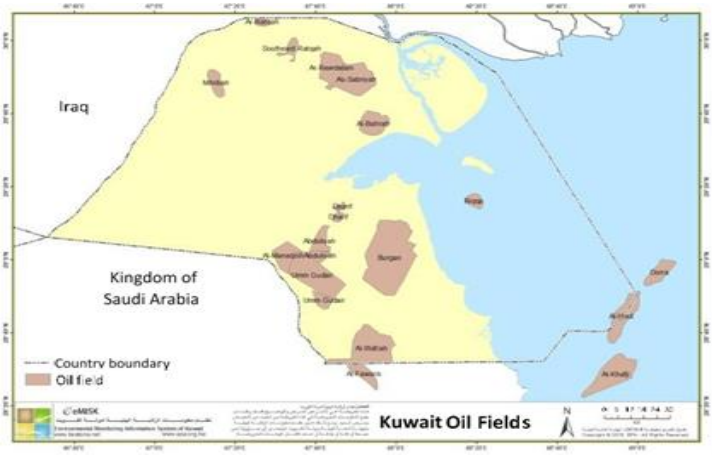

Figure 1-22: Kuwait's oil fields.
(Source: eMISK, EPA)

Arabia, the Petrochemical Industries, and Kuwait National Petroleum Company (KNPC), which operates the country's three oil refineries.

The Ministry of Oil estimates the country's proven oil reserves at 101.5 billion barrels, just over 7% of the world total. Additional reserves of about five billion barrels is held in the Partitioned Zone with Saudi Arabia. Much of Kuwait's reserves and production are concentrated in a few mature oil fields that were discovered in the early to middle decades of the past century. Figure 1-22 shows the distribution of Kuwait's oil fields.

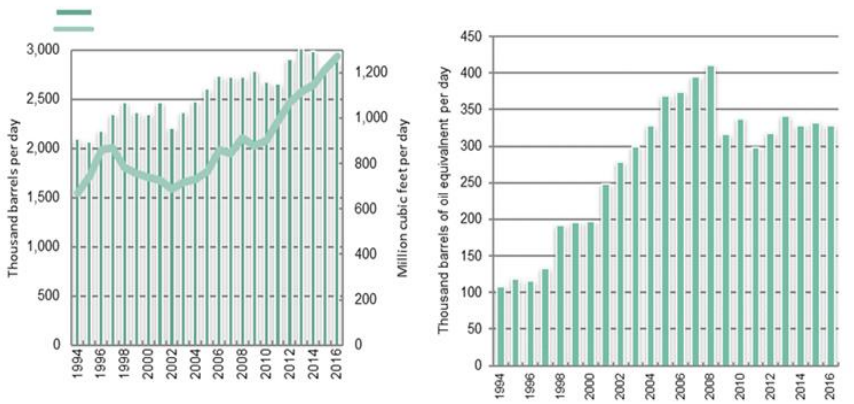

Figure 1-23: Kuwait's daily crude oil and dry natural gas production, 1994-2018 (Left). **(Source: Kuwait Petroleum Corporation);** Right: Kuwait's daily crude oil and oil by product consumption, 1994-2018. **(Source: Organization of Arab Petroleum Exporting Countries (OAPEC) Data Base)**

Gross crude oil production in Kuwait reached about 2.883 million barrels per day in 2016 while natural gas production exceeded 1,200 million cubic feet per day in that year (see Figure 1-23, left). In January 2018, KPC officials disclosed plans for the company to spend over $500 billion to boost its crude production capacity to 4.75 million barrels per day by 2040. Nearly $114 billion of this amount was allocated over the next five years (2018-2022). Kuwait's current (2018) crude oil production capacity is about 3.15 million barrels per day (bpd).

About one-sixth of Kuwait oil and gas production is consumed in the domestic market. According to estimates by KNPC, which produces and markets the refined products, half of the domestic consumption goes to power plants and seawater desalination units, while the rest is consumed mainly by the oil industry itself, followed by the transport sector. Only a small proportion is consumed by households. Figure 1-23 (right) shows the Kuwait's daily consumption of crude oil and oil products in thousands of equivalent barrels of crude in the period 1994 – 2016. The decline in oil consumption since 2009 was due, among other factors, to the shift toward the use of more natural gas in power stations and petrochemical industries. Finally, due to low natural gas production relative to consumption requirements, Kuwait has been a net importer of natural gas since 2009. In 2016, Kuwait's total imports of natural gas reached about 152.3 billion cubic feet, nearly 417 million cubic feet per day. (KNPC data).

- ***Natural Gas***

Regarding natural gas, Kuwait had an estimated 1.8 trillion cubic meters of proven natural gas reserves as of 2015. Kuwait's reserves are not considered significant relative to global reserves and this has spurred an extensive drive in natural gas exploration. The utilization of the discovery of large non-associated gas reserves, which was discovered in the northern area of the country had been delayed by parliamentary opposition since 2006. However, in September 2016, Kuwait awarded contracts to international companies to enable the start-up of production of gas from these reserves by 2018. Yet, the $3.6 billion second phase plan of the project is on hold after tenders were unexpectedly cancelled in late 2017.

Total daily average production of associated and non-associated natural gas increased during 2016 to 1,737 million standard cubic feet per day (MMSCFD) against a target of 1,530 MMSCFD, i.e. higher by about 14%. In addition, average production of dry (non-associated) gas reached 1272 million cubic feet per day, i.e. nearly 464.4 billion cubic feet in 2016. In addition, average gas exported to the LPG unit in KNPC amounted to 1625 million standard cubic feet per day (MMSCFD), exceeding the target of 1465 MMSCFD. On the other hand, KOC has succeeded in reducing gas flaring to 1%, and strives to achieve less than 1% in line with its strategy. However, despite its efforts, repeated closure of KNPC's Acid Gas Removal Plant had pushed KOC's gas flaring rate to 1.31%, higher than the tolerance level of 1.15%.

- *Electricity*

Regarding electricity, given Kuwait's harsh climate, high population growth rate, and rapid socio-economic growth, demand for electricity is steadily increasing to keep pace, particularly during the hot summer period due to air conditioning- and water desalination-related electricity demand. For Kuwait, coping with such multidimensional growth in electricity demand has proved to be a major challenge with repeated power outages experienced in 7 residential areas during the hottest month of July 2016 when temperatures exceeded 50°C.

Total installed electric capacity in 2016 was about 18,850 megawatts (MW). Small (18-42 MW) and medium (100-200 MW) gas turbines account for about 40% of total installed capacity and are usually used in emergencies or during the time of peak load. Due to the high operational costs and low thermal efficiency of gas turbines, they are usually kept as standby with a high level of availability.

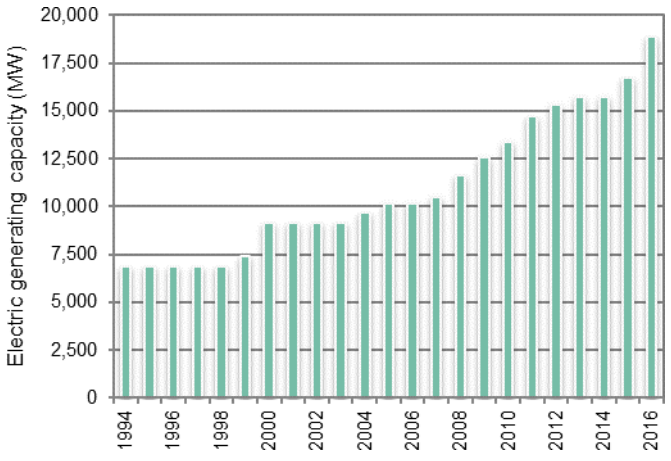

Figure 1-24: Total installed electric capacity, 1994-2016.

(Source: Ministry of Electricity and Water, Statistical Yearbook 2017: Electrical Energy)

The remaining electric capacity consists of steam turbines ranging in size from 120 to 300 MW and combined cycle units (185-280 MW). Natural gas, heavy fuel oil, crude oil and gas oil, are all used as primary fuels for electric generation depending on boiler design, with priority given to natural gas relative to its availability. Figure 1-24 presents the development of total power installed capacity in MW between 1994 and 2016.

Over the period from 2000 to 2015, electricity generation has been increasing by 5.1% on average per year. (Ali and Alsabbagh, 2018). The Ministry of Electricity and Water (MEW) is solely responsible for generation, transmission and distribution of power and water in Kuwait. Although the country has been slow to reform such avital sector, progress is taking place as the government looks to attract foreign investors. Three major Public-Private Partnership projects are expected to be launched soon: the 2.7 GW Al-Zour North Second and third Project, the three phases of 5.4 GW Al- Khiran Project and the 3.6 GW Al- Nwaiseeb Project. Within the vision of New Kuwait, Kuwait started a three- phase process, with the goal of generating a total of 3,070 MW of renewable energy (15% of the country total annual consumption) by 2030. The first phase is comprised of 70 MW energy park built on a 100-square- kilometre area in Al-Shigaya, a desert zone about 100 km west of Kuwait City.

The second and third phases are projected each to produce 1,500 MW individually. The country determination to increase investments in the renewable sources of energy, mainly solar and wind has intensified after its decision to abandon its plan to construct a nuclear plant.

Kuwait ranks fifth in the world in terms of per capita electricity consumption. Between 1971 and 2014, Kuwait's per capita electricity consumption has been growing by an average annual rate of 3.8% (from 3,011.95 kWh in 1971 to 15,213 kWh/cap/year in 2014). The residential sector accounts for 64% of the country's total electricity consumption due to air conditioning demand in order to adapt to high temperatures, a much higher share the OECD countries (31%) (IEA, 2017).

While the country's harsh weather is a key factor behind this level of demand, the highly subsidized energy tariffs is believed to be the biggest driver behind such extraordinary electricity consumption in Kuwait. The cost of electricity is subsidized by more than 90%. Electricity cost of production is about $0.130 per KWh but is priced to consumers about $0.007 per KWh. (https://oxfordbusinessgroup: Rising Cost Growing Demand Has Prompted Drive Boost Generating Capacity and Explore Alternatives).

Over the past decade, Kuwait has adopted policies aimed at reducing per capita electricity consumption and has organized several public awareness campaigns to specify the urgency of energy conservation. Policies attempt to reduce electricity consumption in the building sector in general in Kuwait. These policies include the update of the Energy Conservation Program in 2014, the use of renewable energy to generate electricity and the setting of renewable energy penetration targets. Within the government energy reform initiative of 2016, electricity and water rates have been revised and adjusted to encourage consumers to rationalize consumption. The new tariffs became effective on 22 November2017.

- *Transportation*

Kuwait has an extensive, modern and well-maintained network of road infrastructure. In addition, Kuwait's most recent Midrange Development Plan ((2017-2018) includes several ambitious projects that expand and upgrade the country's major highways and other means of transport. In fact, the development of transport infrastructure in general is an essential part of the "New Kuwait" vision. Various transport key projects are in progress including the expansion of airport facilities, a railway, a metro, bridges and seaports. In light of the ongoing technological advancement in the telecommunications industry which has become a basic part of all contemporary infrastructure, Kuwait also recognizes that the term "infrastructure" goes beyond the traditional concept of land, sea and air transportation.

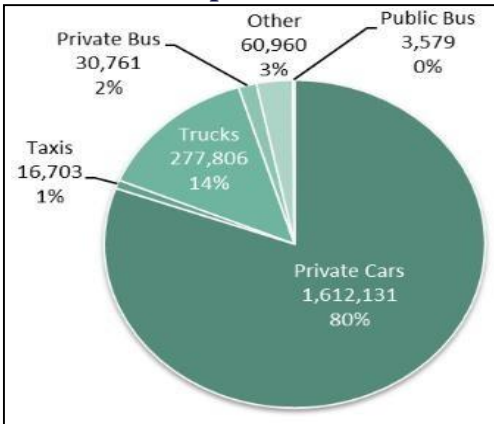

Figure 1-25: Vehicle stock profile, 2016.

(Source: CSB, the annual statistical abstract 2015/2016)

To achieve a "sophisticated modern transport and communication infrastructure", the government is striving to realize five targets: (1) increasing the capacity of Kuwait's International Airport; (2) addressing the domestic traffic problem; (3) developing new economic and urban centers at the Northern part of the country, (4) maximizing the capacity of ports to support the transition of Kuwait to a financial and commercial hub; and (5) modernizing the technologies of the telecommunications sector and keeping abreast of the continuous advancement in this field.

Kuwait has an extensive, modern and well-maintained network of road infrastructure. By 2016, the total length of paved roads exceeded 7,100 kms. Yet, despite such great expansion in road capacity, the pace of increase in the number of vehicles in Kuwait outperforms such expansion. In the same year, the number of vehicles number had exceeded 2 million, of which 80% were private, because of is it because of low fuel costs, as an adaptation measure due to heart, Lack of adequate climate-adapted public transport infrastructure. The rest consists of public and private trucks, buses and taxis. (Figure 1-25) presents the distribution of vehicles by type in Kuwait in 2016.

The second pillar of the Mid-Range Plan which deals with the domestic traffic problem includes the development of new roads and ports that link the Northern part of Kuwait with neighboring countries, limiting traffic congestion and involving the private sector in the construction of the needed infrastructure. This program includes the 37-km long Sheikh Jaber Al-Ahmad Sea-Bridge terminals (Figure 1-26), which seeks to increase the efficiency of the transport network, reduce the traffic congestion and shorten the distance between Kuwait City and Sabiya at the Northern part of Kuwait Bay. The Bridge which entered its pre-final completion phase includes the construction of two artificial islands containing buildings for traffic and emergency services, the authority which monitors the maintains the bridge, a fuel station and a marina, as well as a main navigation bridge with a height of 23 meters and an opening of 120 meters for the passage of ships.

Figure 1-26: Sheikh Jaber Al-Ahmad cross-sea bridge.
(Source: eMISK)

In addition, the 570 km long railway network project, which aims to increase trade volume and to facilitate the movement of passengers among GCC countries, will have a positive impact on the domestic traffic by reducing the need for road transport and reducing pollution resulting from the use of vehicles and trucks. The project also aims to encourage the private sector to participate in the construction and development of the national projects and to benefit from its practical experience, which has a positive impact on the local economy, especially through the transfer of technology and knowledge, thus enhancing the efficiency of employees and raising the level of services provided as well as creating more career opportunities.

Figure 1-27: Kuwait international airport new terminal
(Source: Ministry of Public Works website)

Air Transport. The development of Kuwait's air transport system includes the increase of the capacity of the country's international airport to 25 million passengers through the construction of new passengers' facilities using the highest world specifications, adding new terminals (Figure 1-27), increasing the efficiency and the capacity of the runway to enable it to receive modern aircraft and the Airbus A380, adapting the latest technologies of air navigation and the latest international standards, and adding a new air control tower serving the third runway and the middle corridor.

Figure 1-28: Shuwaikh seaport.

(Source: Kuwait Ports Authority website)

Maritime Transport. There are further plans to develop the maritime transport system to maximize the capacity of the ports to enable it to support the transformation of Kuwait into a regional financial and commercial hub. At the top of the maritime transport program is the project of Mubarak Al-Kabeer Port, which seeks to increase trade exchange activities, boost the volume of regional trade, increase the volume of investments, increase economic resources, raise economic growth rates, develop the services provided by sea ports, increase their absorptive capacity and contribute to the reconstruction and development of the new northern urban area. Mubarak Al-Kabeer port will have a capacity of 24 berths, an ability of receiving outsized ships and a capability to handle nearly eight million containers. The project will help in the creation of an industrial zone and providing thousands of new job opportunities.

The development of Shuwaikh seaport (see Figure 1-28) is an essential part of the program. It aims to increase the efficiency of the navigation channel in the port to accommodate larger number of up-to-date container vessels with deeper depths, in addition to the enhancement of safety factor.

- ***Built Infrastructure***

Since the first half of the twentieth century, Kuwait City has transformed itself from a small walled city to a metropolitan area experiencing rapid and unprecedented population growth with only a relatively small increase in the extent of its urban area. Most of the highly urbanized areas are located along the coast (see Figure 1-29). This has led to a number of lifestyles, economic and environmental challenges (Alghais and Pullar, 2016).

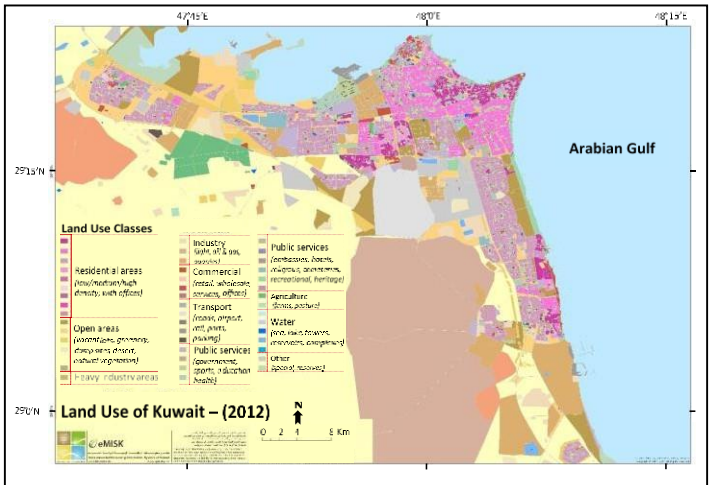

Figure 1-29: GIS map of land use in State of Kuwait.

(Source: eMISK, KPA)

Future urban developments are planned for beyond the periphery of existing urban centers. Two of the most prominent are briefly described in the bullets below.

- **Kuwait's Islands Project. The initial phase of an ambitious project to transfer five of the Kuwaiti uninhabited islands (Boubyan, Failaka, Warba, Miskan and Ouha) into economically feasible areas was presented to His Highness the Amir who backed the initiative as part of the Kuwait future strategy and a corner stone of the vision to transform Kuwait into a regional and global trade and financial hub, while also boosting development of all other sectors of the economy. The project aims to support the country's development through various projects on these islands, which will turn them into free trade zones that link the East to the West. The Supreme Council of Planning is studying the benefits of adopting other international models to create a comprehensive and multi-purpose free trade zone in these islands to enhance Kuwait's regional and international competitiveness and attract foreign investment. Realization of the project will require new legislation, exceptional resolutions, and other governmental measures.**

Figure 1-30: Conceptual rendition of Silk City to be built at Subyia. **(Source: Tamdeen Group)**

- ***Madinat Al-Hareer (Silk City).*** **Madinat Al Hareer project (see Figure 1-30) was initially proposed by the Tamdeen Group, a private corporation before its approval by the government where it becomes part of the Kuwait future strategy. The project site is Al- Subiya in northern Kuwait and would cover about 250 km^2. The project is planned to be built in phases and be completed within 25 years at an estimated cost of US$ 132 billion. The city will be connected to Kuwait City via the Jaber Causeway. It will accommodate at its center a one-kilometer high skyscraper tower (Burj Mubarak) that will be surrounded by mixed- use tall buildings. The proposed capability of the city housing is expected to reach 700,000 people. One of its four villages are the Ecological Village which will includes national parks and reservations for wild animals and rare planets as well as nature reserves for migrating birds from central Asia and Africa. The village will include a center for environmental studies and vast green spaces, as well as be surrounded by a green belt of gardens and vast green spaces. The Chinese government has shown interest in collaborating on the project along with others in the five Kuwaiti islands as part of the Chinese 'One Belt, One Road' initiative promoting economic prosperity of Eurasia countries.**

- ***Industry***

In 2016, the industrial sector's contribution to GDP was 7.2% (current prices) and 5.7% (constant prices). Since 1994, nearly all manufacturing industries demonstrated some improvement in term of their contribution to the GDP (see Figure 1-21). Chemicals and chemical products exhibit an almost two-fold increase in the GDP through the years 2000-2016. This alone gives chemical industries a special significance. Although growing, recycling has the lowest GDP contribution compared to other manufacturing activities.

- *Agriculture and Fisheries*

An arid climate and poor soils mean that Kuwait's arable area is limited. The Public Authority for Agriculture Affairs and Fish Resources (PAAF) records only 18,900 ha as being cropped, although crops provide 56% of the gross value of agricultural production in Kuwait (CBS data). In real terms, the agriculture sector's contribution to GDP is very small, 0.53% in 2016 (World Bank development indicators).

Farming systems are composed of small- and intermediate holders as well as specialized agribusinesses focused on growing date palms, greenhouses, open field vegetables, livestock production, and dairy/poultry production. Farms differ in size, productivity, profitability and marketing potential (see Figure 1- 31). Cropping systems are based on pure stand cultivation; monoculture and irrigation techniques vary from basin, furrow to micro-irrigation. Concerns related to yield limitation exist and are mainly caused by pests and poor crop management and systems optimization practices.

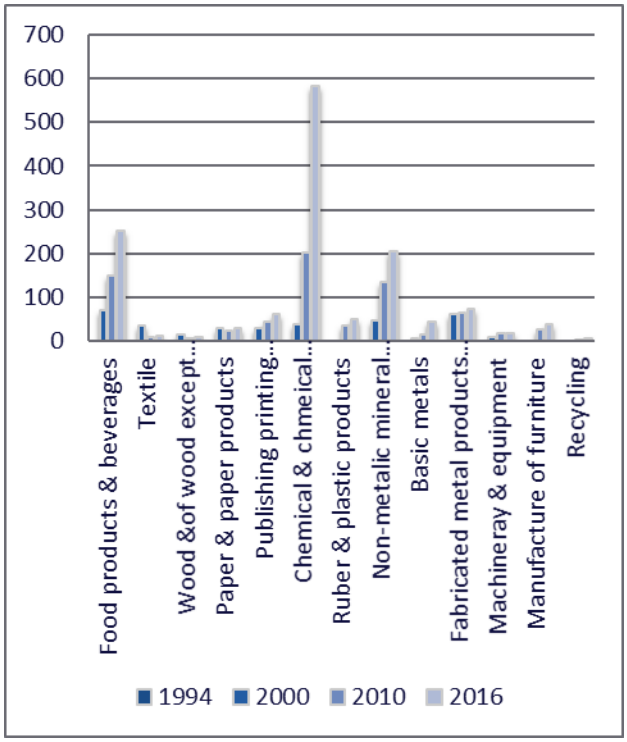

Figure 1-31: Contribution of manufacturing activities to GDP in million KD, 2016.
(Source: Central Statistical Bureau)

Livestock and animal production provide about 38% gross value of agricultural production in Kuwait (CBS data). Livestock production under Kuwait's harsh climatic conditions and shortage of good quality fresh water at reasonable cost makes fodder production and livestock production in Kuwait difficult. All local livestock production is subsidized, particularly the dairy industry, and depends heavily on most animal feed being imported, which means higher costs of production, requiring subsidies for most local livestock products to compete pricewise with imported products. Grazing is widespread, with sheep, goats and camels the main livestock involved (see Table 1-2).

The Public Authority for Agricultural Affairs and Fish Resources (PAAF), was established in 1983 to manage all types of activities in the agriculture sector and to formulate policies for developing plant, animal, and fishery resources, including land allocation. In order to support local agricultural production PAAF heavily subsidizes selected agricultural activities. (Table 1-1) summarizes the various agricultural subsidies provided by the government during the fiscal year of 2015-2016. A portion of the subsidies is directed towards the expansion of protected agriculture production in greenhouses, encouraging water saving irrigation technology, and the utilizing treated wastewater in irrigation.

Table 1–2: Breakdown of agricultural subsidies, 2015-2016 (Source: Public Authority for Agricultural Affairs and Fish Resources)

Subsidy	Value of Subsidy (million US$)	Subsidy share(%)
Subsidy for plant productions	8.2	27%
Subsidy for fodders	15.7	51%
Subsidy for fisheries	0.5	2%
Subsidy for milk and cows	3.9	12%
Subsidy for palm trees	1.8	6%
Other Subsidies	0.5	2%
Total	30.6	100%

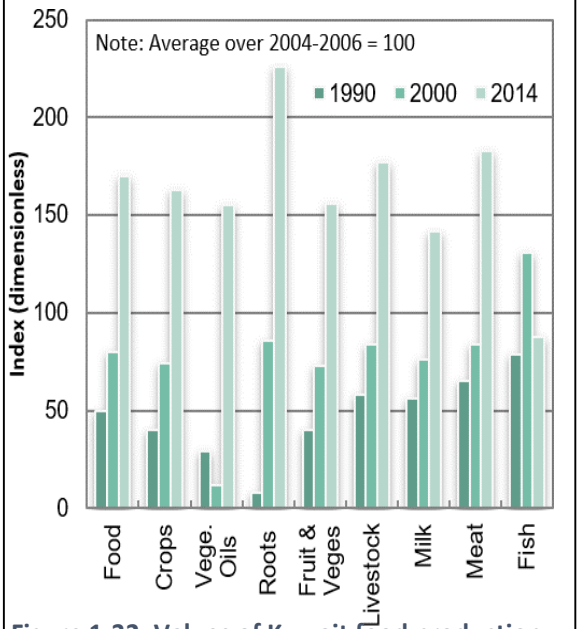

Figure 1-32: Values of Kuwait food production indices. **(Source: PAAF)**

Over the years, Kuwait's food production has been growing substantially. Figure 1-32 reflects the growth of the value of such production for three years (1990, 2000 & 2014) using the index number of each type of food production (excluding cereals because of the sharp increase in its 2014's value). Kuwait's crops, which are mostly grown in greenhouses in Wafra, Abdally, Jahraa and Sulaibiya, include tomatoes, cucumber, pepper, okra, green beans, marrow, eggplant, strawberry, onion, mallow, coriander, peppermint, melon, parsley, cabbage, lettuce, snake cucumber, dill, cauliflower, purslane, watermelon and red radish. Roots and tubers include Potatoes, Radishes and Root Beets; while vegetables are varied including onions, and green leafy vegetables. Total value of crops products has increased threefold from 2006-2007 to 2016-2017.

The country's key policy objective in agriculture is to provide for some of the local needs. To enhance the locally available food, 500 plots of land (see Figure 1-33), each with 50,000 square meters, were allocated by PAAF in Al-Abdali, the northeastern town, to support meat and poultry production in particular.

A sub-project of 200 integrated farms was also launched aiming to increase plants, crop production and to support other agricultural activities such as sheep farming, fish farming, poultry and other activities. However, 50 larger plots, each with 170,000 square meters for raising cattle and milk production are being removed as the current location obstructs a proposed railway route.

Since the 1990s, overfishing and environment degradation caused 50% decline in the total local fisheries product (Al-Husaini et al., 2015). Fish products are actually the most important renewable food resource (finfishes and shrimps) with an annual production about 4,500 tonnes, representing only 16% of total demand. Most of the commercial important species are zobaidy (Pampus argenteus), harmoor (Epinephelus coioides), suboor (Tenualosa ilisha) and newaiby (Otolithes ruber). Total imported fish products including both fresh and frozen reached 23,285 tonnes in 2012.

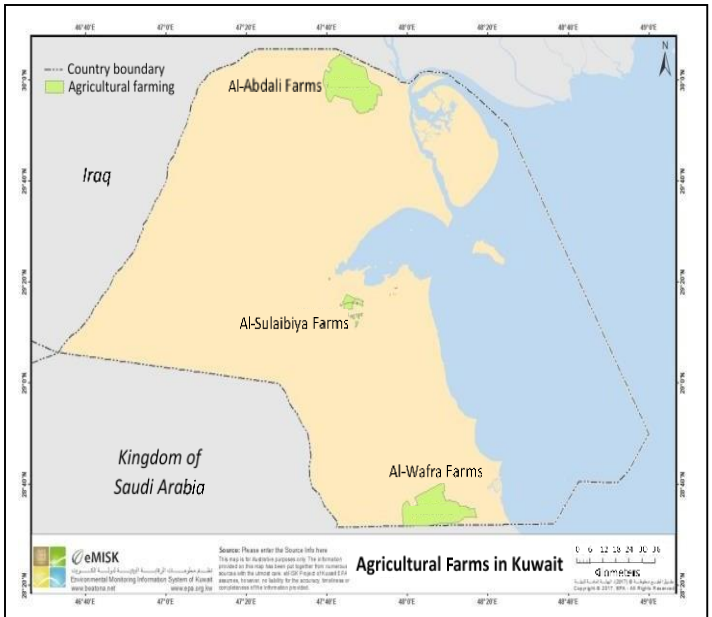

Figure 1-33: Agriculture areas in Kuwait. **(Source: eMISK)**

Aquaculture practices have been growing in response to the emergence of protected coastal and marine areas. The reduced access to fishing has been partly offset by fish farming projects. These projects provide fish and shrimp to local market throughout the year at reasonable prices. Among these projects is a 10 km2 pilot project of floating fish culture in the Al-Khiran area, with an expected productivity of nearly 2,000 to 3,000 tonnes of fish annually. The proposed Boubyan Island project has an expected yield of 3,000 tonnes of fish, 3000 tonnes of shrimp, and 60 tons of marine algae.

Other proposed projects include the cultivation of wild fish in Al-Sulaibia, Al-Wafra and Al-Sabia, utilizing treated wastewater for fish farming. The proposed 8 km2 Al-Sabia shrimp farm project will include 300 breeding ponds and two water pumping stations with an expected production capacity of 2,000 tonnes of shrimp annually. In addition, there is a shrimp reproduction plant with an annual capacity of six million shrimp larvae.

Aquaculture is a relatively new and potential source of fish production in Kuwait. It is currently being expanded to supplement local depleted landings from capture fisheries. Two types of aquaculture systems are practiced in Kuwait: (i) culture of Nile tilapia (Oreochromis niloticus) in concrete tanks using brackish water in agricultural farms, and (ii) culture of marine species such as gilthead bream (Sparus auratus), European sea bass (Dicentrarchus labrux) and sobaity sea bream (Sparidentex hasta) in cages located in the Kuwait Bay. Two key events – the mass fish kills in 2001 in the Kuwait Bay and the Iraq war in 2003 – crippled production. Most of the cages were destroyed as nobody was allowed to go near the cages due to security reasons during the war.

As for green areas, PAAF is active in establishing parks and gardens as well as projects of planting trees and greenery on the sides of roads and in public squares. In this regard, there are 134 public parks, and 635 projects of side road planting extended to nearly 1,700 kms long. The landscaping areas cover about 1.2 million square meters. The projects are divided into 12 sites with an area of 34 thousand acres, in addition to a number of parks such as Al-Salmiya Bolivar, Al-Wafra and Al-Abdali.

- ***Food Security***

Throughout its modern history, Kuwait has heavily relied on food imports since only a negligible fraction of food demand can be met by local agriculture. Kuwait produces roughly 1% of its crops from its arable land, using traditional agriculture practices (Analysis of Hydroponic Agriculture in Kuwait - Market trend, Growth and Opportunities (2015-2020), December 2017, Mordor intelligence). Almost all of its fruits and vegetable produce come from hydroponic or horticulture practices (see Figure1-34).

Kuwait has always faced a unique set of food security challenges due to its climate, limited arable land and water scarcity. Full food self-sufficiency, meaning the country producing all its food requirements, is understood to be an impractical and unachievable goal with an expectation of continued reliance international food trade markets. The Council of Ministers established a Ministerial Committee to supervise the development of a Food Security Investment Strategy for Kuwait. The overwhelming conclusion of the evaluation was that Kuwait currently enjoys a high level of food security.

Figure 1-34: Hydroponics farming in Kuwait.
(Source: Kuwait News Agency website)

Food is readily available and accessible to all residents and Kuwait ranks internationally as one of the most food secure countries thanks to its economic circumstances and government policy.

Kuwait is resource rich, has a large international wealth reserve, easy access to the global food markets, a generous government food subsidy program and significant strategic reserves of basic food commodities. Nevertheless, opportunities have been identified for improving efficiency through the use of incentives and reforms, including the reforms to the system of subsidies, reduction in food waste and encouraging greater efficiency through competition within the supply chain.

- *Environmental and Waste Management*

Despite the small geographical area of the country and the relatively small population, Kuwait has one of the highest per capita rates of municipal solid waste (MSW) generation in the world, 1.32kg/capita/day. Kuwait produces more than 1.9 million tons of municipal solid waste annually. Figure 1- 35 summarizes the typical composition of MSW, with the largest share being organic food wastes at 45%. Paper and plastics, prime candidates for recycling and reuse, together make up 40% of total solid waste generation.

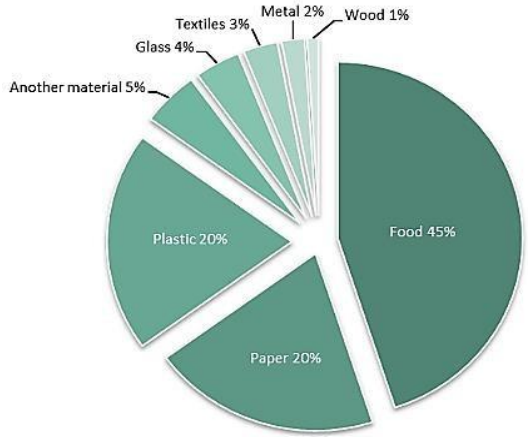

Figure 1-35: Weighted averages of all waste composition.

(**Source: KM, Fichtner; 2013)**

Until recently, the dominant MSW disposal method has been landfills. In contrast to its limited area, Kuwait used to have a relatively large number of landfills sites (14 in total), of which 11 have been closed prior to achieving their capacity, because of improper disposal methods and concerns related to public health and environment. Such dumpsites generate huge amount of toxic gases (methane, carbon dioxide etc.) and are plagued by spontaneous fires. Characteristics of the three remaining landfills - Mina Abdullah, Al-Jahra and South of 7th Ring Road - are summarized in Table 1-3. The total area of these landfills is estimated at 9.44 km^2.

Table 1–3: Municipal solid waste generation, 2016 (Source: KM)

Landfill	Area size (km^2)	Solid waste (thousand tonnes)
Mina Abdullah	**2.42**	**478.3**
South of 7th ring road	**5.35**	**1,381.8**
Al-Jahra	**1,67**	**465.**
Total	**9.44**	**2,325.2**

The management of domestic wastewater is the responsibility of the Ministry of Public Works. In 1965, the first sewer system was established in Kuwait, and the first domestic wastewater treatment plant was commissioned in the 1970, with a capacity of 100,000 m^3/day. By 1994, there were 3 established domestic wastewater treatment plants; and to meet the further increase in the rate of water consumption per person (275 liter/day) more domestic wastewater treatment plants were built, which make the number reach on total of 7 treatment plants. Table 1-4 lists the domestic wastewater treatment plants, along with the treatment type, design values and daily inflow.

Figure 1-36: Kuwait industrial area

(Source: eMISK)

There are 7 industrial areas, as presented in Figure 1-36, where most industrial units are located. In the past, most of these industrial areas were not connected to the sewer system, resulting in the industrial wastewater effluents discharged directly to the environment without treatment. In 2010, an industrial wastewater treatment plant was established in Al-Wafra area with a capacity of 8,500 cubic meters per day, with the possibility of increasing the capacity to about 15 thousand cubic meters per day. With the passing of Environment Law No. 42 in 2014, as amended by Law No. 99 in 2015; Article 35 committed all government agencies and the private sector to treat industrial wastewaters produced by their facilities. Accordingly, the Central Station was designated to receive the industrial treated wastewater from the different sectors.

The Ministry of Health is responsible for the disposal of medical wastes, the treatment of such wastes through sterilization by autoclave and final backfilling in the Kuwait Municipality landfill sites. Most medical wastes are sent to incinerators. Currently, the Ministry of Health manages three incinerators as listed in the Table 1-5.

Table 1–5: Incinerators of Kuwaiti Ministry of Health (Source:MOH)

Incinerator name	Online year	Capacity (kg/hour)
Shuaiba-1	2002	500
Kabd-1	2009	500
Shuaiba-2	2014	500

Table 1–4: Domestic wastewater treatment plant characteristics (Source:MPW)

Treatment plant	Treatment type	Design inflow (thousand m^3/day)
Sulibiyah (Al-Ardeiah)	Reverse Osmosis	425
Kabd (Al-Jahra)	Tertiary treatment	180
Al-Reqah	Tertiary treatment	180
Um-Alhaiman	Tertiary treatment	27
Wafrah (not working)	Tertiary treatment	4,500
Subah Al-Ahmad Marine city	Tertiary treatment	5,000
Khiran City (not functional yet)	Tertiary treatment	1,500

1-12 The role of women

In many developing countries where the populations are reliant on natural resources for their livelihoods, women commonly face higher risks and greater burdens from climate change impacts. Such conditions are not applicable in Kuwait society. The economic development driven by the oil and gas industry paved a path of socio-economic prosperity in Kuwait. In 1976 the government established Kuwait's Fund for Future Generations, and it has set aside 10% of the state's revenues annually for it. There are various calls and attempts to diversify the economy in Kuwait, with top down efforts leading towards establishing Kuwait as an economic center in the region. While the youth are leading the bottom up trend of establishing various small and medium projects minimizing the dependence on the government jobs.

Since 1960s, a comprehensive scheme of social welfare was created. Kuwaiti women have enjoyed access to higher education and relative freedom to advocate for improved economic and cultural rights, particularly as compared to women in neighboring countries. Women in Kuwait have almost equal access to various resources.

It is well established that education has a dramatic impact on addressing the impacts of global warming. General education in Kuwait is obligatory for all Kuwaitis between the ages of 6 and 14. Girls and women do seem to excel in all levels of education through advanced degrees. For example, the top percentage of High school graduates are girls, and about three-fifths of Kuwait University students are women. Women with more years of education have fewer, healthier children and actively manage their reproductive health. Education also enables women to face the most dramatic climatic changes. A 2013 study found that educating girls "is the single most important social and economic factor associated with reducing vulnerability to natural disasters." This decreased vulnerability also extends to their children, families, and the elderly.

Although women have been empowered through education, their participation in higher levels of decision-making processes does not reflect their percentage in higher degree holders and professionals. The social climate often prevents women from fully contributing to general policymaking, and particularly climate-related planning, policymaking and implementation. Nonetheless, many women are very active in NGOs advocating measures to reduce environmental impacts in general and climate change in particular.

2. National Institutional Arrangements Relevant to the Preparation of National Communications and Biannual Updated Reports

2.1 National Government Structure

The State of Kuwait is a constitutional, hereditary emirate ruled by princes (Emirs) drawn from the Al-Sabah family. The Constitution of Kuwait, endorsed by the Constituent Council on 11 November 1962, has elements of a presidential and a parliamentary system of government. The country has six (6) governorates: Al- Kuwait (capital), Al-Jahra (largest), Al-Ahmadi (several major oil refineries), plus governorates located close to the capital: Al-Farwaniyah, Hawalli, and Mubarak Al-Kabeer.

His Highness Sheikh Sabah Al-Ahmad Al-Jabir Al-Sabah is the Emir of Kuwait, head of state and Commander-in-Chief of Kuwait's armed forces. The Emir, a member of al-Sabah dynasty that has been ruling since approximately 1752, exercises his executive authority through the Prime Minister and the Council of Ministers. The Emir is constitutionally empowered to appoint the Prime Minister.

Legislative power is vested in the Emir and the parliament which convenes in the National Assembly building (see Figure 1-37). Parliament consists of fifty members, who are chosen in direct elections that are held every four years.

Figure 1-37: Kuwait National Assembly building.

(Source: KNA official website)

In accordance with the country's constitution, the fifteen cabinet ministers are also members of parliament. Kuwait's parliament is not only the oldest legislative assembly among in Gulf Cooperation Council (GCC) states but possesses the greatest political authority of any in the GCC. Since 2005, all Kuwaiti citizens, both male and female at least 21 years of age, are eligible to vote.

The Emir is empowered by the Constitution to dissolve the parliament and call for new elections, or in cases of national emergency can dismiss the parliament outright and/or suspend certain articles of the Constitution and assume supreme authority over the country. Either the Emir or the parliament can propose amendments to the constitution; a two-thirds majority of the members of the Assembly is required to adopt a change.

The nomination of a successor to the Emir is the prerogative of the ruling Al-Sabah family, and is subject to parliamentary approval under the Constitution. If the nominee does not win a majority of votes of the Assembly, the parliament must vote on and approve another candidate for the post.

The Constitution allows for the establishment of political parties. At the current time, a law has not yet been enacted to regulate them. As a result, no political parties are operational in Kuwait in a formal sense. Nevertheless, several members of parliament identify themselves and function as de facto political parties on the basis of religious sect/belief, social class or tribe.

Kuwait has an independent judiciary system. Civil laws are based on a combination of British common law, French civil law, and Islamic religious law, the latter having a considerable role in personal and family matters. In each of the country's six governorates there is a summary court.

There is also a court of appeals; a Cassation Court, which is the highest level of judicial appeal; and a Constitutional Court.

2.2 National Institutional Arrangements Relevant to the Implementation of Climate Change Actions

The institutional structure of climate change in the State of Kuwait falls within the framework of an institutional system starting from the First Deputy Prime Minister of Kuwait who in turn chairs the Supreme Council of Environment, where the Environment Public Authority is among the members of that council as shown in Figure 1-38.

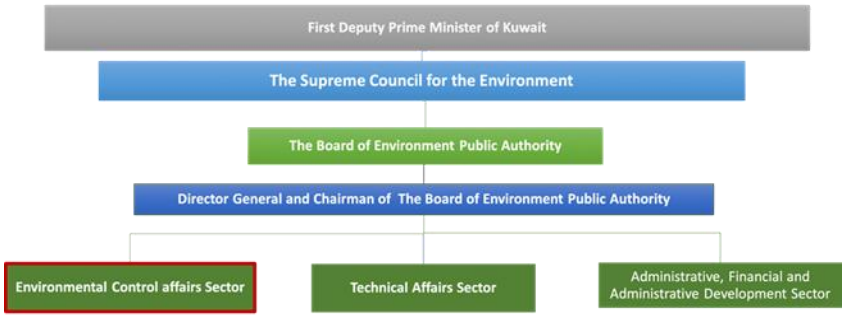

Figure 1-38 Structure of Environment Public Authority

The Kuwait Environment Public Authority (KEPA) is the national focal point for the United Nation Framework Convention of Climate Change (UNFCCC). The Climate Change Section is a unit of the Air Quality Monitoring Department and is the implementing entity of the UNFCCC in the State of Kuwait. The two major responsibilities of the Climate Change Section are as follows:

- Leading the negotiating team, which includes all the state stakeholders concerned with climate change; and
- Managing the reporting system such as Nationally Determined Contributions (NDCs), National Communications (NCs) & Biennial Update Reports (BURs).

The KEPA Director General presides over the Board of the Environment Public Authority, which organizationally has three sectors: The Administrative, Financial and Administrative Development Sector, Technical Affairs Sector, and Environmental Control Affairs Sector. The Climate Change Section is one of the sections under the Air Quality Monitoring Department. The graph below Figure 1-39 shows the institutional arrangement for the management of climate change issues in the Environment Public Authority.

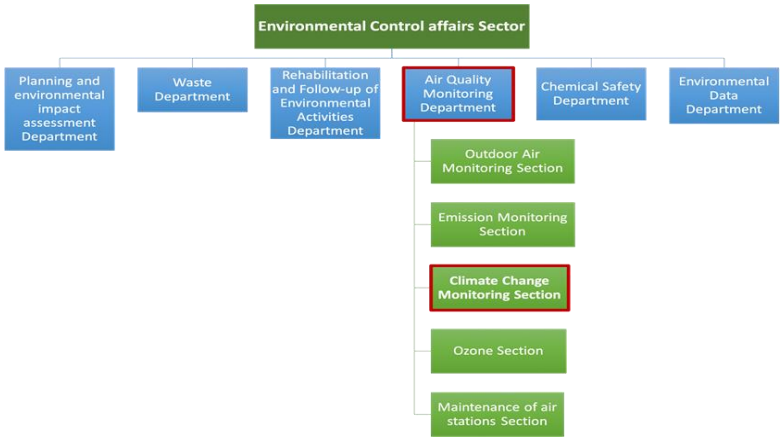

Figure 1-39 Structure of Environmental Control Affairs Sector

To facilitate climate change activities, the National Committee on Ozone and Climate Change (see figure 1-40) was established, chaired by the Environment Public Authority, with representatives from the General Secretariat of the Supreme Council for Planning and Development, Ministry of Oil, Kuwait Petroleum Corporation, Ministry of Electricity and Water, Ministry of Foreign Affairs, and General Directorate of Civil Aviation, as members.

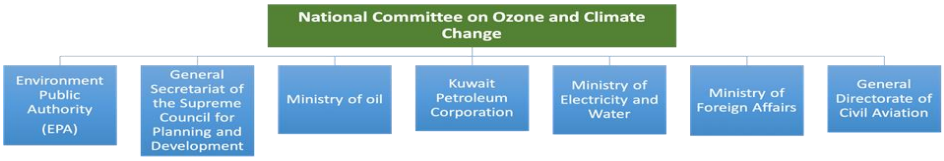

Figure 1-40 National Committee on Ozone and Climate Change

The National Committee on Ozone and Climate Change subsequently established the Climate Change Negotiation Group Committee to handle climate change negotiations as shown in figure (1-41)

Figure 1-41 Climate Change Negotiation Group Committee

2.3 National Institutional Arrangements Relevant to UNFCCC National Reporting

The preparation of Kuwait's UNFCCC national reports such as the national communications, biennial update reports, national greenhouse gas inventories, and other such reports is undertaken by a national team managed by the Climate Change Section in the Air Quality Monitoring Department of the Kuwait Environment Public Authority. The national team was selected primarily from relevant ministries and institutions and with the senior management of the Climate Change section from KEPA for coordinating the team, some of those experts were members of the negotiating team who are familiar with climate change issues and the Convention and its related legal instruments.

The knowledge developed during the preparation of Kuwait's Initial National Communication (INC) was utilized to build up the organizational and technical structure of the Second National Communication (SNC) and biennial updated reports (BUR). The capacity was built up by engaging and training key stakeholders, namely KEPA technical staff, public sector staff, and civil society stakeholders. Key organizations participating in the development of the SNC and the BUR are indicated throughout the Acknowledgements section.

A Project Steering Committee (PSC) oversees the overall coordination and implementation of the SNC, while the National Climate Change & Ozone Committee provides overall policy and cross-sectoral guidance. The KEPA executed project activities at the national level and appoints a National Project Coordination (NPC) team that works under the supervision of a National Project Director (NPD). A small project management support team is established at KEPA to facilitate implementation and reporting. Three Task Forces (TF) were established as follows:

- *National circumstances & other information Task Force (NTF). This task force develops SNC and BUR contents regarding national circumstances, technology needs assessments, research and systematic observation, and capacity building and institutional framework sector.*
- *National GHG Inventory (SNC & BUR) & mitigation Task Force (GTF).* This task force develops SNC and BUR contents regarding emissions associated with all sectors of the Kuwaiti economy (i.e., oil and gas, energy, transport, waste sector, industry, and agriculture sector. This task force also addresses domestic measurement, reporting and verification (MRV).

- *Climate Impacts, Vulnerability and Adaptation Task Force (CIVA TF)*. This task force develops SNC and BUR contents regarding vulnerability of sectors and systems in Kuwait, namely, water resources, public health, coastal zones, and marine ecosystems. This task force also focuses on climate, dust storms, and Arabian Gulf waters.

Memberships of the various TFs from government institutions and stakeholders were established based on the technical dictates and expertise requirements of the scopes of work. Each Task Force Head submitted a report to the NPC, which was followed up by a technical review process, with subsequent revisions as needed. Figure 1-42 illustrates the organizational structure of the project.

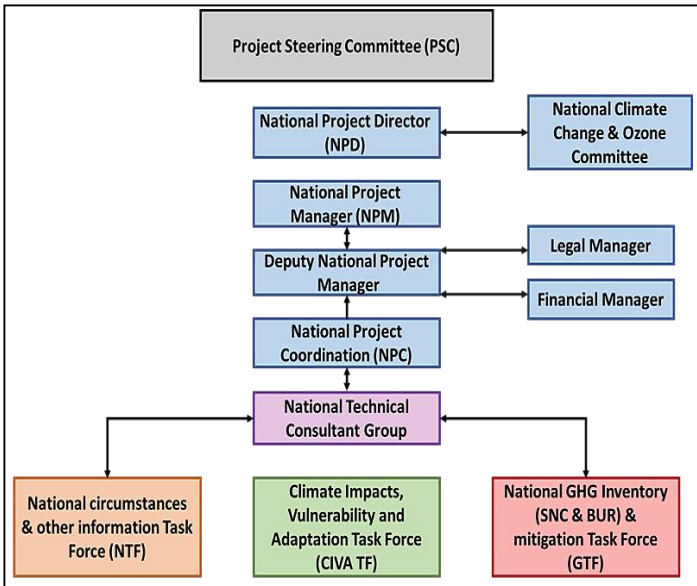

Figure 1-42: Organizations structure for the development of the SNC and BUR.

2. National Inventory Report

2.1 National GHG Inventory Overview

This section presents estimates of national anthropogenic greenhouse gas emissions and sinks for the year 2016. The inventory includes four categories: energy; industrial processes and product use (IPPU); agriculture, forestry and other land use (AFOLU); and waste. The results presented below are based on an inventory assessment prepared by Al-Sayegh et al., (2018).

Table 2-1 presents total GHG emissions and sinks for the year 2016. Total and net GHG emissions in 2016 were 86,336.448 Gg CO2-equivalent, which includes 82,556.572 Gg from energy; 1,932.156 Gg from industrial processes and product use; 154.371 Gg from agriculture, -13.190 from forestry and other land use and 1,706.539 Gg from waste. Emissions from perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulfur hexafluoride (SF6) in Kuwait are negligible as the products containing these gases are not produced in the country.

Table 2- 1: Total GHG emissions and sinks for the year 2016

	GHG Sources & Sinks	CO2-equiv	CO2	CH4	N2O
1	Energy	82556.572	81985.033	10.919	1.104
2	Industrial processes and product use	1932.156	1932.156	0.0	0.0
3	Agriculture	154.371	2.761	6.570	0.044
4	Forestry & other Land Use	-13.190	-13.190	0.0	0.0
5	Waste	1706.539	4.172	77.847	0.218
Total National Emissions		**86349.638**	**83924.122**	**95.336**	**1.366**
Net National Emissions		**86336.448**	**83910.932**	**95.336**	**1.366**

Energy-related activities accounted for the dominant portion of GHG emissions in Kuwait in 2016. Approximately 95.6% of all GHG emissions are associated with the combustion of fossil fuels for electricity production and transport, as well as the release of fugitive emissions from oil and gas operations. Emissions from waste management accounted for 2 % of all GHG emissions, followed by IPPU and AFOLU categories which accounted for about 2.2% and 0.16% of total emissions, respectively.

2.2 GHG Emission Trends

The trend in total GHG emissions for the previous 1994 and 2000 inventory and the GHG inventory for the year 2016, per sector. Over the 1994-2016 period, total emissions have increased by about 139%; from **36211** Gg CO2-equivalent in 1994, **48678** Gg CO2-equivalent in 2000, to 86,336 Gg CO2-equivalent in 2016, or roughly 4 %/year. By 2016, national emissions reached 86,336.448 Gg CO2-equivalent.

Over the 1994- 2000 period, CO2-equivalent emissions from energy use have increased by 35.5%, or about 5.19% per year, due primarily to increased energy use for electricity generation, desalinated water production, and process heat in manufacturing. Notably over the 1994-2000 period, CO2-equivalent emissions from AFOLU, though small in absolute terms, increased by 150 %, or about 16.5% per year.

For the period from 2000 to 2016, total GHG emissions increased by 77 %, or about 3.6 % per year. While energy related GHG emissions growth continues to represent the overwhelming majority of Kuwait's emissions, the growth rate slowed to 3.6% per year, or roughly two thirds the 1994-2000 rate. This trend holds true for AFOLU- and waste-related GHG emissions, which slowed to 2 % and 2.38 % per year, respectively, and are well below their 1994-2000 growth rates. On the other hand, IPPU-related emissions grew by 5 % per year.

Table 2-2: Aggregate GHG emissions and removals (year and gas, in CO2eq)

Year	*1994*	*2000*	*2016*	*Percentage change between 1994 and 2016*
Gas	**Gg CO2-eq**			
CO2	**35080.2246**	**47056.2092**	**83910.932**	**139.2%**
CH4	**46.8417**	**66.6204**	**95.336**	**103.53%**
N2O	**0.4753**	**0.7205**	**1.366**	**187.4%**
HFCs	**0.0**	**0.0**	**0.0**	**N/E**
PFCs	**0.0**	**0.0**	**0.0**	**N/E**
SF6	**0.0**	**0.0**	**0.0**	**N/E**
Total (Gg CO2-eq)	**36211.2433**	**48678.5926**	**86336.448**	**138.42%**

***GHG inventory for 1994 is estimated by using IPCC 2006 and may not match with INC 1994.**
****GWP for CH4 = 21**
*****GWP for N_2O = 310**

Table 2-3: GHG Emissions and removals by year and sector

Year	*1994*	*2000*	*2016*	*Percentage change between 1994 and 2016*
Sectors	**Gg CO2-eq**			
Energy	**34345.0576**	**46533.4226**	**82556.572**	**140.37%**
Industrial Processes and Product Use	**1022.3166**	**873.3267**	**1932.156**	**88.997%**
Agriculture, forestry and other land use	**40.512**	**101.2701**	**141.181**	**248.49%**
Waste	**803.3571**	**1170.5732**	**1706.539**	**112.426%**
Total	**36211.2433**	**48678.5926**	**86336.448**	**138.424%**

2.3 Emissions by Greenhouse Gas Type

The following bullets provide an overview of GHG emission totals by all GHG types for the year 2016.

- ***CO2:*** Net CO2 emissions were estimated to be 83910.932 Gg, or 97.2 % of Kuwait's total greenhouse emissions in the year 2016. Figure 2-1a summarizes the contribution associated with CO2 emissions at both the sector and activity levels.
- ***CH4:*** Methane had the second largest share of greenhouse gas emissions. Total CH4 emissions were estimated to be about 95.336 Gg which equals 2002 Gg of CO2-e, or about 2.3 % of Kuwait's total greenhouse emissions on a CO2-equivalent basis. Figure 2-1b summarizes the contribution associated with CH4 emissions at both the sector and activity levels.
- ***N2O:*** Nitrous oxide emissions were very small compared to other GHGs. Total N2O emissions were estimated to be only about 1.366 Gg which equals 423.46 Gg of CO2-e, or about 0.5 % of Kuwait's total greenhouse emissions on a CO2-equivalent basis. Figure 2-1c summarizes the contribution associated with N2O emissions at both the sector and activity levels.

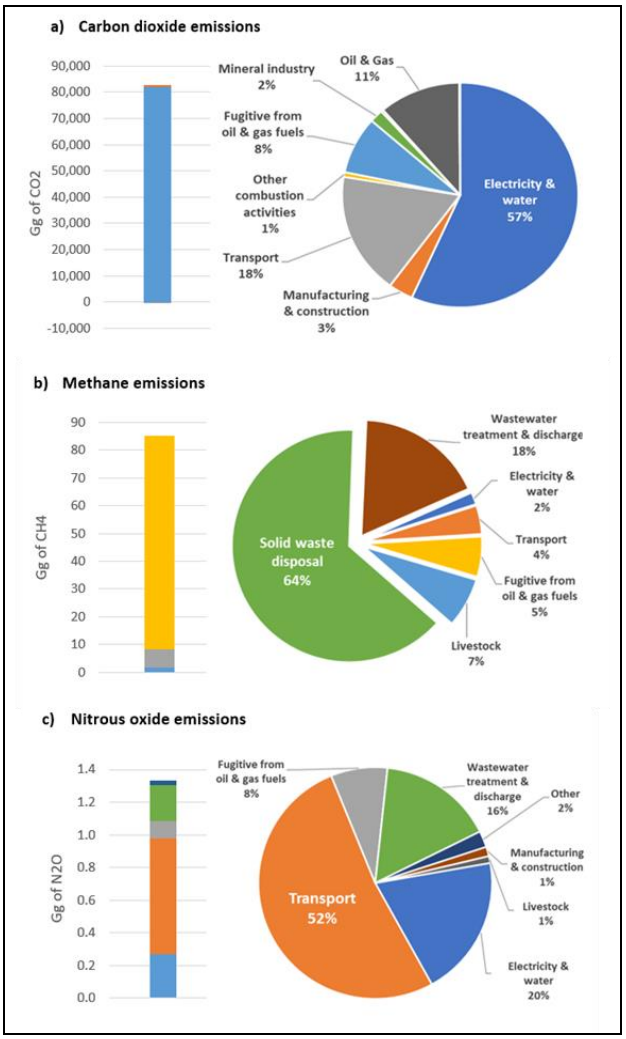

Figure 2-1: Breakdown in GHG missions, 2016 (Gg).

2.4 Sectoral Emissions Information

- Energy

The energy sector includes electricity generation, water desalination (Public Electricity & Heat Production), oil and gas stationary combustion activities, manufacturing industries and construction, other fossil fuel combustion activities, and fugitive emissions from oil & gas operations. Table 2-4 provides a breakdown in energy sector GHG emissions for the year 2016 for these source categories. Relative to overall anthropogenic GHG emissions in Kuwait, the 82556.572 Gg CO2-equivalent represents about 95.6 % of total national emissions.

TABLE 2-4: BREAKDOWN IN ENERGY SECTOR GHG EMISSIONS FOR THE YEAR 2016

GHG Sources & Sinks	CO2-equiv	CO2	CH4	N2O
Public Electricity & Heat Production	47665.808	47558.320	1.428	0.250
Oil & Gas (Stationary Combustion)	9405.310	9395.372	0.178	0.020
Manufacturing & construction	2856.533	2848.244	0.129	0.018
Transport	15000.757	14701.603	3.794	0.708
Other combustion activities	569.266	568.011	0.045	0.001
Fugitive emissions (oil & gas)	7058.898	6913.483	5.345	0.107
Total National Emissions	**82556.572**	**81985.033**	**10.919**	**1.104**

Figure 2-2 illustrates the breakdown in energy related GHG emissions in 2016 by activity. Emissions from electricity and desalinated water production are primarily associated with the combustion natural gas and oil products showed the highest share of GHG emissions about 58%. The contribution of upstream and downstream activities, in oil and gas industry, of the total GHG emissions is about 11 %. Transport activities are based overwhelmingly on the use of gasoline and diesel oil and accounted for about 18% of total emissions from energy-consuming activities. Fugitive emissions of methane, a gas that has a high global warming potential, accounted for about 9 % of all GHG emissions in the energy industries sector. Other combustion activities and manufacturing/construction accounted for the remaining 4%.

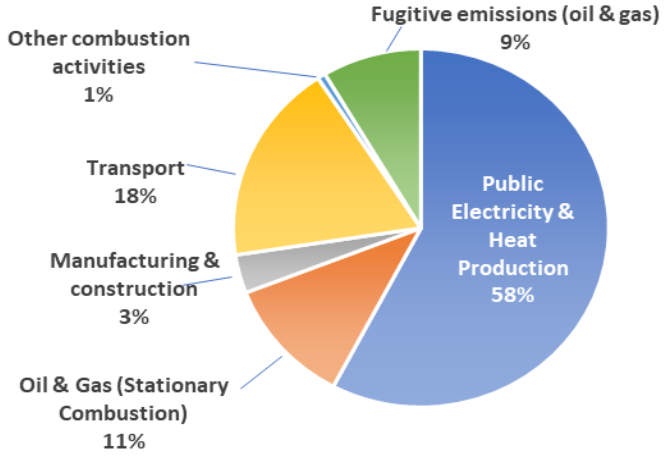

Figure 2-2: Breakdown of GHG Emissions Associated with Energy Activities, 2016.

- **Industrial Processes and Product Use**

Table 2-5 summarizes GHG emissions associated with industrial processes and product use in 2016. Industrial processes are the third largest emitter of anthropogenic GHG emissions in Kuwait, accounting for 1932.156 Gg of CO2– equivalent, or about 2.2 % of national CO2–equivalent emissions in 2016.

The mineral and chemical industries represent the sole source of emissions from industrial processes and product use. For the mineral industry, GHG emissions are associated with cement, lime and glass production and account for about 81% of total sectoral GHG emissions. For the chemical industry, emissions are solely associated with ammonia production. About the metal industry the main industries in State of Kuwait as a source of emissions are iron and steel production and ferroalloys production.

TABLE 2-5: GHG EMISSIONS ASSOCIATED WITH INDUSTRIAL PROCESSES AND PRODUCT USE IN 2016

GHG Sources & Sinks	CO2-equiv	CO2	CH4	N2O
Mineral industry	1561.889	1561.889	0.0	0.0
Chemical industry	262.743	262.743	0.0	0.0
Metal Industry	107.523	107.523	0.0	0.0
Total National Emissions	**1932.156**	**1932.156**	**0.0**	**0.0**

- **Agriculture, Forestry and Other Land Use**

Table 2-6 summarizes GHG emissions associated with agriculture, forestry, and other land use in 2016. Agricultural practices are the smallest source of anthropogenic GHG emissions in Kuwait, accounting for total national emissions and removals is only 141.181 Gg of CO2–equivalent, or about 0.16 % of net national CO2–equivalent emissions in 2016. Most of the emissions from AFOLU activities are associated with methane production from livestock. Kuwait's extensive managed green areas acted as a CO2 that resulted in a sequestration of 13.19 Gg CO2-equivalent.

TABLE 2- 6: GHG EMISSIONS ASSOCIATED WITH AGRICULTURE, FORESTRY, AND OTHER LAND USE IN 2016

GHG Sources	CO2-equiv	CO2	CH4	N2O
Livestock	142	0.0	6.570	0.013
Aggregate & non-CO2 sources on land	12.371	2.761	0.0	0.031
Total National Emissions	**154.371**	**2.761**	**6.570**	**0.044**

GHG Sinks	CO2-equiv	CO2	CH4	N2O
Land	-13.190	-13.190	0.0	0.0
Total Removal Emissions	-13.190	-13.190	0.0	0.0

GHG Sources & Sinks	CO2-equiv	CO2	CH4	N2O
Total National Emissions and Removals	141.181	-10.429	6.570	0.044

- **Waste**

Table 2-7 summarizes GHG emissions associated with waste management activity in 2016. Relative to overall anthropogenic GHG emissions, the 1706.539 Gg CO2-equivalent represented about 2 % of total national emissions. Waste-related GHG emissions are associated with solid waste disposal, incineration and wastewater treatment and discharge.

TABLE 2- 7: GHG EMISSIONS ASSOCIATED WITH WASTE MANAGEMENT IN 2016

GHG Sources & Sinks	CO2-equiv	CO2	CH4	N2O
Solid waste disposal	1281.819	0.0	61.039	0.0
Incineration & open burning of waste	4.172	4.172	0.0	0.0
Wastewater treatment & discharge	420.548	0.0	16.808	0.218
Total National Emissions	**1706.539**	**4.172**	**77.847**	**0.218**

Table 2-8. National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors (Decision 17/CP.8, Table 1)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total national emissions and removals	83910.932		95.336	1.366				
1. Energy	81985.033		10.919	1.104	NE	NE	NE	NE
A. Fuel combustion (sectoral approach)	75071.550		5.575	0.996	NE	NE	NE	NE
1.Energy industries	56953.692		1.606	0.269	NE	NE	NE	NE
2.Manufacturing industries and construction	2848.244		0.129	0.018	NE	NE	NE	NE
3.Transport	14701.604		3.795	0.708	NE	NE	NE	NE
4.Other sectors	568.011		0.045	0.001	NE	NE	NE	NE
5.Other (please specify)	0		0	0	NE	NE	NE	NE
B. Fugitive emissions from fuels	6913.483		5.345		NE	NE	NE	NE
1.Solid fuels			0		NE	NE	NE	NE
2.Oil and natural gas			5.345		NE	NE	NE	NE
2. Industrial processes	1932.156	NE	0	0	NE	NE	NE	NE
A. Mineral products	1561.889				NE	NE	NE	NE
B. Chemical industry	262.743		0	0	NE	NE	NE	NE
C. Metal production	107.523		0	0	NE	NE	NE	NE
D. Other production	0				NE	NE	NE	NE
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	0		0	0	NE	NE	NE	NE
3. Solvent and other product use	NE						NE	
4. Agriculture		NE	6.570	0.013	NE	NE	NE	NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
A. Enteric fermentation			**5.854**					
B. Manure management			**0.716**	**0.013**			**NE**	
C. Rice cultivation			**0**	**-----**			**NE**	
D. Agricultural soils			**NE**	**NE**			**NE**	
E. Prescribed burning of savannahs			**NE**	**NE**	**NE**	**NE**	**NE**	
F. Field burning of agricultural residues			**NE**	**NE**	**NE**	**NE**	**NE**	
G. Other (please specify)			**NE**	**NE**	**NE**	**NE**	**NE**	
5. Land-use change and forestry	**2.761**	**-13.190**	**0**	**0.031**	**NE**	**NE**	**NE**	**NE**
A. Changes in forest and other woody biomass stocks	**NE**	**-13.190**						
B. Forest and grassland conversion	**0**	**0**	**NE**	**NE**	**NE**	**NE**		
C. Abandonment of managed lands		**NE**						
D. CO2 emissions and removals from soil	**NE**	**NE**						
E. Aggregate sources and non-CO2 emissions sources on land	**2.761**	**0**	**0**	**0.031**	**NE**	**NE**		
6. Waste	**4.172**	**NE**	**77.847**	**0.218**	**NE**	**NE**	**NE**	**NE**
A. Solid waste disposal on land			**61.039**	**----**	**NE**		**NE**	
B. Waste-water handling			**16.808**	**0.218**	**NE**	**NE**	**NE**	
C. Waste incineration			**----**	**----**	**NE**	**NE**	**NE**	**NE**
D. Other (please specify)			**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
7. Other (please specify)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Memo items								
International bunkers	**3359.073**		**0.161**	**0.091**	**NE**	**NE**	**NE**	**NE**
Aviation	**1718.057**		**0.012**	**0.048**	**NE**	**NE**	**NE**	**NE**
Marine	**1641.016**		**0.149**	**0.042**	**NE**	**NE**	**NE**	**NE**
CO2 emissions from biomass	**NE**							

-Note: Numbers may not add up due to rounding by IPCC 2016 software.

Table 2-9: National greenhouse gas inventory of anthropogenic emissions of HFCs, PFCs and SF6 (Decision 17/CP.8, Table 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs[a,b](Gg)			PFCs[a,b](Gg)			SF_6[a](Gg)
	HFC-23	HFC-134	Other (to be added)	CF4	C2F6	Other (to be added)	
Total national emissions and removals	**N/E**	**N/E**		**N/E**	**N/E**		**N/E**
1. Energy							
A. Fuel combustion (sectoral approach)							
1.Energy industries							
2.Manufacturing industries and construction							
3.Transport							
4.Other sectors							
5.Other (please specify)							
B. Fugitive emissions from fuels							
1.Solid fuels							
2.Oil and natural gas							
2. Industrial processes	**N/E**	**N/E**		**N/E**	**N/E**		**N/E**
A. Mineral products							
B. Chemical industry							
C. Metal production	**N/E**	**N/E**		**N/E**	**N/E**		**N/E**
D. Other production							
E. Production of halocarbons and sulphur hexafluoride	**N/E**	**N/E**		**N/E**	**N/E**		**N/E**
F. Consumption of halocarbons and sulphur hexafluoride	**N/E**	**N/E**		**N/E**	**N/E**		**N/E**
G. Other (please specify)							
3. Solvent and other product use							
4. Agriculture							
A. Enteric fermentation							

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs[a,b](Gg)			PFCs[a,b](Gg)			SF_6[a](Gg)
	HFC-23	HFC-134	Other (to be added)	CF4	C2F6	Other (to be added)	
B. Manure management							
C. Rice cultivation							
D. Agricultural soils							
E. Prescribed burning of savannahs							
F. Field burning of agricultural residues							
G. Other (please specify)							
5. Land-use change and forestry							
A. Changes in forest and other woody biomass stocks							
B. Forest and grassland conversion							
C. Abandonment of managed lands							
D. CO2 emissions and removals from soil							
E. Other (please specify)							
6. Waste							
A. Solid waste disposal on land							
B. Waste-water handling							
C. Waste incineration							
D. Other (please specify)							
7. Other (please specify)							
Memo items							
International bunkers							
Aviation							
Marine							
CO2 emissions from biomass							

2.5 Other Information

- Methodology

The methodology used to develop the inventory is based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (Good Practice Guidance) prepared by the Intergovernmental Panel on Climate Change (IPCC). Reference and sectoral approaches were implemented to estimate GHG emissions in each emission category. Emissions up to the year 2016 were estimated using the inventory results for the year 2000 using IPCC's Inventory Software (Version 2.54). The Tier-1 approach of the IPCC guidelines was utilized in the calculations for all reporting categories, since State of Kuwait does not have national emission factors and does not have detailed data to calculate the inventory.
GHG emissions are reported both in absolute units of carbon dioxide, methane and nitrogen oxide emissions, as well as in units of CO2-equivalent by applying 100-year GWPs of 1 for CO2, 21 for CH4, and 310 for nitrogen oxide, as recommended by the IPCC in its Second Assessment Report. Unless as otherwise noted, default emission factors from the IPCC guidelines have been used.

- Uncertainty Assessment

Emissions/removals estimates are based on three key factors: methodology, modeling, and input data and assumptions. While each of these three contributes to uncertainty levels, they were kept to as low levels as possible. There is minimal uncertainty associated with the methodology as appropriate QA/QC procedures were undertaken and the IPCC Software was used as the main tool in the inventory. On the other hand, there is uncertainty associated with input data and assumptions (i.e. emission factors and activity data). Default emission factors provided in the 2006 IPCC Guideline were adopted, thus reflecting the uncertainty embedded in these estimates.

For Kuwait, CO2 represents about 97% of GHG emissions and are associated with the categories listed previously in table 2-2. Hence, most of any uncertainty in the inventory will be associated with these categories. Using the results from Table 7a – Uncertainties generated as part of the IPCC-2006 Software Report, all the combined uncertainty levels are below 10%. This suggests a high level of confidence in the inventory results.

- Quality Control

QC/QA Program was implemented in this inventory according to IPCC good practice guidance. Specifically, the 12 QC activities called for in Table 8.1 of the guidance document were followed without exception where applicable.

- Key Category Analysis

The analysis was performed using Approach 1 recommended in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.4 Ch.4. Key categories were identified using a pre-determined cumulative emissions threshold and were those that, when summed together in descending order of magnitude, add up to 95% of the total level. Given Kuwait's circumstances as a major oil producing and exporting country which leads to uniformity of emissions in Kuwait over the years (energy sector was always the leading sector in economy and therefore in GHG emissions), the analysis was limited to level assessment excluding trend assessment. Analysis was also limited to CO2 since the latter represents 97.2% of total GHG emissions. Table 2-10 summarizes the results of key category analysis.

Table 2- 10: Key category analysis results.

IPCC Category	GHG	2016 Emissions in 2016 (Gg)	Level assessment (%)	Cumulative Total of level assessment (%)
Public Electricity & Heat Production	CO_2	47558.320	56.6	-
Transport		14701.603	17.5	74.1
Oil & Gas (Stationary Combustion)		9395.372	11.2	85.3
Fugitive emissions (oil & gas)		6913.483	8.2	93.5
Manufacturing Industries and Construction		2848.244	3.4	96.9
Total National Emissions		81417.022	1	96.9

2.6 Challenges and Recommendations

The primary challenge to the development of the current GHG inventory is data-related, namely availability, accuracy, and consistency. These challenges are rooted in administrative and institutional barriers that impede the application of locally available technical capacity to collect, manage, and analyze pertinent data. Addressing these challenges should address the following:

- Establish and enforce a national statistical data system, which logs operational and production data and information, in governmental and private organizations.
- Establish strategic collaboration agreements between KEPA and public organizations to ensure a sustainable supply of related data.
- Given the above two points, a national emissions inventory system is to be developed with key sectors in the country.
- Hold periodic workshops for public organizations for training and educating critical authorities with the IPCC emissions inventory system.
- Call for and support the conduction of a national project to determine local emission factors related to the indigenous resources.
- Establish a GHG inventory committee with high-level representation from key ministries/institutions, having clear oversight and coordination authority.
- Develop an integrated database of relevant information including annual statistical abstracts and annual reports from specific entities.

2.7 Mitigation Actions and Their Effects

Kuwait is committed to efforts that harmonize economic growth with a low-carbon, climate-resilient development. Domestically, it has already undertaken several strategic projects to reduce its carbon footprint. Internationally, it has expressed through its Nationally Determined Contribution a commitment to explore future GHG emission reduction policies and measures in the energy sector (State of Kuwait, 2015).

Such actions will reflect practical ways to promote clean energy initiatives, introduce new low- carbon technologies, and develop long-term partnerships to exploit sustainable energy opportunities. Progress toward such actions is already underway, and when fully implemented, will eventually lead to substantive greenhouse gas mitigation in an increasingly carbon-constrained world.

The rest of this section is based on an analysis of potential GHG reductions in the energy sector by Alsayegh et al., (2018). The energy sector was selected as it represents the largest share of GHG emissions in Kuwait. The section concludes with a proposed set of strategic mitigation actions for achieving deeper GHG reductions in the future.

The goal of the GHG mitigation assessment was to establish annual and cumulative GHG emission reductions due to the implementation of several promising GHG mitigation options. The scope of the assessment focused on fugitive emissions from oil & gas operations and combustion-related emissions associated with electricity and desalinated water production. Together, these activities accounted for between 76% and 81% of emissions over the 1994-2016 period (see Figure 2-3).

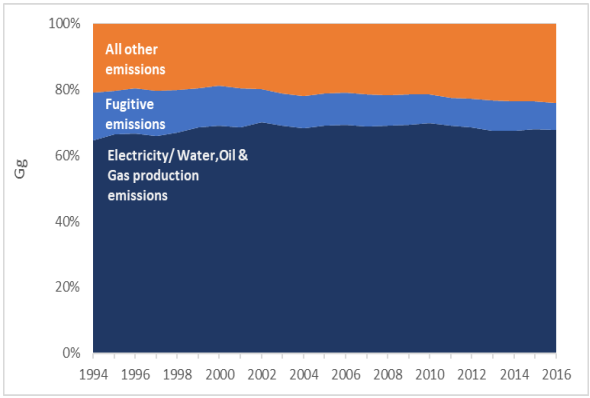

Figure 2-3: Share of oil & gas and electricity water production emissions, 1994-2016

While there are other GHG reduction opportunities in the next largest-emitting sector, transportation, which accounted for roughly 18% of emissions in 2016, a tactical decision during initial mitigation planning was made to look at the way that electricity is produced and at efficiency improvements in upstream oil & gas operations. (Refer to table 2-11: National Appropriate Mitigation Actions)

2.7.1 Baseline Scenario

Two emission scenarios were considered: A Baseline Scenario which assumed the continuation of historical trends in energy supply and demand, and a Mitigation Scenario which assumes the implementation of measures to reduce fugitive emissions, enhance supply side efficiency in electricity production and introduce renewable energy. Due to resource and time constraints, the assessment was limited to GHG reductions only (i.e., costs were not considered). The Baseline scenario incorporated activities that have taken place to date to reduce emissions. A 19-year planning horizon was considered, from 2016 through 2035.

Box 2–1: Regression model used to project Baseline Scenario emissions through 2035 The final form of the econometric model for year t is as described below. All regressions statistics confirm that the model adequately produces actual GHG emissions over the 1994-2016 period (e.g., R^2 over 0.96).

$$CO_2e_t = 6.3E+03 + 0.018178*(P)_t + 3.17E-08*(GDP)_t$$

Where:

CO_2e_t = national GHG emissions in year t

P = national population in year t

GDP = Gross domestic product in nominal US dollars in year t

A linear regression model was developed to project Baseline Scenario emissions to 2035. Population and GDP data over the 1994-2016 were used to establish trends between these variables and national CO2e emissions. The model was developed using simple regression and analysis of variance (ANOVA) techniques. Box 2-1 provides details of the final form of the model. Most of the data required to undertake the assessment was acquired from governmental sources. Average annual growth rates of 2.65%, 1.8%, and 2.0% were used for population, GDP, and inflation, respectively. Physical properties of fuels (e.g., GHG emission factors, energy densities) are based on IPCC default factors used in the development of the GHG inventory.

The Baseline Scenario incorporates emission reductions associated with several recent projects that have been implemented as part of the Clean Development Mechanism (CDM) to stimulate sustainable development and emission reduction targets under the Kyoto protocol. A brief overview of these projects is provided in the bullets below.

- Flare gas recovery at the Mina Al Ahmadi Refinery: This project aims to recover gases that are currently flared at one of the refineries operated by the Kuwait National Petroleum Company. The project involves the installation of a Flare Gas Recovery Unit (FGRU) to recover gases for subsequent commercial uses. Annual GHG emission reductions are about 54.4 Gg. The cost of this project is about 36,436,050 USD.
- Flare gas recovery at the Mina Abdullah Refinery: This project aims to recover gases that are currently flared at another of the refineries operated by the Kuwait National Petroleum Company. The project involves the installation of an FGRU to first cool and then compress the recovered gases. After the cooling and compression steps, the gases are treated in an amine absorber to remove hydrogen sulfide and then reused for thermal heat generation. Annual GHG emission reductions are about 89.5 Gg. The cost of this project is about 67,322,831 USD.
- Solar photovoltaics: This project introduces a 10 MW solar photovoltaic farm in western Kuwait partially meet electricity demand at 29 oil wells and related infrastructure in the region. The major electrical load at oil wells consists of electric submersible pumps which would otherwise be met by the central grid. Annual GHG emission reductions are about 13.7 Gg. The cost of this project is about 23,035,461.89 USD.
- Improved electric distribution efficiency: This project introduces capacitor bank technologies at various 11/0.433 KV substations to improve the power factor in the electric distribution system. Capacitor banks were implemented in 632 transformers around Kuwait City and showed substantial improvement in the average power factor, leading to a reduction in distribution losses. Annual GHG emission reductions are about 112.7 Gg. The cost of this project is about 21,620,426.37 USD.

Baseline scenario trajectories of GHG emissions, CO2e emissions per capita and CO2e emissions per $ of GDP are illustrated in Figure 2-4. The left side of the figure shows that GHG emissions are projected to grow from about 86,000 Gg in 2016 to over 142,000 Gg by 2035, an average annual increase of about 2.67% per year. The right side of the figure shows historical and projected trends for CO2e emissions as a function of population and GDP. Notably, per capita emissions showed sharp increases over the 1994-2002 period and declining per capita emissions over the 2002-2016 period, suggesting that energy efficiency and energy conservation measures have been effective in counteracting steady population growth. Additionally, while CO2e emissions as a function of GDP show inter-year volatility, there is a noticeable downward trend – from 3.6 in 1994 to about 1.0 in 2016 - suggesting that the economy is becoming more efficient from a carbon footprint perspective.

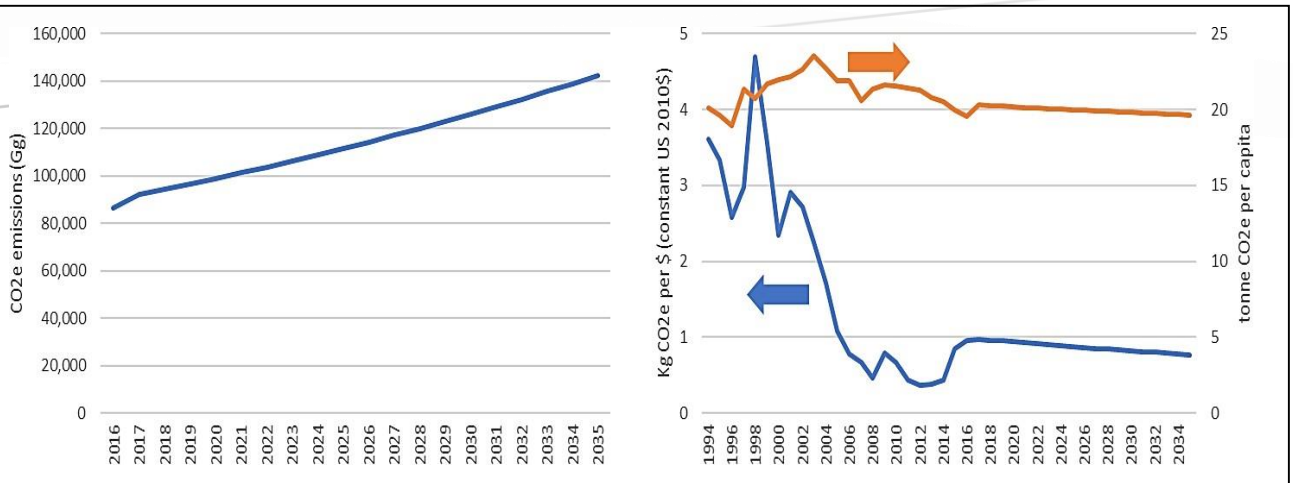

Figure 2-4: Left: Projected CO2e emissions in the Baseline Scenario; Right: Historical trends and projections for CO2e emissions per capita and per constant US$ of GDP

2.7.2 Mitigation Scenario

The GHG Mitigation Scenario incorporates emission reductions associated with several projects that have been proposed as expansions to the distribution efficiency and solar photovoltaic projects described above. A brief overview of these projects is provided in the bullets below.

- ***Expansion of improved electric distribution efficiency.*** This project expands the introduction of capacitor bank technologies at additional outdoor and indoor 11/0.433 KV substations to improve the power factor in the electric distribution system. Online years are 2019 and 2020 for outdoor and indoor substations, respectively. Annual GHG emission reductions are about 219.8 Gg for outdoor substations and 351.8 Gg for indoor substations, or total annual reductions of 571.6 Gg. The cost of the outdoor project is about 15,171,000 USD and the cost of the indoor project is about 13,084,000 USD. Therefore, the total project cost estimated to be 28,255,000 USD.
- ***Expansion of renewable-based electricity production.*** The Shagaya Renewable Energy Master Plan represents a 3-phase national vision to meet 15% of electricity requirements by renewable energy by 2030. The Plan incorporates solar thermal, solar photovoltaic and wind technologies. Phase I of the Plan introduces 50 MW of concentrated solar power, 10 MW of solar photovoltaics and 10 MW of wind in 2018 with a total installation cost for this phase is 581,151,807.81 USD. Phase II introduces an additional 1,500 MW of solar photovoltaics by 2022 with a total installation cost estimated to be 1,711,218,140.9 USD. Phase III of the Plan introduces an additional 200 MW of concentrated solar power, 1,200 MW of solar photovoltaics and 100 MW of wind by 2030 and its cost is yet to be determined. By its completion, the Plan will have introduced a total renewable energy capacity of 3,070 MW. Annual GHG emission reductions are about 5,000 Gg, equivalent to a displacement of 12.5 million barrels of oil equivalent.

The results of the GHG Mitigation scenario are illustrated in Figure 2-5. The left side of the figure shows projected CO2e emission reductions by measure. The right side of the figure shows the resulting annual GHG emissions in the Baseline and GHG Mitigation scenarios. By 2030, total annual emission reductions are about 5,600 Gg, representing a reduction of about 4% of Baseline scenario emissions in that year. Cumulatively, nearly 60,000 Gg of CO2e is avoided over the entire planning period by the measures.

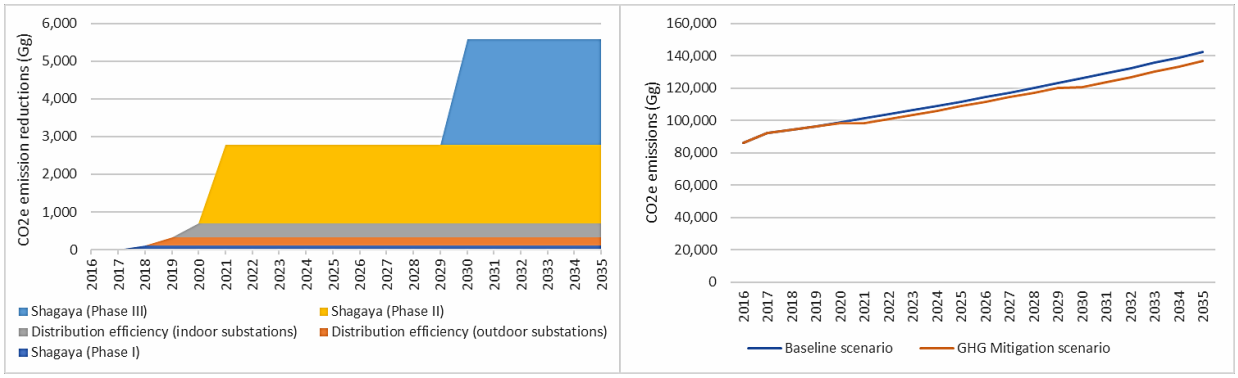

Figure 2-5: Left: Projected CO2e emission reductions in the GHG Mitigation Scenario; Right: Projected CO2e emissions in the Baseline and GHG Mitigation Scenarios

2.7.3 Future GHG Mitigation Opportunities

Going forward, there are several priority strategies that are being considered for achieving additional reductions, as outline in the bullets below.

- ***Power supply.*** **Supply side combustion efficiency can be increased by shifting from current technologies to combined cycle gas turbines and maximizing the use of reverse osmosis over multi-stage flash technology in seawater desalination. Moreover, emissions can be further decreased by fuel switching (i.e., replacing liquid fuels in existing thermal power plants with natural gas).**
- ***Transport.*** **There are several promising mitigation options for transport sector that are strategic for Kuwait. These include fuel efficiency improvements for vehicles, alternative clean fuel, transportation infrastructure improvement, as well as tariff and subsidy redistribution. The cost of the clean fuel project is 15,401,935,078.24 USD and the cost for the other improvement in this sector also expected to be high.**
- ***Industry.*** **The industrial sector in Kuwait covers chemicals, manufacturing fertilizers, cement industry, metallic products and food processing. Waste heat recovery from industrial processes is an important GHG reduction measure. Furthermore, adoption of more advanced plants, technologies, and processes are effective mitigation options leading to reduced electricity demand.**
- ***Waste.*** **Mitigation options in waste sector are based on the objectives of the National Development Plan in improving the efficiency of waste management by developing a safe waste management system for Solid, liquid and hazardous waste (Ensures the reduction of pollution levels resulting from traditional waste handling). Encourage the rehabilitation of landfill and gas utilization. Utilization of biogas from waste-water treatment. And, encourage waste recycling (Through providing all scientific consultations and provide incentives for investors to carry out recycling activities). Currently there are serval projects proposed in order to improve the efficiency of this sector with an estimate cost 1,280,202,046.28 USD.**

Therefore, Kuwait plans to build up its mitigation assessment capacities especially those related to human resources. Additionally, in order to improve the quality of future mitigation assessments, there is an urgent need to develop a national database for monitoring and reporting information related to GHG emissions and mitigation projects.

Table 2-11: National Appropriate Mitigation Actions

No.	Title	Description	Start Year	Coverage (i.e. sectors & gases)	Objectives	Result Achieved -Estimated Outcomes & Estimated Emission Reduction	Cost (US Dollar)	Use of International Market Mechanisms
1	Flare Gas Recovery at the Mina Al Ahmadi Refinery	The project involves the installation of a Flare Gas Recovery Unit (FGRU) to recover gases for subsequent commercial uses. This project registered as a CDM project.	2012	This project covers the energy sector, and the gases CH4, CO2, N2O, as well as NOx, NMVOCs, CO, and SO2	This project aims to recover gases that are currently flared at MAA refinery operated by KNPC. Avoiding burning such gasses will reduce the release of GHG emissions	Annual GHG emission reductions are about 54.4 Gg	$36,436,050	NO
2	Flare Gas Recovery at the Mina Abdullah Refinery	The project involves the installation of an FGRU to first cool and then compress the recovered gases. After the cooling and compression steps, the gases are treated in an amine absorber to remove hydrogen sulfide and then reused for thermal heat generation. This project registered as a CDM project.	2012	This project covers the energy sector, and the gases CH4, CO2, N2O, as well as NOx, NMVOCs, CO, and SO2	This project aims to recover gases that are currently flared at MAB refinery operated by KNPC. Avoiding burning such gasses will reduce the release of GHG emissions	Annual GHG emission reductions are about 89.5 Gg	$67,322,831	NO
3	Solar Photovoltaics	This project introduces a 10 MW solar photovoltaic farm in western Kuwait partially meet electricity demand at 29 oil wells and related infrastructure in the region. This project registered as a CDM project.	2015	The project covers the energy sector, and the gases CH4, CO2, N2O, as well as NOx, NMVOCs, CO, and SO2	TO lower the demand load on the central grid, leading to lower use of oil and gas for energy production and thereby leading to reduction on GHG emissions from the oil and gas sector for energy production	Annual GHG emission reductions are about 13.7 Gg	$23,035,461.89	NO
4	Improved Electric Distribution Efficiency	This project introduces capacitor bank technologies at various 11/0.433 KV implemented on 632 transformers substations to improve the power factor in the electric distribution system. This project registered as a CDM project.	2015	This project covers the energy sector, and the gases CH4, CO2,	Improved electric distribution efficiency lowers the cost of electricity leakage, thereby reducing demand on primary electricity	Annual GHG emission reductions are about 112.7 Gg	$21.620426.37	NO

No.	Title	Description	Start Year	Coverage (i.e. sectors & gases)	Objectives	Result Achieved -Estimated Outcomes & Estimated Emission Reduction	Cost (US Dollar)	Use of International Market Mechanisms
5	Expansion of Improved Electric Distribution Efficiency - Phase 2	This project introduces capacitor bank technologies at various 11/0.415 KV substations implemented on 376 transformers to improve the power factor in the electric distribution system. This project in process to registered as a CDM project.	2019	N2O, as well as NOx, NMVOCs, CO, and SO2	production and subsequently lowering demand on the use of oil and gas for electricity production and leading to reduction on GHG emissions	Annual GHG emission reductions are about 219.762 Gg	$15,171,000	NO
6	Expansion of Improved Electric Distribution Efficiency - Phase 3	This project introduces capacitor bank technologies at various 11/0.415 KV substations implemented on 610 to improve the power factor in the electric distribution system. This project in process to registered as a CDM project.	2020			Annual GHG emission reductions are about 351.791 Gg	$13,084,000	NO
7	Expansion of Renewable-based Electricity Production - The Shagaya Renewable Energy 3 phase Master Plan	Phase I of the Plan introduces 70 MW of RE capacity, (50 MW of concentrated solar power, 10 MW of solar photovoltaics and 10 MW of wind), supervised by KISR	2018	This project covers the energy sector, and the gases CH4, CO2, N2O, as well as NOx, NMVOCs, CO, and SO2	To meet 15% of electricity requirements by renewable energy by 2030. the Plan will have introduced a total renewable energy capacity of 3,070 MW. Annual displacement of 12.5 million barrels of oil equivalent and hence, reduce emissions	Annual GHG emission reductions are about 5000 Gg	$581,151,808	Not CDM project
		Phase II introduces an additional 1,500 MW of solar photovoltaics supervised and funded by KNPC	2022				$1,711,218,141	Not CDM project
		Phase III of the Plan introduces an additional 200 MW of concentrated solar power, 1,200 MW of solar photovoltaics and 100 MW of wind supervised by KAPP	2030				To be determined	

CHAPTER THREE

Vulnerability Assessments

This chapter presents an overview of key sectors that are highly vulnerable to climate change in State of Kuwait. A vulnerability Assessments was providing on the Second National Communication of the State of Kuwait as one of its components. This component aimed to improve assessments on climate change impacts on, and vulnerability of different socio-economic sectors and resources at national and decentralized level, ecosystems, natural resources as well as development of adaptation actions. The climates vulnerability assessment and adaptation where be assessed for priority sectors as follows:

- Climate Modelling.
- Water Resources.
- Sea Level Rise (SLR) & Costal Developments.
- Public health & Dust storms.

As results of that, all land areas of Kuwait will become warmer in the future, with the greatest change projected to occur during the winter months. Across the entire country, annual average temperatures show the greatest rise under RCP8.5, between 4.3° to 4.5°C by the 2071-2100 period (see Figure 3-1), compared to the historical average. Kuwait will also become drier in the future, with average annual rainfall in the western part of the country showing the greatest decrease under RCP8.5, roughly between 15% and 18% lower than the historical average. The Arabian Gulf water will also experience change. Historical monthly sea surface temperatures in the Arabian Gulf have steadily increased at a rate of 0.6 (±0.3) °C per decade, a trend three times greater than the concurrent global average.

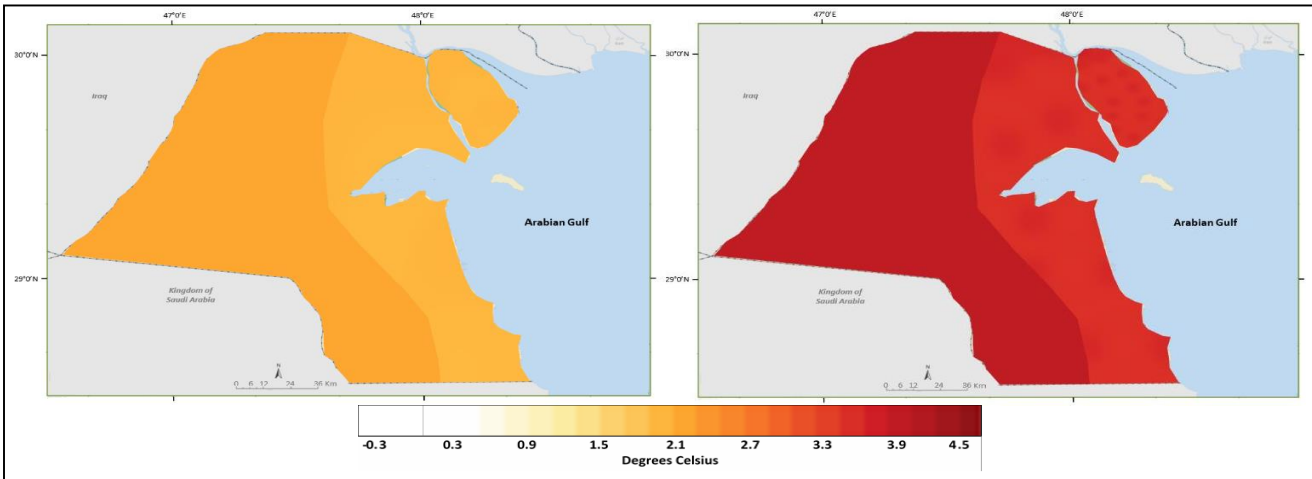

Figure 3-1: Annual average projected change in temperature under RCP4.5 (left) and RCP8.5 (right) for the 2071-2100 period **(Sources: CORDEX-MENA; ICBA)**

Many sectors are vulnerable to these climatic changes, with potentially grave environmental and social effects, compounded by the country's adaptation challenges. A summary of the key findings of the vulnerability assessments is contained in the bullets below.

- Water resources: Population growth, urbanization, industrial growth, and agricultural development are key drivers underlying Kuwait's high per capita water consumption. Coupled with a hyper-arid environment, low annual rainfall, no permanent lakes or rivers, and limited fresh groundwater resources, sustainable water resource management is a key national priority. A number of potential adaptation policies were analyzed (i.e., water tariffs, improved water efficiency, leak reduction, and improved irrigation efficiency) with each showing significant water savings and associated carbon dioxide emissions.

- Coastal zones: Rising sea levels pose threats of wetland flooding, aquifer and agricultural soil contamination, destructive erosion and lost habitat for fish, birds, and plants. Sea level rise also poses a threat to the built environment in the form of Arabian Gulf waters reaching further inland, particularly under high tide conditions and especially when combined with storm surge associated with extreme storm events. Boubyan Island would be highly impacted under by sea level rise, with roughly half the island inundated in the highest sea level rise scenario. Only the relatively higher land in the interior of the island would be visible by the end of this century. Coastal areas along Kuwait Bay are also projected to be adversely impacts by rising seas, especially the western coast near Doha Port and densely populated neighborhoods around Kuwait City.

- Public health: With climate change, increased heat stress from higher temperatures and increased cardiovascular and respiratory diseases associated with more frequent dust storms, represent looming health threats to the population. These additional risks could exacerbate current major health problems such as ischemic heart disease, stroke, road injury and lower respiratory infections, whilst potentially undermining Kuwait's social protection systems.

CHAPTER FOUR

Domestic measurement, reporting and verification (MRV) arrangements

4.1 Institutional Arrangement for MRV

The Environment Public Authority is the body responsible for the protection of the environment in the State of Kuwait in accordance with the law of its establishment (Law No. 21 of 1995 and amended by Law No. 16 of 1996), which was entrusted to the Department of Environmental Affairs in the State and works as a regulatory body on the state of the environment in general. In 2014, the Environmental Protection Act (Law No. 42 of 2014 and the amendments thereto) was promulgated under Law No. 99 of 2015 which provides the general regulatory and policy framework for environmental protection in the State of Kuwait.

The Environment Public Authority is the only official body in the state to measure emissions and the adoption of emission values from all major sources in the State of Kuwait.

As the national focal point for the United Nations Framework Convention on Climate Change (UNFCCC), the Environment Public Authority (EPA) established a special section deal with the United Nations Framework Convention on Climate Change (UNFCCC) in 2007. The most important mandate of this section is to meet Kuwait's commitments to the United Nations Framework Convention on Climate Change, and its main objectives are to establish an inventory of greenhouse gas emissions from all major sources and to follow up on the implementation of mitigation programs and projects and calculate the expected reduction rates of these projects.

Through the application of Article 116 of the Environmental Law Act 42 of 2014 and its amendments, which stipulate that "the Commission is committed to cooperating with the concerned authorities in the State to develop a national plan for environmental data management adopted by the Supreme Council. The Authority shall publish and make available data to the population in the State of Kuwait in a documented and transparent manner. The executive regulations of this law shall specify the types of data, the mechanism of its circulation and the responsibility of the entities thereof."

In addition, the Environment Public Authority has attached the most importance to environmental data management in the State of Kuwait. The law includes some legal articles that oblige all sectors of the State to inform the KEPA about the size of their emissions of pollutants of various kinds through direct electronic connection with KEPA for existing projects.

On the other hand, the General Authority for the Environment, through its powers assigned to it by the Environmental Protection Act, approves all projects to be established, whether developmental or industrial, to verify its strategic objectives, namely the preservation of the three elements of the environment, air, water and land, control of climate change and integration between water cleanliness and security, conservation of land resources and the achievement of human health and ecosystem conservation.

Therefore, paragraph 14 of Article 7 on the powers of the General Authority for the Environment under the Environmental Protection Act (Law No. 42 of 2014 and its amendments) provides for "the preparation of a system to assess the environmental returns of the various projects of the State and the development of guidelines and necessary procedures." Article 16 of the law stipulates that "all parties subject to the provisions of this law shall be prohibited from starting any project or introducing any amendments or expansions to existing activities or obtaining any licenses without conducting environmental impact assessment studies in accordance with the regulations of this law."

Environmental and social assessment is a procedural tool whose breadth, depth and type of analysis depends on the nature and scope of the proposed project and its potential environmental and social impacts. This process aims at assessing environmental and social outcomes and identifying the potential environmental and social risks of the project on its area of influence. It examines project alternatives and identifies ways to improve project selection, location, preparation, planning, design and implementation by avoiding, reducing, mitigating or compensating negative environmental and social impacts and enhancing positive impacts. Mitigation or management of negative environmental and social impacts throughout project implementation. Safeguards are always preferred to mitigation or compensatory measures if this is feasible and achieves feasibility.

Moreover, economic activities and projects in Kuwait are classified as follows for purposes of determining whether environmental and social impact studies are required (based on the Environmental and Social Impact Assessment System in the State of Kuwait):

- **Category A includes a list of projects that require preparation of a comprehensive study to assess environmental and social outcomes. Because of the size and intensity of their environmental impacts, projects in this category will have potential or obvious negative social or environmental impacts and are diverse, non-refundable or unpredictable.**
- **Category B includes a list of projects requiring the preparation of the Environmental and Social Assessment Report. Because of the magnitude and intensity of their environmental impacts, projects in this category will have potential negative social and environmental impacts that are limited, location-specific, highly recoverable and can be addressed through mitigation actions.**
- **Category C includes a list of activities and trades requiring the filling of the environmental assessment form. These activities and crafts within this category will have limited environmental impacts.**

Table 4–1: projects classified

Sector	A Projects that required comprehensive study to evaluate environmental and social effects	B Projects that required the report of environment and social evaluation	Sector	A Projects that required comprehensive study to evaluate environmental and social effects	B Projects that required the report of environment and social evaluation
Chemical Industrial Sector	**Facilities to produce Petrochemicals materials**		Irrigation and agriculture and animals' sector	**Agriculture areas and forestry projects**	Aquaculture farms
	Facilities to produce and treat fossil coal			**Protected areas(Wilderness &Sea areas)**	**Forestry farms**
	Manufacture and iterate and treat grease and mineral oils			**Big projects to breed animals**	**medium projects to breed animals**
	Factories to produce essential chemicals				Veterinary Hospital
	Manufacture iron steel				
	Manufacture glass and fiber glassy wool				
Oil& Gas Sector	**All sector activities**	**All sector activities**	Water resource projects sector	**All sector activities**	**All sector activities**

Sector	A Projects that required comprehensive study to evaluate environmental and social effects	B Projects that required the report of environment and social evaluation	Sector	A Projects that required comprehensive study to evaluate environmental and social effects	B Projects that required the report of environment and social evaluation
Engineering Projects and construction sector	**Manufacture cement, gypsum and ceramics**	**Manufactures to produce Brick**	Urban Development Sector	**Structural chart to enhance Regional and civil areas**	**Build and expand residential areas**
	Facilities to produce Reinforcing steel	**Asphalt Production Plant**		**Specify industrial areas**	**Build hospitals with medium size**
		Fuel Station		**Build residential areas**	Temporary residence for the labors
				expand residential areas	Stations/small modules to Sewage treatment
				Build hospitals	
Energy Sector	**All sector activities**	**All sector activities**	Waste sector		**All sector activities**
Infrastructure big projects sector	**All sector activities**	Project of Irrigation by groundwater	Alimental and agriculture industries sector		Melting animals and plants oil
			Infrastructure medium projects sector		**All sector activities**

4.2 Current Domestic MRV Framework

Greenhouse gas emissions-related data are requested by official letters from EPA to different entities and then collected on excel sheets either as a hard copy or by emails. The Climate Change Section then distributes the collected data to the GHG task force for evaluation and uploading into the IPCC 2006 Software. A review committee was established by expert members from Kuwait University, Kuwait Institutional Scientific and Research (KISR) and Kuwait Foundation for the Advancement of Sciences (KFAS) in order to ensure that all requirements are fulfilled and to approve the output results. A higher National Committee for Ozone and Climate Change presided by the General Director of KEPA, with members that are the assistant undersecretaries from various stakeholders will give the final approval for the results to be published, as shown in Figure 4-1 below.

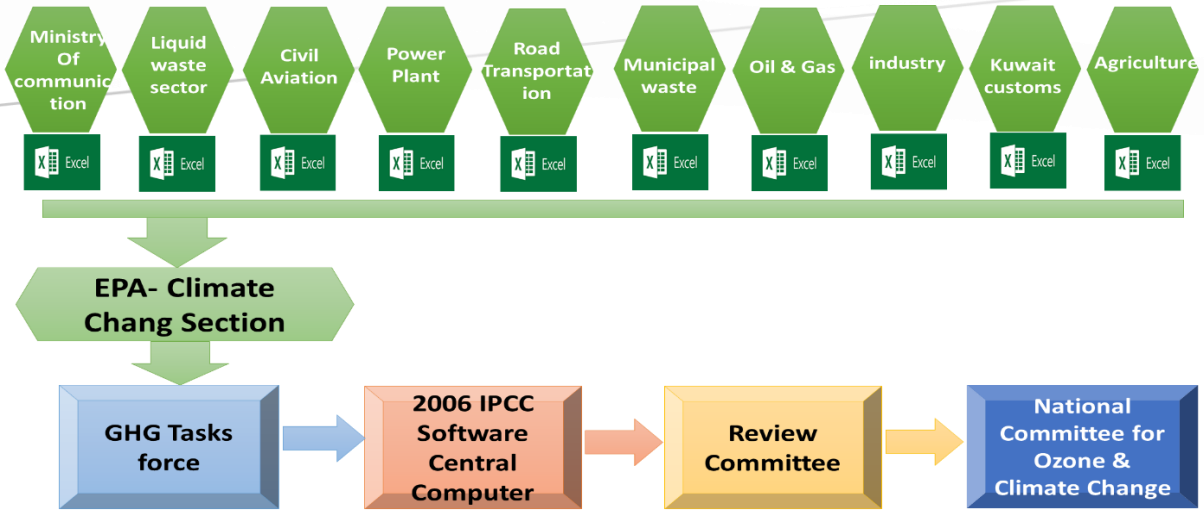

Figure 4-1: Current Kuwait Domestic MRV Framework

4.3 Domestic MRV Framework from 2020

The State of Kuwait has established a Greenhouse Gases Data base as one of the main outcomes of its Second National Communication project. This National Inventory System was developed by Dubai Carbon for the State of Kuwait. The system applies IPCC 2006 guidelines in estimating GHGs for the state of Kuwait to conform with the UNFCCC reporting requirements. This system is currently installed at KEPA and in the future it will be connected to ministries, authorities and entities in the country so that the data is received periodically.

Beginning in 2020, it is envisioned that an electronic online-based emissions measurement and reporting system will be operational. This system will allow agencies covering different economic sectors from which emissions come to input emissions data into the eMISK system for integration into the National Inventory System (NIS) that is run by the KEPA Climate Change Section. This will facilitate and make it easier for national GHG inventories to be generated as shown in Figure 4-2 below.

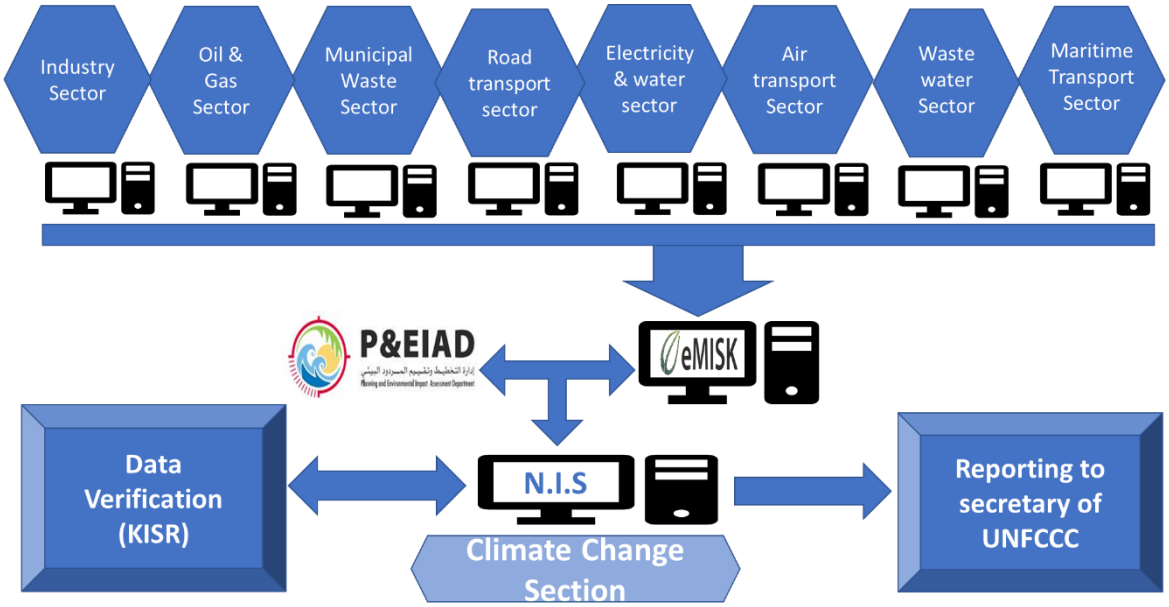

Figure 4-2: National Inventory System

The system will be operational starting in 2020 after ensuring the safe transfer of data from the main sectors to EPA, and matching emission inventory values in the national system with the issuance of the Intergovernmental Panel on Climate Change (IPCC-2006).

I. Measurement

Under the law, future projects are required to periodically report the measurement of various emissions affecting the environment, including greenhouse gases, as a requirement for the preparation of national communications and annual reports. Therefore, a national GHG inventory system has been developed from the main emissions data sources of the country.

The EPA will inventory the emissions from the industrial activities of the private and public sectors represented in category A with significant environmental impact and category B with the average environmental impact. The basic data shall include the types and quantities of fuel used for calculating rates of CO2 emitted.

II. Reporting

The Climate Change section at the Environment Public Authority will be responsible for compiling data from various sectors of the State through the National Greenhouse Gas Inventories (NIS) system, preparing annual inventories for the National Communications Service and annual reports as a requirement for the implementation of the State's obligations to the UNFCCC.

III. Verification

Following the adoption of the National Greenhouse Gas Inventories (NIS) system, the EPA will establish a partnership from one of the accredited research institutions such as Kuwait University, Kuwait Institute for Scientific Research, in the country to act as a third party to validate the data and its accuracy and comply with the requirements of the UNFCCC Secretariat and the Intergovernmental Panel on Climate Change (IPCC), and the verification structure will be at three levels as shown in Figure 4-3 below.

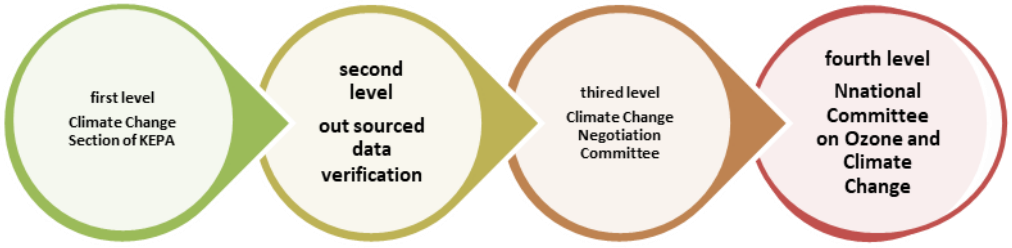

Figure 4-3: verification structure

5.1 Impact of Response Measures & UNFCCC Perspective:

Parties of UNFCCC shall take into full consideration, in the implementation of the commitments of the Convention, the specific needs and concerns of developing country Parties arising from the impact of the implementation of response measures.

When addressing climate change concerns, the Convention and its related legal instruments (Kyoto Protocol and Paris Agreement) commit Parties to strive to minimize adverse economic, social and environmental impacts on other Parties, especially developing country Parties, and in particular those identified in Articles 4 paragraph 8 part (h), paragraph 9 and paragraph 10 of the Convention, taking into account Article 3 of the Convention (UNFCCC, 1992). Article 4.8 of the Convention and Articles 2.3 and 3.14 of the Kyoto Protocol (UNFCCC, 1998) provide a basis for addressing the impact of the implementation of response measures.

5.1.1 Economic and Social Consequences of Response Measures

Risks & Vulnerabilities of Impacts of Response Measures:

Climate change response measures instituted to minimize emissions of greenhouse gases often exert profound adverse effect on sustainable development plans and programs of many developing countries. These effects are particularly severe on those countries whose economies are heavily dependent on a single sector such as hydrocarbons or tourism.

Many developing countries affected by the sectors which might be subject to significant vulnerability due to impacts of response measures (UNFCCC, 2014). The State of Kuwait is one of the developing countries that are adversely affected by response measures in areas with regards to:

- Conventional fuels (oil &gas);
- Renewable energy technologies;
- Consumer goods subject to eco-labelling and standards;
- Energy-intensive trade-exposed goods;
- Air-freighted goods;
- Tourism;
- Marine-transported goods;
- Agriculture.

Also, there are several international agreements and organizations whose decisions or norms would be influential on the impact of response measure on the State of Kuwait such as:

- World Trade Organization (WTO).
- International Originations for Standardizations (ISO).
- International Civil Aviation Organization (ICAO).
- International Maritime Organization (IMO).

Among the main challenges faced by the State of Kuwait as a result of climate change which affect the responses taken by the State to measure and address them are the geographical location of the State of Kuwait and its exposure to high temperatures, the lack of freshwater resources and the frequency of sand storms.

Therefore, some actions must be taken by the country to avoid any adverse effects of the imposition of response measures. Such actions should be related to several variables when addressing the significant adverse impacts that such response measures may have on the economic, social and environmental conditions of the State of Kuwait. These adverse impacts require that a comprehensive and structured assessment framework must be established by the State of Kuwait in order to ensure that all actions, taken to address such adverse impacts, are appropriate to national circumstances and are consistent with Kuwait's long-term sustainable development objectives and plans.

Modeling Approach of Response Measures:

Each country would have their own evaluation system for the adverse effects of climate change and the impact of response measures on their countries, with each developing country working on enhancing the modeling activities and data sets for assessing the impact of implemented response measures on their national circumstances. To do so, these countries need to be provided with support such as financial support, technology need assessments and national capacity building.

5.2 Response Measures with Economic and Social Consequences on Kuwait

-Carbon Taxes

Kuwait economy relies heavily on its oil exports, which represent virtually the only source of government income, and contribute to more than half of the country's GDP. Since the linkages between climate change and greenhouse gas emissions was established in the 1980s, crude oil and its derivatives, as key sources of emissions have come under tough pressure from the environmental policies and procedures in many developed countries. The idea of carbon taxes has been embraced by these countries. Such taxes would eventually reduce oil consumption and encourage the use of clean renewable resources, a trend that would ultimately reduce the income of oil-exporting countries, including Kuwait.

-New Sources of Energy

Additionally, the world has witnessed a shift in the nature and pattern of its dependence on oil products since the unprecedented rise in oil prices in the first half of the 1970s, where it becomes less dependent on oil in power generation which has shifted toward the use of alternative fuel such as nuclear, natural gas and renewable sources. With this shift, most of the world oil consumption goes now to the transport sector. However, this sector is also threatened by the shift from the use of oil-based fuels to other substitutes, especially with the recent development of hybrid and electric cars. Many advanced countries support the spread of such alternative means of transport which would eventually leads to lower demand on oil.

5.2.1 Kuwait National Actions to Address Economic and Social Consequences of Response Measures

Investment in Clean Fuels

In response to tightening environmental standards on oil products by developed countries, Kuwait has been quick to invest in the production of environmentally friendly oil products through the largest project in Kuwait's history - the Clean Fuel Project (15.5 billion U.S. dollar) which includes the modernization of Mina Al-Ahmadi and Mina Abdullah refineries. Kuwait also retired its Shuaiba refinery and decided to replace it with Al-Zour refinery, which is specialized in producing fuel that is compatible with emerging environmental standards in developed countries.

Investment in Other Clean Products

Kuwait has also committed itself to upgrade its petrochemical products by updating the specifications of these products in order to ensure that they meet the newly required specifications in advanced markets. Likewise, the Ministry of Commerce and Industry has committed the local manufacturing sectors to comply with the new international standards in the production of their products.

Natural Gas Energy Production and Consumption

In order to reduce harmful emissions caused by the fuel mix in electricity production in Kuwait, the Ministry of Electricity and Water has shifted most of its power generation plants from the use of oil to natural gas. Kuwait has also launched several programs to use renewable energy sources, especially solar energy. Through intensive media campaigns, Kuwait is encouraging consumers to rationalize consumption of electricity, water and fuel. Besides, since 2016, the country has moved towards changing the energy pricing structure.

Investment in Indoor Activities

Climate change forces countries with harsh weather, such as Kuwait, to invest heavily in sheltered buildings for indoor activities. Examples of such buildings include covered sport areas, gymnasium halls, schools, public facilities and markets. In addition to the high construction costs, these buildings also require high operating costs, efficient air-conditioning systems and greater consumption of electricity and fuel.

Work Disruption and Delay

Rising temperatures, in the relatively long summer period of Kuwait, that approach or exceed 50 degrees Celsius in many days of July and August, lead to a stop of outdoor activities and works. Such disruption of work increases the cost of production and delays the completion of projects.

New Development Projects

In compliance with world efforts towards lower greenhouse gas emissions, Kuwait has been adhering to environmentally friendly standards in its various new development projects, such as Sheikh Jaber Causeway project, the new urbanization projects, the new power plants project, etc.

5.3 Economic Diversification from the Point of View of the State of Kuwait

The vision of His Highness Sheikh Sabah Al-Ahmad Al-Jaber Al-Sabah, Emir of The State of Kuwait is to "rebuild Kuwait as a modern financial and trade Centre. The aim of this strategy is to diversify our economy as we can no longer be dependent solely on oil for our revenues. We need to utilize the creative energy of our young people. We have to immunize them from the stray thoughts and the deviant behavior and work on their adherence to our religion", http://www.newkuwait.gov.kw/.

The State of Kuwait is working on maintaining public life and continuing all services and developing facilities in all aspects based on 2035 vision "New Kuwait". Applying the vision, at the present time, in the investment and industrial sectors, is facing many obstacles. Kuwait is the most oil-dependent economy country in the Middle East. It has a single source of national income which is oil production. Oil revenues account for about 95% of the country's total income. The high oil-dependent revenue in the Kuwaiti economy is subject to fluctuation according to world oil prices, showing a decline as oil prices fall.

Depending on the governmental sector in investment and industry is essential given that the private sector contributes not more than 10% of the economy. Furthermore, Kuwait has strict laws and rules governing foreign investment in the country that can discourage foreign investors from investing in Kuwait. In addition, it impedes the economically competitive spirit in Kuwait compared to neighboring countries and it would reduce the opportunity for the country to be a commercial and economical center.

Establishing economic diversification in Kuwait needs professional development in Kuwait's human resources sector. The country suffers from a shortfall of professional human resources. To start building human resource capacity, the country needs to invest in the infrastructure of its education, research and technology development sectors.

The lack of suitable lands and natural resources to be utilized for heavy industries that has a direct influence on the economics of the country limits economic diversification opportunities as well.

As a conclusion, in order to achieve the vision of His Highness and achieve economic diversification, strong levels of domestic investment and financing in the country's human resources to develop skills and expertise are necessary.

CHAPTER SIX

6.1 Constraints, gaps, and needs to be addressed in relation to the undertaking of climate change-related actions

Inadequate capacity (technical, financial and institutional) remains one of Kuwait's significant challenges as it confronts climate change. Enhancing capacity will depend on overcoming serious institutional, financial and technical constraints and gaps that currently interfere with affective action. With adequate support, Kuwait can build climate change resilience and explore the viability of low-emission development trajectories. The subsections below outline the key constraints, gaps, and needs to facilitate compliance with UNFCCC obligations and aspirational adaptation goals.

- Constraints

Several technical, institutional, legislative, and financial constraints across various levels have been identified hindering implementation of climate change adaptation and mitigation activities in Kuwait. The following bullets are examples of such constraints:

- Lack of accurate data bases, and inadequate information and data collection, analysis and dissemination;
- Weak cooperation arrangements between agencies for providing GHG inventory data, resulting in difficulties in timely data collection; and
- Lack of familiarity with current methods and tools for undertaking a quantification of climate change impacts in vulnerable sectors.

- Gaps

The following outlines the key capacity gaps relative to understanding climate change impacts in Kuwait, as well as policies and measures associated with GHG mitigation:

- Lack of access to long-term climate information and associated uncertainties for use in conducting vulnerability and adaptation assessments;
- Inadequate institutional and technical capacity to plan and implement climate change adaptation measures; and
- Limited funding for climate change related research focused on Kuwait and surrounding region.

- Needs

Several capacity development needs were identified during the process of preparing the SNC which are also applicable to the preparation of the BUR. The following are among the key needs:

- Build public, and policy-maker awareness on climate change;
- Strengthen institutional and technical capacities through information and knowledge management;

- Enhance coordination among stakeholders at different levels, especially as it pertains to database development for future GHG inventories;
- Better integrate climate change considerations into national and sectoral development planning and policy dialogues; and
- Promote involvement of local media in building awareness regarding climate change impacts and risks.

Additionally, strengthening future capacity of stakeholders to promote and support GHG inventory development, climate change vulnerability assessment, identification of adaptation strategies, GHG mitigation analysis, and technology needs assessment is needed.

Key recommendations regarding the needs in relation to the development of national GHG inventories are summarized in the bullets below.

- Establish a national system to collect and manage activity and emission data required for updates to the inventory;
- Establish an ongoing GHG inventory committee with high-level representation from key ministries/institutions, having clear oversight and coordination authority; and
- Develop an integrated database of relevant information including annual statistical abstracts and annual reports from specific entities.

Key recommendations regarding the needs with respect to the analysis of national GHG mitigation opportunities are summarized in the bullets below

- Obtain training in methods and tools to analyze in detail the costs, benefits, and co-benefits of GHG mitigation policies and measures, starting with those included in Kuwait's nationally determined contributions;
- Build a cost and performance database regarding energy supply and energy demand management technologies and practices; and
- Develop a centralized database for monitoring and reporting information related to GHG emissions and mitigation projects.

Key recommendations regarding the needs with respect to the assessment of vulnerability of key sectors and systems, together with the formulation of adaptation strategies are summarized in the bullets below.

- Obtain training in modeling approaches to assess the impacts of a) rising season coastal zones, b) water efficiency/conservation policies on water demand, c) changing salinity/temperature on commercial fisheries, and d) emissions co-benefits of renewable energy investments on public health;
- Obtain training on how to establish a national framework that links the results of vulnerability assessments to ongoing policy dialogues regarding adaptation options and strategies; and
- Conduct seminars and training workshops to build awareness among managers and decision makers of the consequences of climate change and the need to incorporate adaptation considerations in utility, urban, and resource planning

6.2 Support received for the implementation of climate change-related actions and for the preparation of the BUR

The state of Kuwait received financial support from Global Environment Facility (GEF) for preparing and communicating the reports such as Initial National Communication of the State of Kuwait, Second National Communication of the State of Kuwait and the biennial updated report. The technical support for these reports was provided by the Regional Office for West Asia of the United Nations Environment Programme (UNEP-ROWA). Some technical assistance has been used by UN programmes to improve and build capacity. The State of Kuwait does not receive any financial support to implement any projects related to mitigation actions or adaptation projects, or any technical support from the financial funds under the Convention. Financing of mitigation and adaptation projects undertaken by the State of Kuwait on a voluntary basis from the State's own budget.

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