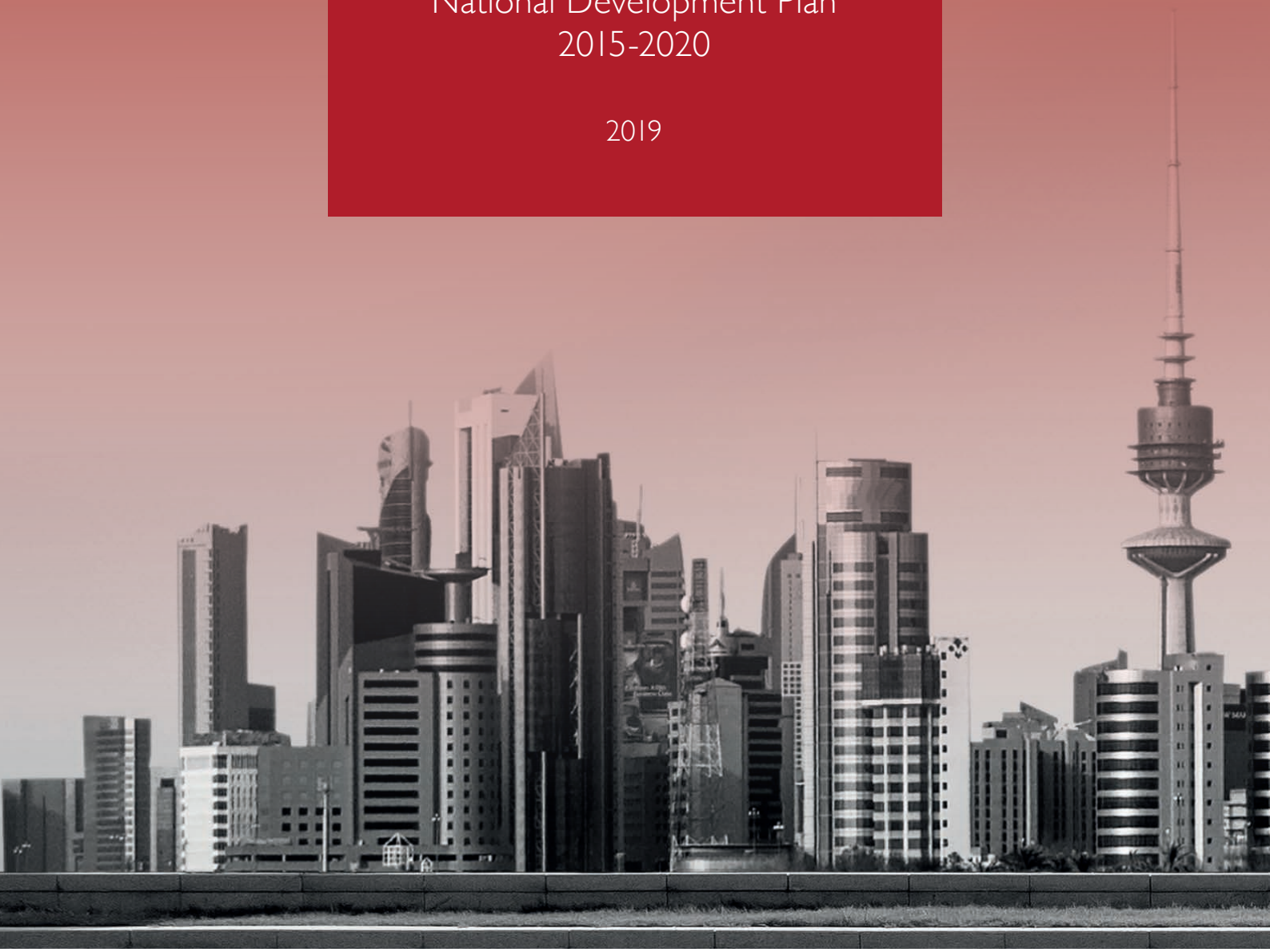
Policy Paper - 04

Policy Paper for the Environment Pillar

Overview of Gaps, Challenges, and Way Forward in Kuwait National Development Plan 2015-2020

2019



مركز الكويت للسياسات العامة
Kuwait Public Policy Center

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Authored by Mohamad Alatoom for KPPC.

Contact Details:
Kuwait Public Policy Center
kppc@scpd.gov.kw
Tel: 22452359
The Kuwait Public Policy Center
General Secretariat of the Supreme Council for Planning and Development
State of Kuwait

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I. Introduction

Background

The United Nations Development Programme (UNDP) and the State of Kuwait, represented by the General Secretariat of the Supreme Council of Planning and Development (GSSCPD), strive to enhance institutional capacities at various government agencies by providing them with the necessary technical support to strengthen their capacities and skills to perform their expected duties.

Under the framework of the institutional and technical support for the establishment of the Kuwait Public Policy Centre (KPPC) project, UNDP collaborates closely with GSSCPD to support the establishment of a pioneer KPPC to address policy making gaps and mainstream policy research, analysis and studies in the policy making process.

The KPPC seeks to be a reliable resource that will influence national policies and strategies. The project builds on UNDP's mandate and strategic vision and aims to promote efficient governance and institutional management. This project will provide a framework of how UNDP will accompany the GSSCPD in its ambition to improve the quality of policy making in Kuwait and, in particular, on how the KPPC can contribute to that while operating under the umbrella of GSSCPD.

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 and projects that are designed to have the most impact on achieving the vision of a New Kuwait.

Twenty key global indicators, and additional sub-indicators, will track and measure Kuwait's progress with the plan and its performance compared with other countries. Global indicator rank is out of a percentile of 100, 1 being at top of the rankings and 100 being at the bottom. Kuwait is aiming, in all indicators, for a position within the top 35% of countries by 2035.

State of the environment in Kuwait

Kuwait's natural resources and environmental quality in a number of areas have been affected by rapid economic expansion, development and urbanization during the past two decades. Issues of concern include: pollution and health hazards; inadequate handling and treatment of urban and industrial waste and sewage; air pollution in Kuwait city and its industrial states; marine pollution, especially in the vicinity of harbors; large scale coastal erosion based on reclamation activities in the coast that have destroyed valuable local marine ecosystems; and open sea marine pollution that affects coastal and marine habitats and biodiversity.

Urban environmental quality is a growing concern. In less than 20 years, the State of Kuwait has become an urban society; the water supply and wastewater services in its urban centers rival those found in many developed countries. The high rate of urban population in the country has particularly accentuated the demands and stresses upon the urban infrastructure.

It is interesting to note that Kuwait's ranking in the Environment Performance Index of 2018 has gained 52 points, and it is classified as ranking 61 out of the 180 countries. As shown in Figure 2 Kuwait has the second-highest score among the Gulf countries after Qatar, and the fourth-highest among the Arab countries. In terms of specific scores, Kuwait ranked 21st among the countries on water resources (score 21) and water quality (score 21). However, with respect to air quality and pollution, Kuwait's rankings are pretty low. On exposure to particulate matter of 2.5 microns or less (PM2.5), the size at which health risks increase, the country's score is 153 and its exceedance score is 150. For climate and energy, Kuwait's score is 161 and its air pollution score is 162.

The 2018 Environmental Performance Index (EPI) ranks 180 countries on 24 performance indicators across ten issue categories covering environmental health and ecosystem vitality. These metrics provide a gauge at a national scale of how close countries are to established environmental policy goals.

https://epi.envirocenter.yale.edu/

FIGURE 1

Kuwait EPI scorecards of 2018

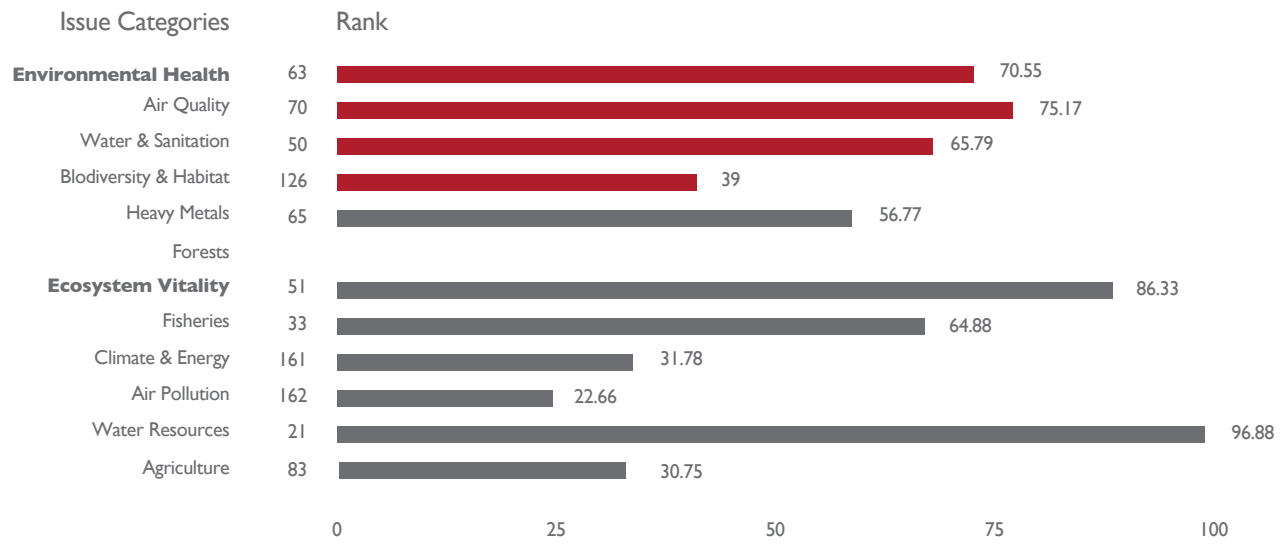
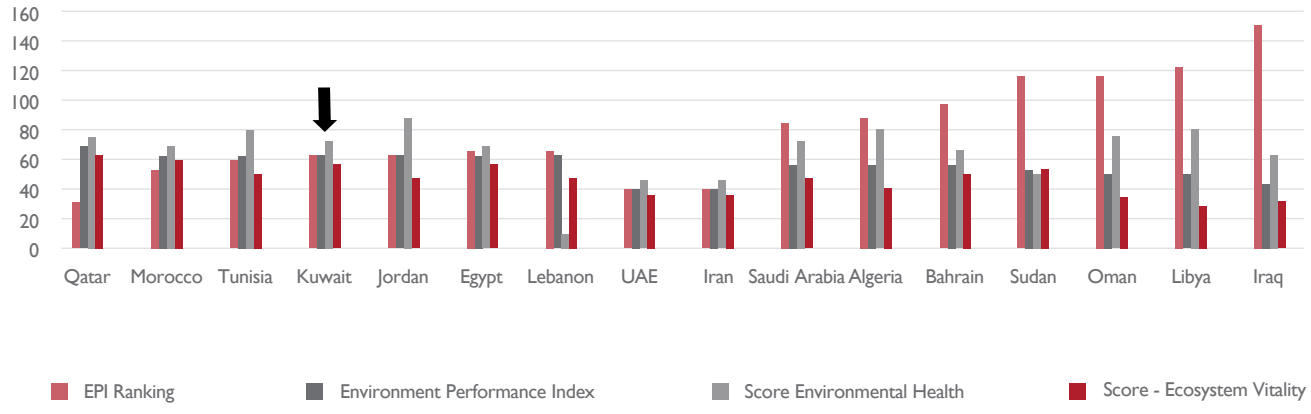


FIGURE 2

Environment Performance Index of Middle East, North Africa and Gulf Countries in 2018



Purpose

The purpose of this report is to analyze the policy gaps in the environment pillar under KNDP as a basis for the setting of future policies for the next KNDP medium-term plan 2020-2025.

Approach

The policy analysis approach was based on the following methods:

- **Semi-structured interviews** with key stakeholders: consultations and stakeholders' engagement to identify policy-related challenges and opportunities. The interviews aimed to understand key stakeholders' perceptions of the appropriateness and effectiveness of existing policies, identify the gaps and recommend policy changes.
- **Data collection and analysis**: assess policy settings against **evidence-based policy (EBP)** principles. EBP is a term often applied in multiple fields of public policy to refer to situations whereby policy decisions are informed by rigorously established objective evidence. Underlying many of the calls for "evidence based policy" is often a (stated or unstated) concern with fidelity to scientific best practice, reflecting the belief that social goals are best served when scientific evidence is used rigorously and comprehensively to inform decisions, rather than in a piecemeal, manipulated, or cherry-picked manner.
- **Benchmarking to best practice:** continuous review of similar policy frameworks, both regionally and globally, to extract best practices that fit the Kuwaiti context.
- **Use evaluative approach:** rigorous evaluation approach to assess the appropriateness of the policy settings. This includes evidence-based assessment, stakeholders' consultations and asking key questions such as:
    - What effects does the policy have on the targeted problem?
    - What are the unintended effects of this policy?
    - Is this policy technically feasible?
    - How does the policy balance evidence and process?
    - Is there enough evidence support the policy theory of change?
    - Is there sufficient capacity to deliver these policies?
    - Do the relevant stakeholders view the policy as acceptable?
    - Is the policy purposive (i.e. objective-oriented)?
    - How far is the policy context from what is being delivered by the government?
    - Are there adequate legislative and institutional settings to underpin policy delivery?

II. Renewable Energy

Existing policies

Kuwait has defined a target of increasing the share of renewables in total energy demand to **15% by 2030**, up from less than 1% in 2019.

Kuwait has already taken some significant measures to catalyze the introduction of renewable energy. The 50 MW Shagaya CSP project is a vehicle to catalyze the scaling up of renewables to 15% of generation by 2030 (22 TWh annually, or 8GW by 2030). The Shagaya 10 MW PV plant and 10 MW wind farm have been operational since November and December 2016, respectively, and the land allocated to Shagaya can accommodate around 2 GW of alternative energy (MEW, 2016)[1]. There are two broad, actionable areas to build on these initial efforts and expedite the penetration of renewables.

Kuwait's renewable energy target sounds reasonable in comparison with the context of the Middle East and North Africa (MENA) domestic targets on Renewable Energy[2].

1 MEW (2016) 'Overview of MEW Energy Policies', Presentation at First Stakeholder Workshop on National Energy Strategy.

2 Poudineh R, Sen A, and Fattouh B (2016) Advancing renewable energy in resource-rich economies of the MENA. OIES Paper MEP 15, Oxford Institute for Energy Studies, Oxford, UK.

BEST PRACTICE BOX: MIDDLE EAST AND NORTH AFRICA (MENA) DOMESTIC TARGETS ON RENEWABLE ENERGY

- Kuwait: 15% of electricity demand (generation) 2030
- Saudi Arabia: 9.5GW of renewable energy 2023
- UAE: 24% clean energy (including nuclear) in energy mix by 2021
- Qatar: 1.8GW solar (16% of generation) by 2020; 10GW solar PV by 2030
- Bahrain: 5% of installed capacity by 2020
- Iran: 5GW wind and solar capacity by 2020
- Morocco: 42% of installed capacity by 2020, including 2GW solar & 2GW wind
- Jordan: 10% of generation by 2020
- Egypt: 20% of generation by 2020
- Yemen: 15% of generation by 2025
- Algeria: 20% of generation by 2030
- Tunisia: 25% of capacity by 2030

FIGURE 3

Relevant SDG 7: Sustainable energy

Relevant SDG statistics in Kuwait		
Renewable energy percentage of the total consumption in 2017	**7.3.1 Energy intensity measured in terms of primary energy and GDP – 2015. (megajoule/$GDP)**	**7.1.1 Proportion of population with access to electricity**
0.1	**1.9**[3]	**100**
Total installed capacity for generating electricity in Kuwait (megawatt)	**Per capita share of consumed electricity in 2014 (kilowatt/hr)**	**Total capacity of Shigaya project for renewable energy by 2030 (gigawatt)**
18,793	**16.1**	**3,070**

3 Total supplied energy in 2015 is 604,094,93 million watt/hr (source – Annual Statistics Book) this equals 21747417480 megajoule, the Grand Domestic Production in 2015 is USD $114.5 billion (source is world bank).

Legal and institutional set ups

Kuwait has several government institutions participating at varying levels in the power sector, all with different mandates. The Ministry of Electricity and Water oversees all aspects of generation, transmission and distribution of electricity. The Kuwait Authority for Partnership Projects is tasked with negotiating power purchase agreements for independent water and power producers, and it negotiated the first such project in Kuwait, Az Zour North Power Station, on behalf of the government. The Kuwait Foundation for the Advancement of Sciences sponsors distributed-photovoltaic projects, and the design and implementation of the first phase at the Shagaya renewable energy complex was overseen by the Kuwait Institute for Scientific Research.

The Higher Energy Committee, set up in 2018 by the Council of Ministers, was tasked with improving coordination between and among ministries, regulatory agencies, infrastructure operators and service providers. An important responsibility of the committee will be to address the lack of coordination, which currently impedes additional renewables capacity in Kuwait.

Gaps

Today, Kuwait relies almost exclusively on oil products and natural gas to meet its energy needs, with each fuel accounting for about one-half of total primary energy consumption. Kuwait plans to substitute natural gas for oil in the power generation sector in order to retain oil-export revenues for savings and investment.

Between now and the year 2035, energy demand in Kuwait is projected to increase by one-third in the business-as-usual case, growing at a much slower pace than over the past couple of decades due to decelerating GDP and population growth. The share of oil in total primary energy demand steadily declines, to just over 40% in 2035, a result of the government's push to switch from oil to natural gas and solar energy for power generation. Natural gas demand is expected to grow at a fast clip, by 2.2% per year from 2015 to 2035.

The energy sector plays a vital role in Kuwait's economy, society and environment. Despite Kuwait's vast solar and wind resources, the country has only recently started to harness its renewable energy potential. The first renewable-energy plants were built at the Shagaya complex in 2017.

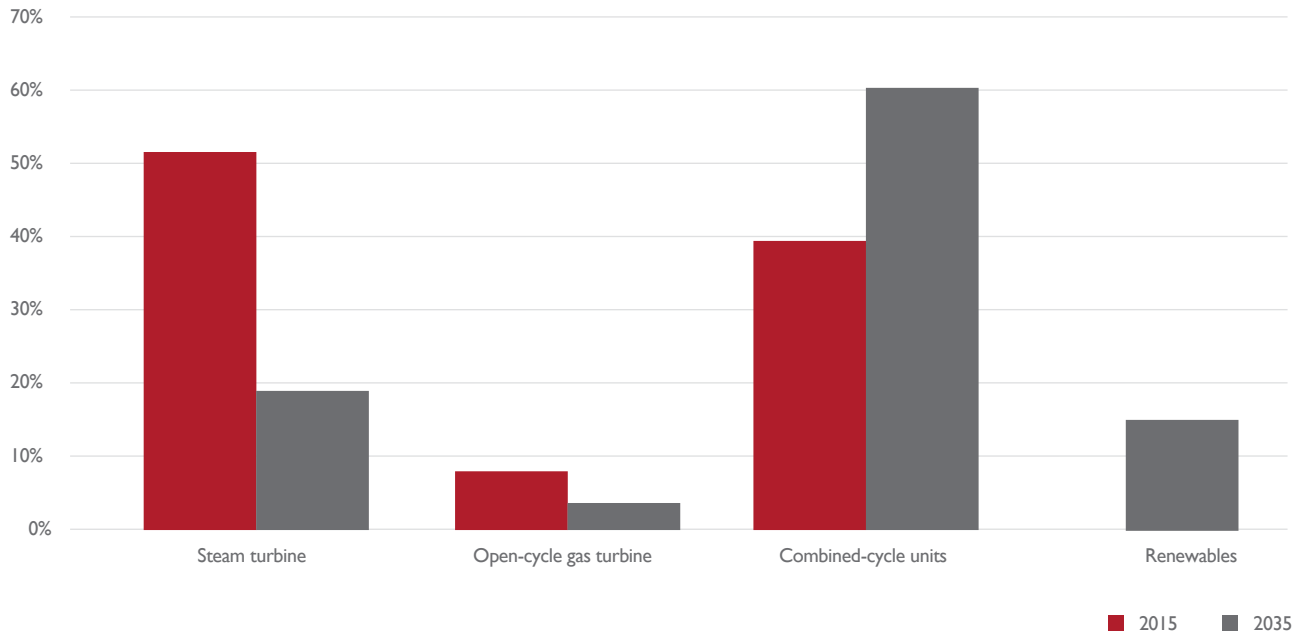
Today, renewable energy capacity at the plants accounts for less than 1% of total generating capacity in Kuwait. Renewable-energy generation capacity is expected to increase to 5 GW; but this capacity will still be insufficient in meeting the Emir's stated goal of fulfilling15% of energy demand from renewable energy by 2030[4].

Kuwait is planning a significant expansion in its generating capacity, mainly combined-cycle plants, over the next couple of decades (Figure 4). Ramping up renewables capacity and retrofitting or purchasing flexible units, however, would be a more sustainable path forward. While the choice of fuel for power generation can be largely attributed to the fact that Kuwait is rich in fossil fuel resources, the overall structure of the power sector itself in Kuwait adds to the slow adoption of renewables.

4 Kuwait Energy Outlook, 2019.

FIGURE 4

Generation technology as a percentage of total installed capacity in 2035 versus 2015



1. Weak institutional and legal set ups

The lack of coordination among various institutions is the main reason for the slow development and deployment of renewable energy technologies. Several authorities are currently contributing in an attempt to achieve the15% target, but these efforts are covered under the strategic plan and are not being coordinated. The lack of coordination brings along strategic and operational risks, for instance, a potential for duplication and reduced efficiency in delivering the target.

Kuwait lacks for a strong state authority that can champion renewable energy while simultaneously exerting overarching influence on existing, powerful institutions, such as the utility companies, to tilt the balance in favor of renewables.
The current regulatory framework does not promote renewable energy and energy-efficient technologies and rebate/incentive programs to incentivize the market. A lack of regulatory independence also is a major concern for the deployment of renewables in Kuwait.

2. *Absence of a strategic action plan for achieving 15% target*

Currently there is no national strategic plan that articulates the path toward achieving the 15% target. The lack of strategic planning leads to scattered and uncoordinated renewable energy investments. A strategic plan will help to bridge the legal, institutional, and capacity gaps to ensure that Kuwait's renewable energy sector is capable of achieving the future targets.

3. *Weak private sector participation*

The shortage of private sector participation in Kuwait's power sector also has contributed to the slow adoption of renewables.

Renewable energy investors face a range of risks including political risks, policy and regulatory risks, technology risks, currency and liquidity risks and power off-taker risks (IRENA, 2016)[5]. These risks and uncertainties not only affect the path of technological evolution and demand for renewable energy but, more importantly, they also affect the cost of capital and the ability to finance projects. Therefore, risks and uncertainties are serious barriers for scaling up renewable deployment, and addressing them requires access to effective risk-mitigation instruments.

Policy and regulatory risks are those risks that are related to changes in investment incentives (for example, removal of renewable subsidies), network codes, grid connection cost models, and permitting processes among others.

Also, renewable investors face uncertainty at multiple points, such as when there is no specific renewable policy, as well as after policy incentives are designed and implemented. The pre-implementation uncertainties include such factors as not knowing if, when, or what type of policy will be implemented to incentivize renewables. The post-implementation uncertainties are related to the stability, transparency, trust and insurance for long-term support.

Rigidities in the electricity sector's structure and the lack of coordination among the various institutions participating in the power sector are the main reasons for the lack of private sector involvement and the slow development and deployment of renewable energy technologies.

In order to increase renewable capacity, the government should consider allocating more sites for renewable projects. Private sector participation could also be expanded through foreign direct investment (FDI).

Private investors perceive several factors as investment risks, such as: a lack of clarity of procurement programs; shifting policies; difficulty in obtaining permits; constraining real estate laws, especially where foreign ownership is specifically prohibited; lack of clarity on land ownership and leasing laws; and cumbersome labor issues. Some of these factors may result in high costs to the private sector when that sector pursues low-carbon investments.

5 IRENA (2016b), 'Unlocking Renewable Energy Investment: The Role of Risk Mitigation and Structured Finance,' IRENA, Abu Dhabi. http://www.irena.org/DocumentDownloads/Publications/IRENA_Risk_Mitigation_and_Structured_Finance_2016.pdf

4. *Weak capacities to manage financing, tendering and procurement processes*

Engaging the private sector is also complicated by the administrative burden of procurement, and an absence of clear guidance on selecting contract holders, granting contracts, selecting sites, awarding construction and environmental permits and obtaining grid access, at a minimum. For example, obtaining all relevant permits for renewable technology becomes expensive and lengthy, increases transaction costs and discourages investors.

A core element is the need for an independent regulator who can design suitable regulatory frameworks for procurement and set out the necessary technical guidelines for integration of renewables within the existing power systems. At present in Kuwait, the regulator is not independent of the government and thus is susceptible to political influence.

5. *Energy subsidies*

Despite reform efforts over the past several years, energy subsidies remain high in Kuwait. The subsidies continued to remain high even after oil prices declined; despite the subsidy reforms undertaken by the authorities during 2015–16, subsidies remain high, reaching close to 8% of GDP in 2016[6]. On average, subsidies in Kuwait are larger than in other oil-exporting countries due to remaining gaps between market and domestic prices[7].

Until mid-2016, Kuwaiti electricity prices were less than one-twentieth of the cost of generation, and had not changed since 1960[8]. Kuwaiti authorities announced cuts to fuel subsidies in August 2016, provoking resistance among the public. Nevertheless, the government began raising utility prices in September 2016. Electricity and water tariffs, outlined in Law No. 20 and approved by Parliament, were raised for most customers.

The electricity tariffs for residential villas and apartments did not change under Law No. 20. The current rates are substantially below the US$0.07 per kWh average tariff rates for GCC countries[9]. Price subsidies diminish fiscal resources available to potentially more productive expenditures, including productive infrastructure spending or social spending. Low domestic prices contributed to excessive consumption of natural resources. Energy subsidies discourage investment by producers and distributors, affecting the ability to produce energy more efficiently. They also encourage investment in energy-intensive activities that create relatively few jobs and discourage private sector investment in renewable energy.

6. *Lack of effective monitoring, verification and evaluation system*

Currently there is no single source of truth when it comes to renewable energy data. Data is scattered among different institutions and reported differently in various government reports.

There are no monitoring, verification and evaluation systems in place, and therefore it is unclear how to track progress toward the targets, build forecasts for the future or determine when and how targets are going to be achieved.

6 Oxford Institute for Energy Studies (2017).

7 International Monetary Fund (IMF) (2018), World Economic Outlook, IMF, Washington, DC. - (2017), "Kuwait: Selected Issues", IMF, Washington, DC, 21 December

8 Kuwait Energy Outlook, 2019.

9 Electricity price in August 2017 or latest available. GCC average excludes Kuwait (IMF, 2017).

Monitoring, verification and evaluation systems make it possible to identify the bottlenecks, track progress, provide robust evidence for the effectiveness of renewable energy delivery and offer a means to adjust policy instruments to make them more effective and efficient.

7. No incentives support schemes

Currently, Kuwait offers no direct or indirect financial incentives to promote investment in renewable energy. This discourages both private sector investment and consumer interest, which is further dampened by the high subsidies on energy prices.

8. Business as usual, including hard pipeline projects, are not adequate to achieve the 15% target

Despite some progress in adding renewables to the generation mix over the projection period, their share of total primary energy demand remains low in 2035, only 3% in the business-as-usual case; that figure takes into account the hard pipeline projects (projects that have been initiated) and growth in demand and generation over the next 10 years[10].

10 Kuwait Energy Outlook, 2019.

III. Low-emissions innovations

Low-emissions innovations are new products, processes and methods that reduce the greenhouse gas (GHG) emissions of production and consumption systems. They can be technological (e.g. technologies for renewable energy, energy storage or smart grids) or non-technological (e.g. institutional and organizational changes that alter behavior, such as electric car sharing and circular economy models). They can focus on supply (e.g. renewable energy, low-carbon cement) or demand (e.g. energy efficiency, material efficiency). They can be interdependent (i.e. uptake of a new technology may depend on a change in behavior) and involve trade-offs (e.g. pollution resulting from the extraction of rare earth minerals).

The **focus of this chapter is on low-emissions innovations in the energy-efficiency sector and**, in particular, to suggest policy framework for Kuwait's energy efficiency agenda using low-emissions innovations.

Improvements in energy efficiency have been shown to directly affect economic growth. Vivid Economics found in a 2013 report that a 1% improvement in energy efficiency led to a 0.1% increase in the annual growth rate of GDP per capita[11], based on a statistical analysis of historical data for 28 Organization for Economic Cooperation and Development (OECD) countries.

Other studies have found similar results. For instance, in the case of Saudi Arabia, Gonand found that an annual increase of 4% in energy efficiency could result in around one mil-

11 Vivid Economics 2013.

lion barrels of oil equivalent being avoided per annum by 2030, increasing per annum oil revenues by between 50 billion and 100 billion Saudi riyals (SAR) depending on market conditions. If recycled back into the economy through investments or public spending, the combined impact of this increase in energy efficiency could lift Saudi GDP growth by between 0.3% and 0.6% per year by 2030[12].

Empirical evidence suggests that the asset value of sustainable buildings exceeds that of conventional structures[13]. Available data from several countries, including mostly Leadership in Energy and Environmental Design (LEED)-rated office buildings in the U.S., shows that certified green buildings are 30% more expensive than noncertified buildings.
Several studies have evaluated the impact of indoor thermal comfort on work productivity, for instance the indoor environment in United States (U.S.) office buildings has increased productivity by 0.5% to 5%, delivering an economic value of between $12 billion and $125 billion annually[14].

Gaps

One model for guiding innovation investment and policy decisions is "systems innovation." Recent work by the OECD shows that policies aimed at transitioning sociotechnical systems to more environmentally sustainable configurations differ significantly from those aimed at increasing the economic performance of existing systems. Aligning these objectives requires policy makers to develop a vision of what future sustainable systems will look like, including which technologies are likely to play a role, which infrastructures will be needed, and how business models and patterns of behavior will need to change.

In order to facilitate the transition, any policy framework also would need to lengthen planning and investment horizons; coordinate across ministries and different levels of government; establish and maintain long-term collaborative partnerships; place increased emphasis on diffusion of knowledge and existing technology, as well as invention of technology; and manage and overcome resistance to socio-technical change.

In response to tightening environmental standards on oil products by developed countries, **Kuwait began to significantly 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. dollars), 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.

In Kuwait, buildings (government, residential, and commercial) consume about 80% of the electricity generated. The Kuwait Institute for Scientific Research (KISR) is the front-runner in developing the Energy Efficiency Technologies Programme (EET) that aims to reduce energy consumption in new and old buildings by 30% and 10%, respectively, by concentrating on the following thrust areas:

- Improvement of energy efficiency in buildings through enhanced building envelope construction, improved air conditioning, and lighting technologies.
- Innovative heating, ventilation, air conditioning (HVAC) solutions using advanced heat exchanger technologies, nanotechnologies.

12 Gonand (2016).

13 International Monetary Fund (2018).

14 Wyon 1996; Fisk and Rosenfeld 1997; Kosonena and Tan 2004; Romm and Browning 2004.

- Develop a Kuwait Reference Energy Scenario (RES) that serves as an index to benchmark consumption of energy by different sectors.

The energy conservation program code mandates the following measures, inter-alia:

- Thermal insulation for columns and beams.
- Mandatory use of water-cooled A/C systems for 500 TR onwards.
- Compulsory use of thermal storage systems.
- Use of variable frequency drives (VFDs) in cooling towers.
- Demand-side management of public buildings, such as schools, from a centralized, remote-control room.

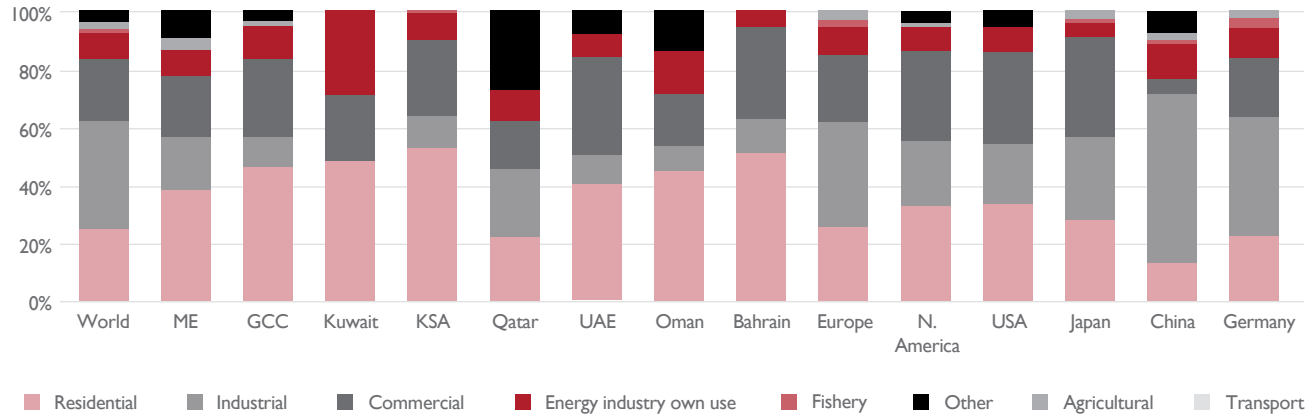
In the **business-as-usual case, residential electricity demand grows by 1.2% per year**, considerably slower than the average annual growth of 5% in 2000-2015. Growth in energy demand for space cooling and heating, which will account for about 70% of total residential energy consumption, will be driven, in large part, by increases in the average annual temperature, estimated to be nearly 0.1o Celsius per year over the projection period.

Per capita energy consumption in Kuwait is among the highest in the world. Due to historically lax energy-efficiency regulations and codes along with its hot climate, demand for air conditioning services in Kuwait accounts for some 70% of residential electricity demand. This is the highest in GCC region – see Figure 5 below.

According to a recent report published by Deliotte, the per capita electricity consumption during the period 2007-2035 in the GCC (including Kuwait) is likely to increase at an annual rate of 2.5%. In just a few years, GCC residents may well be outright leaders in the per capita residential electricity use race[15].

FIGURE 5

Energy consumption - GCC countries vs. selected regions



Going by the electricity consumption patterns of the industrialized and industrializing countries, **the success of an economic diversification strategy in Kuwait may, among other efforts, require a shift in electricity consumption** from "residential" to "industrial" use.

In addition, the share of personal passenger cars in the overall transport mix is quite substantial, reaching 80% in 2017. Kuwait roads and highways cover 7,620 kilometers. In 2016, there were more than two million registered vehicles in Kuwait, and vehicle emissions contributed more than 4.7 millions tons of greenhouse gas emissions.

Other factors that contribute to the large per capita energy consumption in Kuwait are the very generous subsidies for electricity and oil products. There exists vast potential for improvements in energy efficiency through actionable, national energy-efficiency plans, incentive/rebate programs and subsidy reduction. Energy subsidies approached 8% of GDP in 2016. The government has begun tentative steps to reduce them. A new law was passed in 2016 and took effect in 2017 that raised tariffs for electricity and water consumption in all sectors except for the residential sector.

1. Weak institutional and regulatory frameworks

The lack of coordination between various institutions and the lack of a strong state authority that can champion energy efficiency are key barriers to move forward in this space. Current regulatory frameworks do not promote energy-efficient technologies and rebate/incentive programs to incentivize the market. The lack of regulatory independence is also a major obstacle to energy efficiency deployment in Kuwait.

Kuwait has plans to construct 128,000 new houses, all **subject to the more rigorous standards of the recent energy conservation codes and regulations**. Three government entities will be responsible for enforcing the building codes.

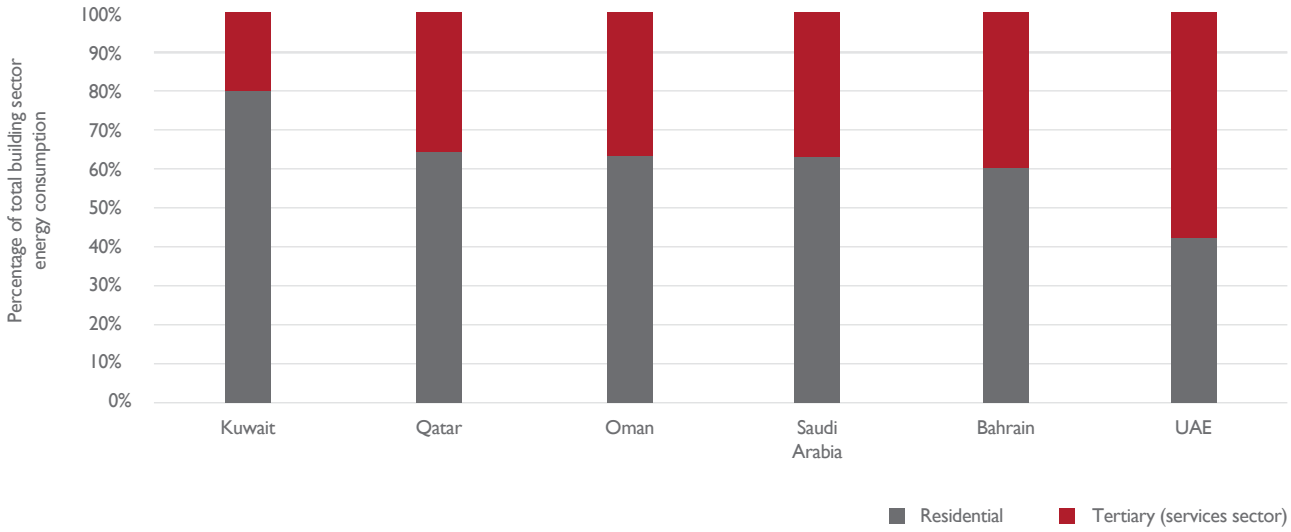
The 1983 energy conservation code was not revised for 27 years, and the buildin
g sector is a major source of inefficient energy consumption. In addition, the code was rather weakly enforced over the years, leaving a very large stock of energy-inefficient buildings.

As a result, the building sector has become a major source of inefficient energy consumption – as per Figure 6 below. Kuwait has the largest residential consumption among GCC countries. Enforcement improved after the introduction of the 2010 codes and regulations, but Kuwait's building stock is quite old in general. It will take years, if not decades, of stock turnover until Kuwait's building sectors sees a dramatic reduction in energy consumption.

Stricter enforcement of regulations and codes in the buildings sector is expected to play a major role in the significant deceleration in energy demand growth in the residential sector over the projection period.

FIGURE 6

2016 energy consumption in the buildings sector (residential percent versus tertiary)



In terms of equipment and appliances, **Kuwait lacks for national mandatory Minimum Energy Performance Standards (MEPS) and labels**, which allows Kuwait's market of inefficient appliances, particularly air conditioners, to grow.

The same problem holds true for lights - an **absence of energy-efficient lighting leads to intensive-energy-consuming lights**.

In the business-as-usual case, oil demand in the transport sector grows by 3% per year, much faster than the growth rate worldwide. **Absence of fuel efficiency standards for passenger vehicles has been an essential factor driving oil consumption in the transport sector**. Providing citizens with a modern, efficient, mass public transportation system, including metro lines, trams and buses, has also proven to be a very successful way to better manage growth in demand for transport. But in Kuwait, **there are very few incentives to switch from current modal transport choices**. Motor gasoline and diesel prices are low, and plans to build a metro have stalled.

The transport sector is projected to account for nearly one-third of total, final energy consumption in 2035 and for all of the increase in greenhouse-gas emissions from oil and oil product use.

2. *Absence of a national strategic plan for energy efficiency*

Both developed and developing countries commonly draft a National Energy Efficiency Action Plan (NEEAP) to build on existing achievements; such plans typically include a comprehensive set of initiatives to unlock further energy efficiency potential. NEEAP identifies specific programs and new initiatives across various sectors, and encompasses energy-ef-

ficiency plans that have been developed by individual institutions. NEEAP sets a national target for energy savings, identifies implementing mechanisms, and provides estimates of energy and monetary savings.

Currently Kuwait lacks such a strategic level of planning for energy efficiency, which makes it challenging to bring scattered efforts together under one umbrella and in response to one national target.

Examples from the GCC region and other countries have demonstrated how NEEAP could be instrumental in advancing energy efficiency developments and innovations. Currently, Kuwait has not set a specific energy-efficiency target, unlike neighboring GCC countries that have a defined national energy target (e.g., a 6% reduction in energy consumption by 2025 in Bahrain).

3. Absence of incentives schemes to promote energy efficiency

End-users have few incentives to use energy efficiently because energy use is subsidized. The matter is complicated by the fact that a majority of the population is comprised of expats who rent buildings belonging to local nationals. The expats are often paid through their employers, and the landlord does not invest in energy efficiency because the tenant's employer pays the energy bill.

4. Weak ESCO Market

In general, the market for Energy Services Companies (ESCOs) in Kuwait remains underdeveloped; however, it is accelerating slowly. The reasons for this are numerous. In order for an ESCO market to flourish, several factors are necessary, including available financing, expertise and a mature legal system. In the past, each of these areas has been lacking with most of the region's available financing being used to promote rapid growth.

The need for energy efficiency was largely overlooked when energy costs were low. This lack of necessity and the acceptance of speed over quality in construction led to a lack of expertise in the market. Combined with the immaturity of the legal system, this led to a very poor environment for ESCO market growth.

Kuwait industrial development requires key energy services that could be potentially provided by ESCOs, such as energy management advisory services and energy audits.

IV. Air pollution

Existing policies

The main objective under the KNDP in addressing air pollution is to **protect the quality of the ambient air environment**. The following are **key policies** covered by the KNDP:

- Achieve integrated management of air quality and reduce emissions levels in industrial areas.
- Enforce environmental standards and measures on industrial activities.
- Establish an integrated management system to prevent gas leaks, and develop an emergency plan linked with surveillance systems that monitor gas leaks in industrial areas; through restricting persistent and moving pollutants, estimate quantities. Perform continuous monitoring of industrial pollution, including noise[16].

The short-term development plan 2015/16-2019/2020 defines the following targets of key air quality parameters[17].

TABLE 1

Targets of key air quality parameters

Indicator	Base year 2012/13	2015/2016	2016/2017	2017/ 2018	2018/2019	2019/2020
PM10 (µg/m)	241	200	175	150	125	90
NO2 (PPB)	37	35	34	32	31	30

16 Kuwait National Development Plan, Medium-term for the years 2015/16 – 2019-2020.

17 Source: KEPA letter number ب.ع.ه/3903 dated 13/11/2014

Section 3 of Environment Protection Law (EPL) No. 42/2014 on Protection of Ambient Air from Pollution states that **KEPA shall offer continuous monitoring and evaluation of the situation and prepare research and studies to protect the quality of the air** from the harmful effects of greenhouse gas pollutants. Articles 48-64 regulate outdoor air pollution and emissions, and Article 51 requires that a national network for continuous monitoring of ambient air quality be established.

These articles also require the government to prepare research on maintaining air quality and **reducing the adverse impacts resulting from the emissions of polluting gases** and direct the government to prepare and **develop a national strategy for air quality** management in the State of Kuwait.

The air quality standards published by KEPA in executive regulation No. 8 far exceed the WHO guidelines for PM10 and PM2.5 on a 24-hour basis. The executive regulations quoted an ambient standard for 24 hours for PM10 to be 350 ug/m3 compared to WHO guidelines of 50 ug/m3. The ambient standard for PM2.5 for 24 hours was quoted to be 75 ug/m3 compared to WHO guidelines of 25 ug/m3. There were no annual air quality standards for PM2.5, PM10 and SO_2

An Environmental Monitoring Information System of Kuwait (eMISK) was established and a Compliance Management System (CMS) was developed under eMISK to serve as a reporting system that enables tracking incidences of violations. The CMS, however, is not yet used as a decision-support tool.

Gaps

Air pollution causes much of Kuwait's environmental damage and directly and adversely affects human health. Recent studies show that Kuwait's populated areas are affected by suspended dust, partly due to natural resources in the region and partly due to uncontrolled emissions from industrial and power plants. One challenge is the increase of uncontrolled emissions directly to residential areas, thereby increasing exposure to pollution.

Kuwait is particularly vulnerable to air pollution that may result from industrial activities and climate change. Any slight shift in weather may result in significant air pollution, especially because of the geographic location and natural circumstances. This significant weather-related air pollution may have caused a large increase in healthy years lost due to disability and mortality and may continue to do so in the future should climate change increase the occurrence of such weather events[18].

Industries, including refineries and shipping outlets that are major contributors to SO2, NO2 and CO pollution, are concentrated in the South. The country's fleet of cars is expected to double by 2030; that, in turn, will increase pollution in major residential and commercial areas.

For decades, Kuwait has suffered from poor air quality due to the frequent dust storms. The country experienced dust storms on an average of 8.3 days per year during the 30-year period from 1987 to 2016. The average number of rising dust days during that same 30-year period was 97.4. But it is important to note that the **number**

18 Kuwait Second National Communication on Climate Change , 2019.

of dust storms and rising dust days has increased in the last decade of that 30-year period (2007-2016) to 12.6 and 131.5, respectively[19].

These frequent dust events significantly contribute to the increase in particulate matter PM2.5 and PM10. As a result, the annual PM2.5 levels have a median of 75 of µg/m3, which is **at least seven times the annual recommended limit set by the World Health Organization** (10 µg/m3) (WHO, 2016)[20]. The high number of days with suspended low particulate matter dust poses a long period of exposure to presumably hazardous air pollution in Kuwait.

In recent decades, **the number of motorized vehicles has grown significantly. That growth has resulted in** increased fuel consumption, oil and energy industry emissions, and dust storms – all of which increase urban air pollution (PM10, CO, CO2, NOx, O3, SO2 and VOCs)[21]. Many studies have shown strong associations between particulate matter (PM) levels and a variety of adverse health outcomes; and research on various sites in Kuwait has documented that the particulate levels are high enough to generate substantial health concerns[22].

Recent research concluded that in areas surrounded by oil fields and refinery activities, such as Um-Alhayman, **non-methane hydrocarbons** (**NMHC) levels exceed the proposed ambient air quality standard for residential areas in Kuwait** (0.24 ppm)[23].

Air pollution, wind roses and meteorological data have been measured and analyzed for two districts in Kuwait, Al-Jahra and Al-Mansouriah, for 2010. Data recorded at five-minute intervals were processed to obtain annual hourly averages and annual one-hour maxima. The concentrations of CO, PM10 and NO2 exhibited different patterns in the two districts and in summer versus winter due to different activities in the surrounding areas.

The concentrations of SO2 were high in both cities - in Al-Mansouriah because of the dense traffic of diesel vehicles and in Al-Jahra because of the flue gases from the nearby Al-Doha power plant and oil refineries. The concentration rose for NMHC in winter in Al-Jahra reflects the oil field activities surrounding this district. The concentration roses for CO and NO2 exhibit almost uniform distributions, reflecting the effects of traffic all around the monitoring stations[24].

The monitoring data from all the stations is averaged to obtain a city average (presented below as monthly averages for year 2011). This data was further utilized for compliance and air quality index evaluations.

19 Kuwait Second National Communication on Climate Change , 2019.

20 World Health Organization. 2016. Ambient air pollution: A global assessment of exposure and burden of disease.

21 Al Bassam; and Khan, 2004.

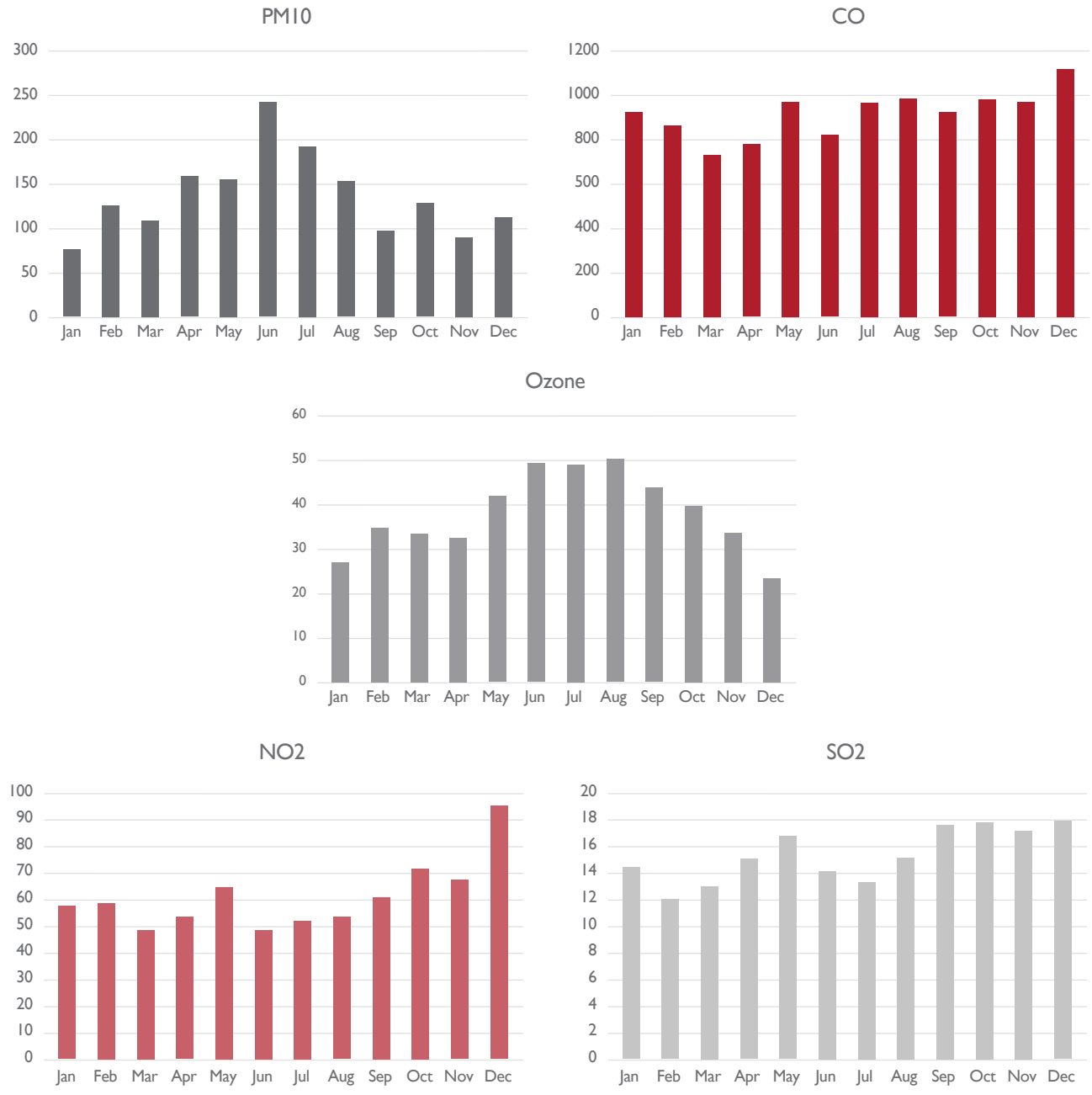
22 Ward Brown et al., 2008.

23 Al-Awadhi, F.A. and S.A. Al-Awadhi, "Spatial-temporal model for ambient air pollutants in the state of Kuwait", Environmetrics, 17, 7, (2006), 739-752.

24 Raslan A. Alenezi , Bader S. Al-Anezi. An assessment of ambient air quality in two major cities in the state of Kuwait. 2015.

FIGURE 7

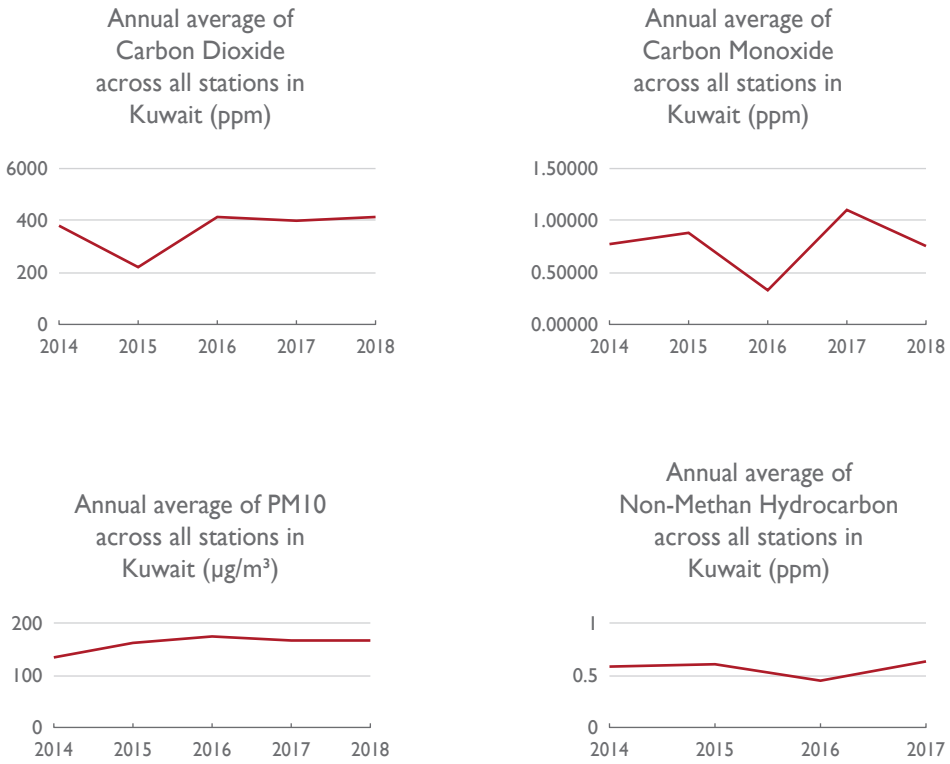
Average concentrations for all stations by month for the period of 2004 to 2012[25]



25 EMISK data.

FIGURE 8

Average annual concentrations for all stations from 2014 to 2018[26]

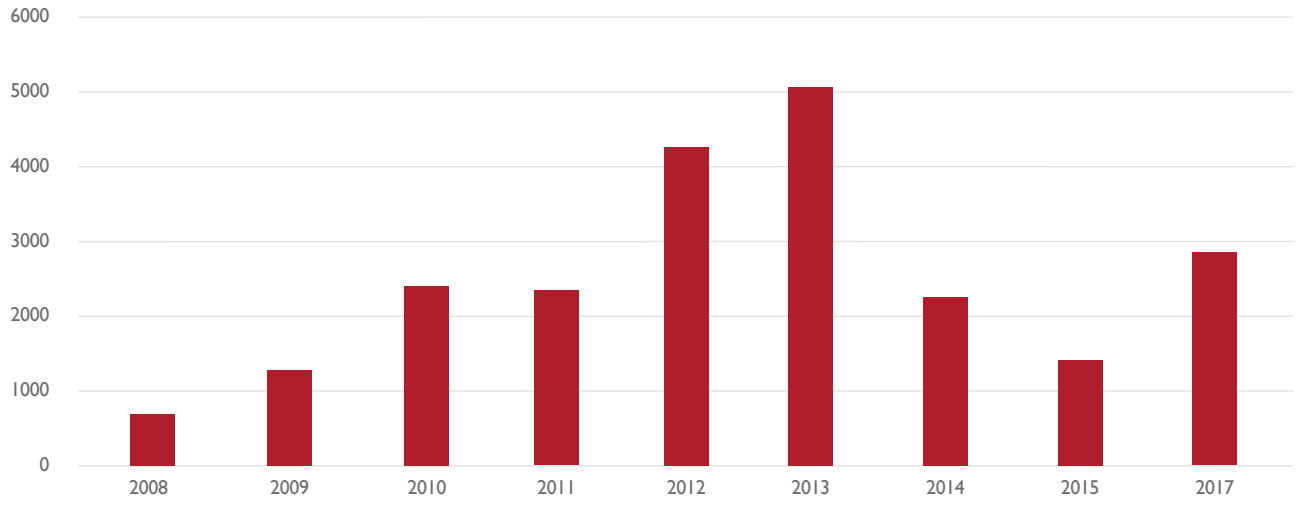


26 EMISK data.

The World Health Organization guideline for ambient PM10 concentrations is 20mg/m3, **which Kuwait exceeds most of the year**. Over the summer months, the highs reach up to 4,000mg/m3, due to regional dust storms that can linger for five to ten days in the upper atmosphere and further exacerbate ground-level pollution. Due to the presence of large oil fields and refineries in the vicinity of the city, the non-methane volatile organic compounds (NMVOC) emissions are higher, which leads to increases in ozone pollution. This is higher in the summer months due to increased photochemical activity.
The ambient concentrations of SO2 and NO2 also exceed the WHO guidelines – see Figure 9, below. There have been an increased number of exceedances in NO2 concentrations, according to national standards. Kuwait experienced a total of more than 2,800 exceedances across all stations in 2017. Of all the pollutants, CO pollution levels are consistently lower, due to high photochemical activity, undergoing oxidation for most parts of the year[27].

FIGURE 9

Number of hourly excesses of NO2 all stations in Kuwait 2008-2017[28]



27 The World Bank, POLLUTION LOAD ASSESSMENT, 2013.
28 Source of data: KEPA.

TABLE 2

Total emissions from all known sources for 2010 in Kuwait city (tons/yr)[29]

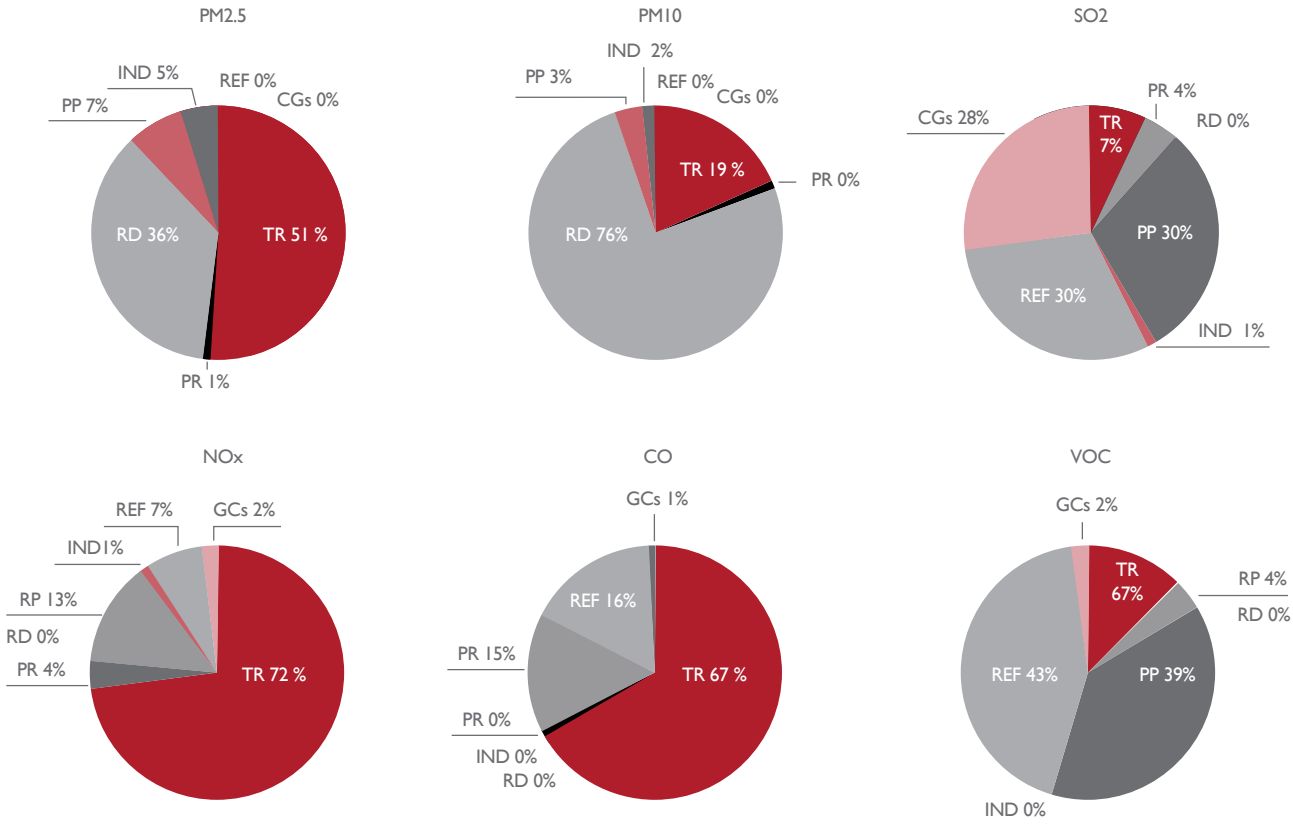
		PM2.5	PM10	SO2	NOx	CO	VOC
Transport	TR	9,720	11,440	5,040	126,060	285,860	69,140
Aviation	AV	20	20	140	1,880	2,260	760
Port	PR	160	200	2,660	6,720	560	22,020
Road dust	RD	7,000	46,640	-	-	-	-
Power Plants	PP	1,360	1,700	20,180	22,900	62,960	228,920
Industries	IND	880	1,100	540	2,320	340	220
Refineries	REF	-	-	20,320	12,800	69,580	252,960
Gathering Stations	GCs	100	100	18,600	3,640	3,240	13,100
	TOTAL	19,240	61,200	67,480	176,320	424,800	587,120

Total city emission loads are estimated at: 19,000 for PM2.5; 61,000 for PM10; 67,500 for SO2; 176,500 for NOx; 425,000 for CO; and 587,000 for NMVOCs in tons/year for the base year 2010. The percent shares by sector are presented below. For the particulate and NOx emissions, the transport sector dominates the total emissions, followed by the mix of industries in the region. Because the primary fuel at the power plants is heavy fuel oil and crude, the total PM emissions are smaller than those generated by a coal-fired power plant with equivalent generation capacity. Most of the SO2 emissions in the transport sector are from diesel vehicles with high sulfur content – but a switch to ultra-low sulfur is expected in the coming years, likely reducing SO2 emissions. The resuspended dust, an important feature of the region, is the major culprit in total PM emissions. The emission sources of SO2, CO, and VOCs are mixed, with industries, power plants, and refineries dominating the totals.

29 Source: EMISK

FIGURE 10

Share of sectors in the annual total emissions for 2010 in Kuwait city[30]



The emissions modeling system is also designed to evaluate future emissions through 2030, using current growth rates for the transport sector. For the projections, it is assumed that industries, power plants and refineries will operate at their capacities. This is assumed because there is limited information on the growth rates for these sectors. Summary of the emissions inventory for future years in presented below.

30 Source: EMISK.

TABLE 3

Total emissions from all known sources for 2030 in Kuwait city (tons/yr)[31]

		PM2.5	PM10	SO2	NOx	CO	VOC
Transport	TR	17,040	20,040	9,200	220,960	501,080	121,200
Aviation	AV	40	40	340	5,000	6,000	1,980
Port	PR	400	500	7,040	17,840	1,480	22,420
Road dust	RD	15,340	102,180	-	-	-	-
Power Plants	PP	1,360	1,700	20,180	22,900	62,960	228,920
Industries	IND	880	1,100	540	2,320	340	220
Refineries	REF	-	-	20,320	12,800	69,580	252,960
Gathering Stations	GCs	100	100	18,600	3,640	3,240	13,100
	TOTAL	35,160	125,660	76,220	285,460	644,680	640,800

By 2030, under the assumptions, the total vehicle exhaust emissions are expected to at least double if no institutional and technical control measures are introduced in the city to either cut the number of vehicles on the road or cut the vehicle kilometers traveled by private passenger cars.

There is sufficient evidence in the published literature that shows a strong relationship between particulate matter (PM) air pollution and detrimental health outcomes (Cohen, 2015)[32]. There is a high prevalence of asthma in Kuwait, where 15% of adults and 18% of children are affected (Khadadah, 2012)[33]. Air pollution may be a significant factor in the exacerbation of symptoms of existing diseases and sensitization of new cases (Guarnieri, 2014)[34]. The prevalence of pollution related- illness in a population that is highly exposed to air pollution can lead to significant health and economic costs.

1. Poor compliance with and enforcement of the EPL legislations

The EPL #42/2014 imposes very stiff and stringent penalties for non-compliance and frequently uses the courts to force violators to pay their fines. **Several departments within KEPA have the responsibility for its enforcement**, and their enforcement responsibility is separate from the enforcement mechanism of other government entities. No criteria exist to determine the nature, risk, gravity and severity of the incidents. **Large numbers of companies do not understand the law and its executive regulations** because they are difficult to comprehend and very detailed.

32 Cohen AJ, Brauer M, Burnett R, Anderson HR, Frostad J, Estep K, et al. 2015. Estimates and 25-year trends of the global burden of dis ease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. Lancet.;389:1907–18.

33 Khadadah M. 2012. The cost of asthma in Kuwait. Med Princ Pract. 22:87–91.

34 Guarnieri M, Balmes JR. 2014. Outdoor air pollution and asthma. Lancet. 383:1581–92.

An air pollution study found that in the Khaldiya residential area of Kuwait, the levels of NMHC and nitrogen dioxide (NO2) exceeded the proposed residential area ambient air quality standards by 56.8% and 26.9%, respectively.[35].

There are two major courses of action that may be taken to address a violation. One is the compliance approach, where remediation measures are voluntarily adopted to bring about and to maintain compliance or to prevent, reduce or eliminate the risk of air pollution harming human health or the natural environment. The second is enforcement, which involves prosecuting the person/company responsible for committing an offense. The two approaches are colloquially referred to as the "carrot and the stick," which alternately references either encouraging or requiring a change in behavior. The carrot is related to voluntary compliance while the stick is related to mandating compliance under the threat of an enforcement action against violators.

Poor compliance and enforcement weakens adherence to the **rule of law and the promotion of good governance** and puts the fairness and credibility of environmental requirements at risk. Noncompliance **weakens investors' confidence** in the Kuwaiti legal environmental system, increases business risk and reduces competitiveness.

Environmental compliance and enforcement (ECE) indicators are necessary to ensure that the EPL and its executive regulations are effectively and fairly enforced and followed. At present, KEPA **does not have a set of indicators that measures performance** and maximizes the results of environmental regulation while minimizing the cost to society. Compliance and enforcement indicators, as well as tracking, are inadequate. In addition, **databases tracking compliance and violation incidents are weak and insufficient**.

The criteria to determine and assess the variability and severity of the factors that influence the selection of compliance and enforcement are unclear.

BEST PRACTICE BOX

The informed decision matrix is a risk tool for assessing the variability and severity of the factors that influence the selection of compliance and enforcement tools. These factors are:

a) Escalating the levels of human health and safety impacts (potential and actual) as well the negative impact on the natural resources
b) Diminishing the likelihood of reaching compliance

The enforcement and compliance systems **lack advisory actions, warnings, compliance assistance and compliance incentives - features that would** foster greater compliance.

35 Abdul-Wahab, S.A., "Two case studies of air pollution from Oman and Kuwait", International Journal of Environmental Studies, 66, 2, (2009), 179-191.

Air pollution enforcement also is complicated by a **lack of qualified inspectors** to perform quality inspections on facilities that potentially violate air quality laws. Also, compliance and enforcement laws are hampered by a **lack of appropriate monitoring and evaluation of the compliance and enforcement** indicators.

2. Poor response to gas leakages and air pollution incidents

A pollution incident means an incident or set of circumstances during or as a consequence of which there is or is likely to be a leak, spill or other escape or deposit of a substance, as a result of which pollution has occurred, is occurring or is likely to occur. While individual leaks are typically small, the sum of all fugitive leaks (at a refinery for example) can be one of its largest emission sources.

A number of techniques can reduce emissions, including improving leak-resistant equipment, reducing the number of tanks and other potential sources and, perhaps the most effective approach, using the method of Leak Detection and Repair (LDR). However, when leaks actually happen, **there has to be clear procedure aiming at treating leaks immediately and minimize emissions**.

Currently, **Kuwait lacks a management plan** to satisfy pollution reporting obligations and outline management's response to an air pollution incident. A response plan would: ensure comprehensive and timely communication to relevant external authorities; minimize and control the risks of any potential pollution incident by following a specific plan of action; and ensure this plan is appropriately implemented by trained staff and is available and understood by the affected business.

In absence of clear response protocol to air pollution incidents, KEPA would be **unable to identify the severity of the incident because criteria as well as roles and responsibilities are unclear and a pre-defined course of action to deal with any incident is lacking**.

In addition, the staff capacity to deal with and manage air pollution incidents is low. Treating air pollution incidents requires specialized skills and technical expertise that need to be built in KEPA.

3. Weak adoption of alternative low-emission means at sources

Industrial production in Kuwait relies on chemical processes that may require the production and use of synthetic gas and may lead to air emissions. Greenhouse gas emissions from industrial processes and product use are primarily byproducts of production.

Emission control typically includes the capture and recycling or combustion of emissions from vents, product transfer points, storage tanks, and other types of handling equipment. Boilers, heaters, other combustion devices and catalytic units may require particulate matter controls.

For instance, the use of carbon monoxide boilers is a standard practice in fluidized catalytic cracking units at refineries. Existing catalytic cracking units should be retrofitted with particulate removal devices, and this technology should be required on all future units. Steam injection in flaring stacks can reduce particulate matter emissions.

The level of emissions is a factor of the process technology used and the level of industrial output. Industrial processes and product use emissions are non-energy related.

Low-emission technology (LET) refers to a range of key advanced technologies designed to significantly reduce airborne pollutants, greenhouse gas emissions and other environmental impacts. **LET alternatives are not available to industries in Kuwait. LET helps to reduce or avoid air-borne emissions at the source**. This largely is because **technical guidance on the emerged technologies is not available to pollutant-emitters**, and therefore industries are not aware of these innovative technologies.

4. High dependence on private vehicles and less on public transport

Kuwait is experiencing steady growth in its population, human activities, the size of its transportation fleet and demands for power. These factors combine to contribute to air pollution in Kuwait's urban environment. The urban population is growing by 3.4% per year on average, and the number of vehicles increased from 543,000 in 1980 to 912,800 in 2002, at an average growth rate of 3.0% per year[36]. In Kuwait, unfortunately, there is no demand for public transportation; therefore, meeting air quality standards will continue to be a challenge. Transport affects air quality through traffic emissions and also increases fuel consumption and damages infrastructure, resulting in road congestion.

Many researchers have reported that NMHC levels exceeded the ambient air quality standard for residential areas in Kuwait. The presence of non-methane hydrocarbons (NMHC) in the atmosphere is a key concern. It was found that the diurnal patterns of NMHC and NO2 concentrations exhibit three peaks that are directly dependent on the traffic density[37].

In recent decades, the number of motorized vehicles has grown significantly. That growth has resulted in increased fuel consumption, oil and energy industry emissions, and dust storms – all of which increase urban air pollution (PM10, CO, CO2, NOx, O3, SO2 and VOCs)[38]. Many studies have shown strong associations between particulate matter (PM) levels and a variety of adverse health outcomes; and research on various sites in Kuwait has documented that the particulate levels are high enough to generate substantial health concerns[39].

Currently, 80% of the vehicles in Kuwait are private cars used for private transportation (about 1,612,131 cars in 2016), The rest are public and private trucks, buses and taxis. Figure 11 presents the distribution of vehicles by type in Kuwait in 2016. This is a clear indication of the high reliance on private cars for transportation purposes, which in turn increases emissions.

36 Institute of Banking Studies, Economic and Financial Data base for Bankers, Research Unit, Kuwait. Institute of Banking Studies, (2004)

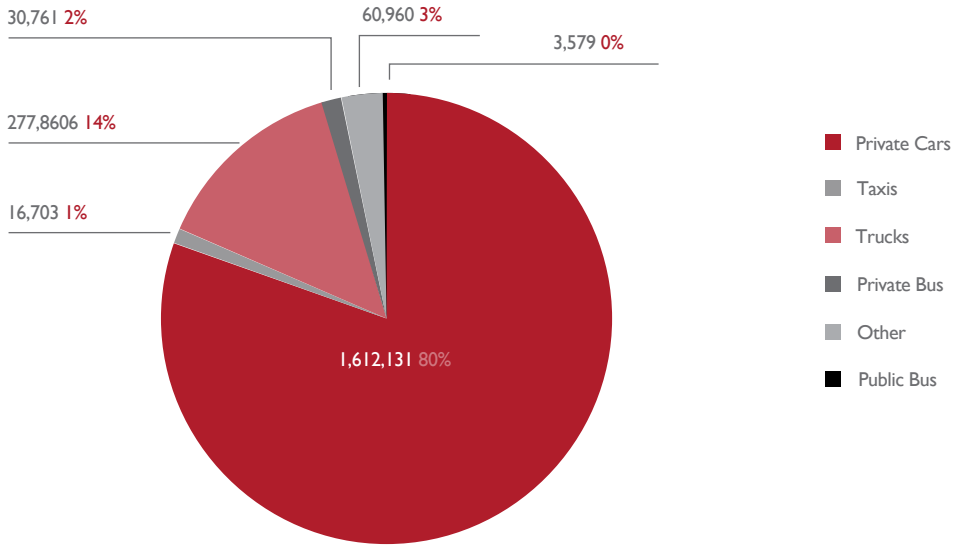
37 Jallad, K.N. and E.-J. Cyntia, "Analysis of ambient ozone and precursor monitoring data in a densely populated residential area of Kuwait", Journal of Saudi Chemical Society, 14, 4, (2010), 363-372.

38 Al Bassam; and Khan, 2004.

39 Ward Brown et al., 2008.

FIGURE 11

Distribution of vehicles by type (2016)[40]



The rapid growth of motorized vehicles is attributed to high incomes and fuel subsidies. In fact, fuel subsidies contributed to a shift in the type of vehicles marketed - inefficient cars with large engines that generate more emissions.

40 Source: CSB, the annual statistical abstract 2015/2016

V. Waste management

Existing policies

The current NDP 2015-2020 defines three key policy objectives for improving waste management effectiveness:

- Increase public awareness through ongoing campaigns, use all communication tools and target all agencies and community categories.
- Develop a safe system to manage solid, hazardous and liquid waste to ensure decreasing the pollution that results from classical treatments of waste.
- Encourage recycling operations by obtaining scientific advice and providing incentives to investors to implement recycling.

The policy objectives, in their current state, do not capture the vision toward the ultimate impacts, for instance environmental outcomes of improved recycling and recovery, and do not define measurable targets against which to track progress.

The defined objectives are not aligned with the national strategic plan for waste and its indicators. These objectives are no longer fit for purpose and therefore should be updated in this white paper.

FIGURE 12

Relevant SDG 12: Sustainable consumption and production

Relevant SDG statistics in Kuwait

Total vehicle oil that was exported in the period 2012-2016 (ton)	Total hazardous industrial waste dumped during the period 2 012-2016 (ton)	Total hazardous medical waste incinerated between 2012-2016 (ton)
27,858	**280,553**	**16,341**
Number of PCB-contaminated electrical transformers that were safely disposed of	**Total amount of oil from electrical transformers that was exported for treatment during 2012-2016 (ton)**	**Total vehicles batteries exported during the period 2012-2016 (ton)**
90	**560**	**15,223**

Gaps

The State of Kuwait has one of the globe's highest rates of solid waste per capita at 1.32 kg/day, an amount that is challenging to manage. Although Kuwait comprises a small geographical area and has a relatively small population, it has a constant need for urban expansion and the consequent development projects, and also has a high standard of living. These factors combine to produce high amounts of solid waste from various sectors, including municipal, industrial, building and construction, medical, and waste from electronics and electrical equipment.

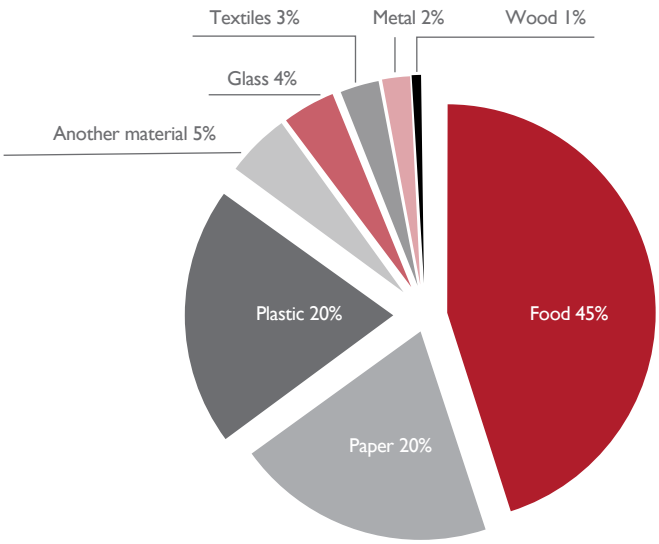
Dumping solid waste in landfills is – and long has been - the dominant method for solid waste management in Kuwait. Despite its limited area, Kuwait used to have a relatively

waste management in Kuwait. Despite its limited area, Kuwait used to have a relatively large number of landfills sites -18 in total. But because of improper disposal methods and concerns related to public health and the environment, 12 landfills were closed long before reaching their capacities; three of them are functional. Such dumpsites generate huge amounts of toxic gases (methane, carbon dioxide etc.) and are plagued by spontaneous fires.

Due to fast-paced urban development, residential areas have expanded over the years until reaching the edges of landfill sites, thus causing grave danger to public health. In addition, Kuwait encourages private companies to work with the recycling industry to reduce the quantity of wastes. Figure 13 summarizes the findings of the Waste Composition Study for Kuwait 2013 done by FICHTNER, which integrates the results from sample surveys performed over the course of six months in 2013 and presents the weighted average percentage shares of each waste fraction.

FIGURE 13

Weighted averages of all waste composition surveys in (After FICHTNER, 2013)



Currently, the rate at which Municipal Solid Waste (MSW) is generated stands at 1.32 kilogram/capita/day[41]. This far exceeds the global average of 0.74 kg/capita/day, and the regional (MENA region) average of 0.81kg/capita/day.

Kuwait produces more than 1.9 million tons of municipal solid waste annually. The solid waste management companies operating in Kuwait collect and transport waste to the landfills on a daily basis all year long. The municipality is now using three landfills for municipal solid waste as shown in Table 4, namely: Mina Abdullah; Al-Jahra; and South of 7th Ring Road. The total area of the aforementioned landfills is estimated at 9.44 Km2.

41 The world generates an average of 0.74 kilogram of waste per capita per day, yet national waste generation rates fluctuate widely from 0.11 to 4.54 kilograms per capita per day. Waste generation volumes are generally correlated with income levels and urbaniza tion rates.

TABLE 4

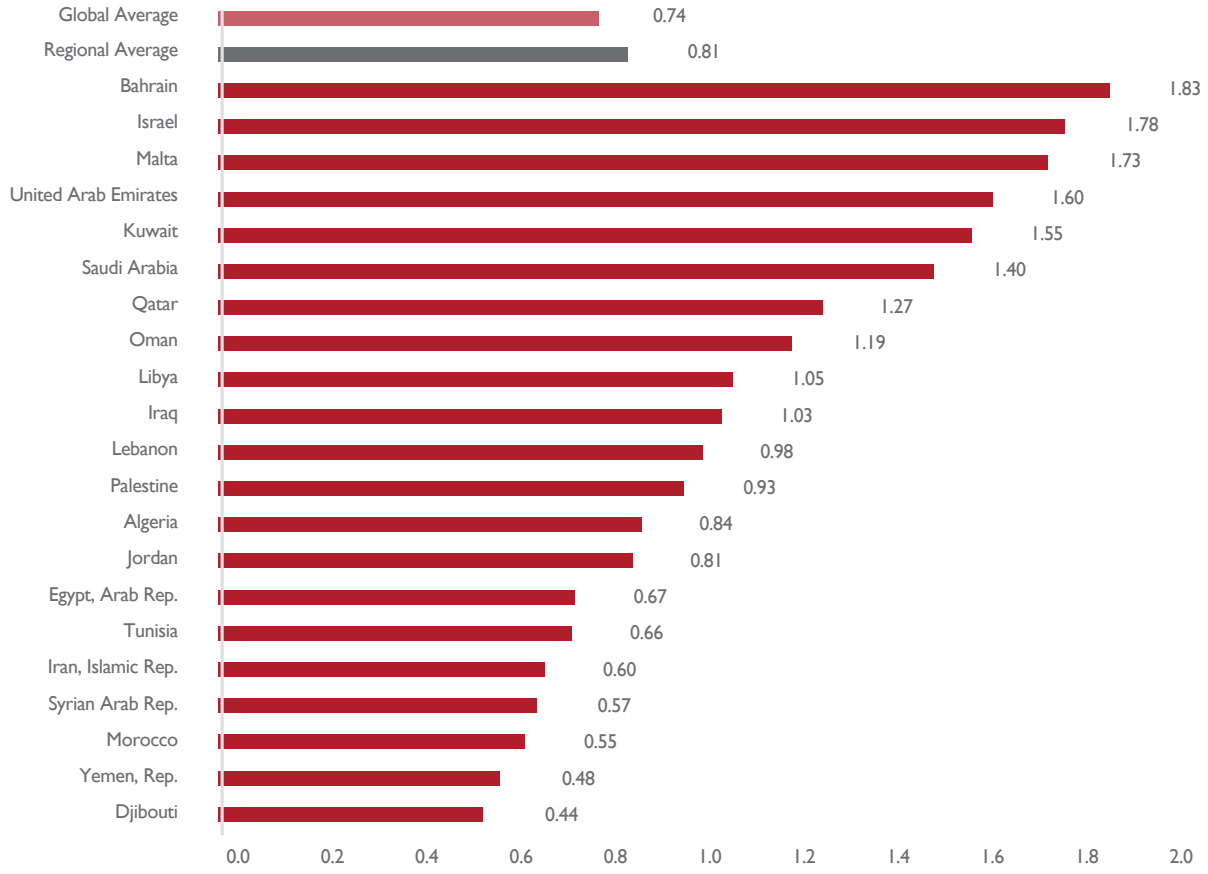
Municipal solid waste generated during 2016

Landfill	Area size km2	Solid waste -ton (for year 2016)
Mina Abdullah	2.42	478,254
South of 7th Ring Road	5.35	1,381,745
Al-Jahra	1,67	465,205
Total	9.44	2,325,204

In 2017, Kuwait generated about 3.85 million tons of solid waste. This can be broken down as follows: nearly 1.7 million tons of municipal waste; 1.3 million tons of construction and demolition waste; 0.44 million tons of agricultural waste; and 0.411million tons of commercial and other waste. There are more than 18 landfill sites in Kuwait, of which 14 were closed and four are in operations (three for MSW and one for CDW). All kinds of waste, including municipal wastes, food wastes, industrial wastes, construction and demolition debris, etc., are dumped at these sites. All of them are unsafe as well as poorly designed and operated. Most of them also are uncontrolled, which represents significant impacts to public safety (fires at closed sites), health and the environment (general population exposure to migrating landfill gases and groundwater contamination), and is coupled with inefficient use of scarce land resources.

FIGURE 14

Waste generation rates: Middle East and North Africa region - kg/capita/day[42]



42 World Bank, What A waste, 2018..

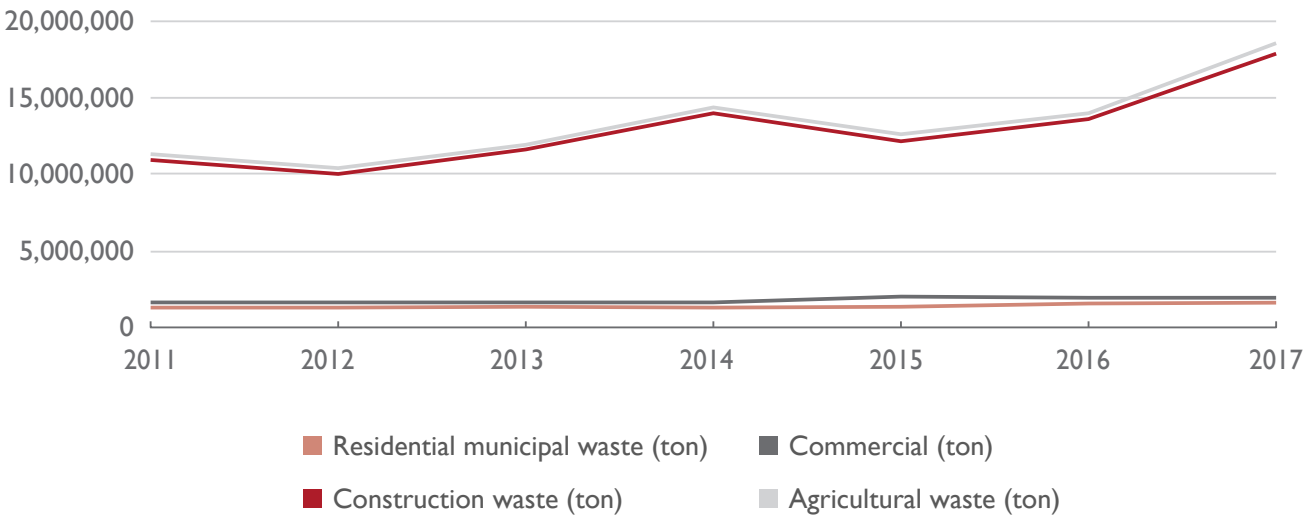
TABLE 5

Kuwait population and amount of waste arriving final dumping sites[43]

Year	2011	2012	2013	2014	2015	2016	2017
Population	3,065,850	3,246,622	3,427,595	3,588,092	3,743,660	3,925,487	
Residential municipal waste (ton)	1,357,395	1,425,023	1,487,265	1,490,235	1,527,878	1,567,965	1,696,923
Commercial (ton)	333,740	371,356	349,576	341,812	364,620	354,808	411,896
Construction waste (ton)	9,414,857	8,493,275	9,878,681	12,078,852	10,378,027	11,810,325	15,851,493
Tires (number)	940,800	883,911	904,084	900,673	1,091,220	3,691,191	19,365,789
Agricultural waste (ton)	142,752	132,267	181,461	265,725	368,934	403,431	437,832

FIGURE 15

Trends in amounts of waste arriving final dumping sites 2011-2017



43 Source of data is Central Statistical Bureau (CSB).

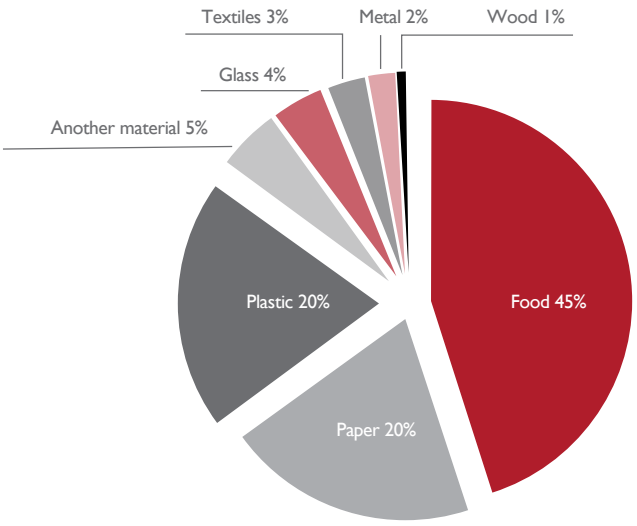
Industrial wastewater. There are seven industrial areas where a majority of the industrial units in Kuwait are concentrated. Most of these industrial areas are not connected to the sanitary sewer system. Then, the industrial wastewater effluents used to be discharged without any treatment into landfills that had been authorized by Kuwait municipality to be used as a dumping site (such as Jahra and South 7th Ring Road sites). Unfortunately, some of these industries disposed of their wastewater in open areas that were not authorized.

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 received load to about 15,000 cubic meters per day. Furthermore, Article (35) of the environment law No. (99) (amendment of the law No. (42) of 2014) committed all government agencies and the private sector to treat the industrial wastewater produced by their facilities. Accordingly, the Central Station was designated to receive the industrial treated wastewater from the different sectors

Clinical & healthcare waste The Kuwait Ministry of Health is the official body responsible for the disposal of medical waste and the treatment of such wastes through sterilization by autoclave and final backfilling in the Kuwait Municipality landfill sites. Most of waste is sent to incineration, which is carried out primarily for clinical and healthcare waste. Currently, the Ministry of Health manages three incinerators.

FIGURE 16

Amount of hazardous medical waste in Kuwait



Hazardous waste: Hazardous waste represents the smallest percentage of the total quantity of waste in Kuwait, but it poses a significant threat to the individual, society and the environment in general, and needs particularly conscientious treatment during its production, collection, storage, transport and disposal.

Hazardous waste management is an underdeveloped secto r in Kuwait, and there is rarely any controlled disposal of hazardous wastes in the region, although certain areas of dumps are usually designated for hazardous wastes. To address these deficiencies, Kuwait is beginning to put into place key elements such as: legal and institutional frameworks; preparation of national waste inventories and data management systems; techniques for waste minimization, management and safe disposal; and mobilization of financial and human resources.

Waste treatment practices in Kuwait are limited to incinerating medical waste, dumping industrial waste and exporting oil and batteries. In 2016, Kuwait incinerated 3,890 ton of medical waste, and dumped 77,310 ton of industrial hazardous waste.

The amount of hazardous waste generated in Kuwait is unknown because to date, waste sources have not been inventoried. For example, the amount of oil and equipment contaminated by poly-chlorinated bi-phenyls (PCB) is unknown and no inventory has been taken despite Kuwait's commitment to meet Stockholm Convention obligation in this area.

1. High waste generation rate

The population of Kuwait has increased by 5.4% annually on average during 1994-2016. The number of households (both nationals and expats) has been increasing as well, with an average growth rate of 7.4% annually. Kuwait is considered an urbanized country, as more than 98% of its population is considered urban. This percentage has remained almost unchanged during the last three decades. The economy of Kuwait has been growing at an average annual rate of 2.6%[44]. Both the population growth and the economic growth are strongly correlated with the MSW in Kuwait, R2 =0.87 and 0.81 respectively[45].

The high generation rate is also attributed to waste management behaviors at the source and attitudes to avoid consumables. Lack of awareness is a main reason waste generation rate is high.

In Kuwait, waste generation is dramatically high and continues to increase. Currently, there is an increase of the daily average per capita generation rate of MSW, which stands at 1.32 kilograms. Kuwait produces more than 1.9 million tons of municipal solid waste annually.

Public awareness activities to explain how to better manage waste at its source are limited. The municipality of Kuwait has been piloting awareness programs in schools to raise awareness about waste, but these activities are limited and do not represent a significant outreach to the broader public.

44 T. W. Bank. (2018). Kuwait. [Online]. Available: https://data.worldbank.org/country/Kuwait

45 A. Al Lahou and M. Alsabbagh, Assessment of Municipal Solid Waste Management in the State of Kuwait, International Journal of Environmental Science and Development, Vol. 10, No. 2, February 2019.

2. *Used landfill practices not sufficient for safe disposal*

At present, all wastes are randomly dumped into landfills without considering safety and environmental precautions from the point of collection and transportation to the last step of final cover in a landfill.

Dumping solid waste in landfills is – and long has been - the dominant method for solid waste management in Kuwait. Despite its limited area, Kuwait used to have a relatively large number of landfills sites -18 in total. But because of improper disposal methods and concerns related to public health and environment, 12 landfills were closed long before reaching their capacities; three of them are functional. Such dumpsites generate huge amount of toxic gases (methane, carbon dioxide etc.) and are plagued by spontaneous fires. All dumping sites in Kuwait are unsafe, poorly designed and operated. Most of them are also uncontrolled, which may significantly impact public safety (fires at closed sites), health and the environment (general population exposure to migrating landfill gases and groundwater contamination), and is coupled with inefficient use of scarce land resources.

Waste dumping practices have a distinct impact on air pollution, nature, land and people. Soil in the area may become saturated with chemicals or hazardous substances.

As buried organic materials decompose, they release methane, a potent greenhouse gas that contributes to global warming. The uncontrolled release of methane gas may create a fire risk in the area. In addition, the air surrounding landfill sites often smells unpleasant due to the decaying organic waste.

As rain falls on the dumping sites, organic and inorganic constituents dissolve, forming highly toxic chemicals that may leach into groundwater. Water that rinses through these chemicals collects at the base of the landfill and usually contains high levels of toxic metals, ammonia, toxic organic compounds and pathogens. This can result in serious contamination of the local groundwater.

Kuwait municipality recognizes the need to move toward engineered landfilling practices that mitigate all aforementioned impacts. The municipality has recently started to address this issue but has struggled with a prolonged procurement process and government bureaucracy.

3. *Limited recycling, reuse and recovery*

There are limited recycling and reuse activities in Kuwait. Currently, less than 2% of the municipal waste is recycled, mainly through scavenging activities by collectors.

In the conventional management hierarchy, recovery of materials via recycling means that waste materials are processed industrially and then reformed into new or similar products. This process requires separation of waste at some stage (preferably at the source). Recycling in Kuwait is complicated by poor separation of waste at its source, insufficient information on its economic feasibility and low awareness of its value.

Existing recycling data is scattered among private sector recycling businesses in Kuwait, and there is no central waste database that brings together reliable information on recycling.

Waste recovery[4] is also limited in Kuwait and made more difficult by the instability of the political decision making process. A key Waste to Energy (WtE) project has been pending a final approval for well over ten years; the project has struggled with a procurement process, government bureaucracy and final decision-making process that have all been prolonged.

The feasibility of WtE projects in Kuwait is challenged by the availability of cheap and subsidized energy sources, and also by an absence of government subsidies, tipping fees, and power purchase agreements for the generated power from waste.

The fact that WtE benefits extend beyond energy is not well articulated to the decision makers; in fact, WtE helps to reduce land consumption by landfills, reduce landfill rehabilitation costs, reduce greenhouse gases, among other benefits.

WtE has increasingly been identified as a renewable energy source of great potential, as it integrates both waste management and renewable energy production into a feasible solution. Given the large amount of waste generated daily and the pace of life in urban communities that continue to aggravate the problem of waste, this is an inexhaustible source of clean energy, one that also ensures that our waste is diverted from landfills.

Private sector participation in the waste recycling and recovery business is limited due to a lack of incentives, a clear legal framework and an absence of national standards governing recyclables. Waste recovery projects are also challenged by the lack of clear power purchase agreements.

BEST PRACTICE BOX

GCC countries have invested/plans to invest in waste to energy projects:

- Saudi Arabia's government has announced plans to develop 3GW of WtE facilities by 2030, in a bid to diversify its energy mix under the banner of Vision 2030.
- In Bahrain, the $480m Askar Waste to Energy facility expects to have a capacity of 1,068 tonnes per day when it launches, generating approximately 25MW of electricity. No date has been given for its launch, but the country aims to reach 700MW of renewable energy power generation by 2030 – met by a mix of solar, wind and WtE technologies.
- In UAE, the Federal National Council passed new legislation with the aim of recycling 75 per cent of all municipal solid waste by 2021, with some emirates seeking to achieve a "zero waste to landfill" target by the end of 2020.
- Emirates Waste to Energy Company – a joint venture between Sharjah's Bee'ah and Abu Dhabi's Masdar – announced plans in January 2017 for a facility that would incinerate around 900 tonnes of waste per day, generating 30MW, with a view to expanding capacity to 90MW.

46 Recover refers to converting non-recyclable waste materials into energy or useable materials, such as compost. Non-combustible materials, such as glass and metals, cannot be recovered; hence, they are sent to landfill to be disposed of in a sanitary way.

4. *Waste services are highly subsidized*

Waste services in Kuwait are highly subsidized. Kuwaiti households pay only 1KD every month (with the electricity bill) for waste, regardless of the waste quantities.

5. *Weak integrated waste planning and governance*

Kuwait currently lacks official documents outlining a national vision regarding waste management. The absence of defined, strategic objectives for the country has impacted the decision-making process for approving large-scale waste recycling and recovery projects.

PROPOSED VISION STATEMENT FOR KUWAIT

Kuwait is developing an effective waste management system that minimizes the adverse effects of waste generation and management on human health and the environment while enabling the effective application of the five-step waste hierarchy to ensure efficient, safe and environmentally sound utilization of waste streams as resource[47].

It is acknowledged that at the time of drafting this report, a process of developing a national waste strategy was underway. The strategy, however, needs to be backed up by strong governance and coordination among concerned agencies.

6. *Hazardous waste is not fully identified and undergoes limited treatment*

Hazardous waste represents the smallest percentage of the total quantity of waste in Kuwait, but it poses a significant threat to the individual, society and the environment in general, and needs particularly conscientious treatment during its production, collection, storage, transport or disposal.

Hazardous waste management is an underdeveloped sector in Kuwait, and there is rarely any controlled disposal of hazardous wastes in the region, although certain areas of dumps are usually designated for hazardous wastes. To address these deficiencies, Kuwait is beginning to put into place key elements such as: legal and institutional frameworks; preparation of national waste inventories and data management systems; techniques for waste minimization, management and safe disposal; and mobilization of financial and human resources. Waste treatment practices in Kuwait are limited to incinerating medical waste, dumping industrial waste and exporting oil and batteries. In 2016, Kuwait incinerated 3,890 ton of medical waste, and dumped 77,310 ton of industrial hazardous waste.

The amount of hazardous waste generated in Kuwait is unknown because to date, waste sources have not been inventoried. For example, the amount of oil and equipment contaminated by poly-chlorinated bi-phenyls (PCB) is unknown and no inventory has been taken despite Kuwait's commitment to meet Stockholm Convention obligation in this area.

47 Draft National Waste Management Strategy Kuwait, KEPA, 2019.

Kuwait also has ratified a number of Multilateral Environmental Agreements (MEA) concerned with identifying and safely disposing of hazardous waste such as: the Stockholm Convention on Persistent Organic Pollutants; the Rotterdam Convention on Hazardous Chemicals and Pesticides; the Minamata Convention on Mercury; and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. As part of its obligations toward these conventions, Kuwait is expected to develop national strategies to define and treat hazardous waste in the country. However, these plans have not yet been created.

Hazardous waste management includes the possession, transportation, handling, storage, and ultimate disposal of waste. However, in Kuwait the treatment of hazardous waste takes place in unregulated or uncontrolled conditions. It has been established that for most part, hazardous wastes are treated in unlicensed facilities using conventional methods such as dumping. The remainder of the waste is treated at authorized facilities with less advanced technologies and low environmental standards. These include incineration plants, landfills and oil recovery. An important fraction of hazardous waste is still mixed with nonhazardous waste and primarily sent to landfills, producing significant adverse environmental impacts from the heavy metals and persistent organic pollutants contained in landfill leachate. This creates a great health risk to municipal workers, the public and the environment.

The main problems affecting the management of hazardous waste in Kuwait include:

- Lack of necessary rules, plans, regulations, and instructions on different aspects of the collection and disposal of waste
- Inadequate institutional capacities
- Lack of hazardous waste prevention activities
- Mixing of hazardous waste with domestic waste or commercial waste
- Lack of collection facilities for hazardous waste
- Failure to quantify in reliable records the amount of hazardous waste generated
- Existing environmental permits mostly fail to allow best available technology
- Waste information systems are insufficiently detailed to gather information about the concentrations of hazardous substances
- Weak enforcement of and compliance with existing regulations.
- Lack of conformity with the best international practices on hazardous waste management
- Inadequate infrastructure and self-sufficiency in hazardous waste management
- Lack of guidance, awareness, and training on how to build capacity for the management of hazardous waste from all sectors

VI. Eco-cities

Existing policies

Kuwait currently lacks a policy framework for addressing urban ecology concepts. The closest policy framework components in support of green infrastructure concepts in Kuwait are building codes that specify a minimum thermal resistance for walls and roofs, size and quality of glazing, and fresh air requirements.

The Ministry of Electricity and Water (MEW) has enforced minimum requirements for efficient energy use in the buildings sector for all new and retrofitted buildings since 1983. This enforcement has been administered through an Energy Conservation Code of Practice that was prepared in accordance with the decision taken by the Council of Ministers in its session 18/80 dated April 20, 1980. The action was spurred by the fact that consumers pay only a fraction (5% to 10%) of their actual power and energy costs.

A revised version of the energy conservation code of practice was developed in 2010, and it contains more stringent energy efficiency requirements for both new and retrofitted buildings in Kuwait.

The 2010 code of practice has several additional requirements compared to the 1983 version. In particular, the 2010 energy conservation code of practice requires the use of thermal breaks for windows frames, more stringent window sizes and properties, use of programmable thermostats, use of more efficient air conditioning systems, and use of proven technologies such as variable speed drives, cool recovery units, and cool storage systems. On the urban planning front, there is also no policy framework that enables eco-cities concepts to be integrated into a master planning process. However, one of the Hareer City's proposed four villages is the Ecological Village, which will include national parks and

reservations for wild animals and rare plants 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. On the other hand, the whole Silk City[48] will be surrounded by a green belt of gardens and vast green spaces to guarantee that visitors and residents enjoy an unpolluted atmosphere.

Currently, KEPA is partnering with the National Parks Board of Singapore toward adopting the Singapore Index on Cities' Biodiversity.

Gaps

Since the first half of the twentieth century, Kuwait has transformed from a small, walled city to a metropolitan area experiencing rapid and unprecedented population growth with only a relatively small increase in the size of urban areas. Most of the developed areas are located along the coastal side of the country. This has caused lifestyle, economic and environmental issues[49]. Accordingly, the government is envisioning, planning and building new satellite cities at the periphery of existing centers.

The collective urban area of Kuwait covers 5.45% of the total land area of Kuwait[50]. The largest urban agglomeration in Kuwait is referred to as the Kuwait Metropolitan Area, which occupies 4.9% of the total land area of Kuwait. Outside of the Kuwait Metropolitan Area (KMA), developments such as the Sabah Al Ahmed New City and Sabah Al Ahmed are well underway.

Based on the Emir's Vision to create a financial and trade center, Kuwait has a two-part strategy for planning its future. Part one is the Kuwait National Development Plan (KNDP), which sets in place the economic development strategy to 2035. Part two is the Fourth Kuwait Master Plan (4KMP), which sets in place the physical planning strategy to 2040.

The 4KMP guides the physical development of the country through a vision of its environment, planning principles, planning strategies and key projects for implementation. The plan operates at a range of scales (national, regional, metropolitan and municipal), providing a full picture of where we are headed and what we need to prioritize to get there.

4KMP recognizes sustainability as a key driver of the spatial plan and national plans generally. Its absence from preceding plans has resulted in the emergence of several unhelpful and unsustainable trends in energy, water, urban design, planning, health and human capital. Driving the changes are several scenarios that are used to make projections of future greenhouse gas (GHG) emissions and assess future vulnerability to climate change. Producing scenarios requires making estimates of future population levels, economic activity, and the structure of governance, social values, and patterns of technological change. Economic and energy modeling can be used to analyze and quantify the effects of such drivers.

48 Madinat Al-Hareer (Silk City). Madinat Al Hareer project 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.

49 Alghais and Pullar, 2016.

50 Fourth Kuwait Master Plan (4KMP), strategy to 2040.

Continuation of unsuitable development practices will cause environmentally damaging trends to continue and potential solutions to these to become more difficult and expensive to implement. Continued rates of energy and water consumption, coupled with population growth, will continue if there is no incentive to economize.

A well-planned, designed and managed green infrastructure for Kuwait will promote healthier living, reduce the impacts of climate change, improve air quality, encourage walking and exercise, reduce the carbon footprint, and improve biodiversity and ecological resilience. Moreover, research on natural capital demonstrates that investing in green infrastructure provides economic benefits to people, such us reducing the need for medical treatments.

WHAT IS "GREEN INFRASTRUCTURE"?

Green infrastructure is an adaptable term used to describe an array of products, technologies and practices that use natural systems – or designed systems that mimic natural processes – to enhance environmental sustainability and human habitability (quality of life).

The three most common approaches to green infrastructure focus on the role of ecosystem services, green engineering and linked green spaces[51]. Green infrastructure is most often used as a way of integrating urban ecology into the built environment.

51 Pitman, S. D., & Ely, M. E. (2015). Green infrastructure as life support: urban nature and climate change. Transactions of the Royal Society of South Australia

Therefore, the design of distinctive public and open spaces in Kuwait will have a strong focus on providing good vegetative cover, retaining existing vegetation and creating opportunities for native plantings to thrive. In addition, special attention should be given to the design of green streets and green buildings and roofs.

Landscape connectivity is essential to connect people with the environment, including connectivity among green spaces, good street connectivity and connections with surrounding neighborhoods. Contact with nature promotes human health and well-being. Hence, green spaces and nature can be key design elements.

WHAT IS URBAN ECOLOGY?

Urban ecology is the study of all living organisms (people, plants and animals) located in urban environments (Parris, 2016)[52]. In general, it is concerned with the distribution, abundance and behavior of organisms and their interactions with the environment. Urban ecology is focused on biodiversity and ecosystem services, with an emphasis on how these vary across space and time, considering the influence of environmental impacts and urbanization processes (Wu, 2014)[53].

Biodiversity is important to conserve in cities because it provides ecosystem services, including health and well-being benefits, and is crucial for the conservation of threatened species and ecological communities.

The primary driver of biodiversity loss in Kuwait cities is the loss of habitat and the subsequent decline in remaining habitat. Urbanization causes changes in both abiotic conditions (e.g. microclimate, lighting, noise, hydrology, biogeochemistry, the introduction of artificial structures, and disturbance patterns) and biotic interactions (due to changes in the occurrence and abundance of organisms) that can affect biodiversity in cities.

As Kuwait is witnessing vast urban development and considering the establishment of new cities according to the new 4KMP, it is becoming increasingly important to address urban ecology and associated human well-being in urban planning.

Kuwait is experiencing a continuous decline and degradation in natural areas as a result of the accelerated pace of urban encroachment needed to meet the increased demand for land by different sectors of the economy and the continuous increase in the number of foreign laborers in Kuwait. The coastal areas have been developed to accommodate a growing population's needs for housing and commercial and industrial activities. As well, these marine areas have been dredged for their coarse sand, which is needed for use in construction.

52 Parris, K. M. (2016). Ecology of Urban Environments. Oxford: John Wiley and Sons.
Paul, M. J., & Meyer, J. L. (2001). Streams in the urban landscape. Annual Review of Ecology and Systematics, 32, 333-365. doi:10.1146/annurev.ecolsys.32.081501.114040.

53 Wu, J. (2014). Urban ecology and sustainability: the state-of-the-science and future directions. Landscape and Urban Planning, 125, 209-221.

1. Rapid urbanization leads to habitat loss

Kuwait is witnessing significant urbanization processes that have myriad impacts on landscapes, such as habitat loss and the subsequent decline in habitat quality; changes to abiotic conditions (e.g. microclimate, lighting, hydrology, nutrient availability, exposure to contaminants and the introduction of artificial structures); and changes in the biotic environment (due to the effects of urbanization on the occurrence and abundance of species).

Kuwait intends to implement the Islands Project, which seeks to support the country's development through various projects on some of its islands. These islands will be turned into free trade zones that link the East to the West. The initial phase of this ambitious project calls for the transfer of five of Kuwait's uninhabited islands (Boubyan, Failaka, Warba, Miskan and Ouha) into economically vibrant areas.

In addition, Al-Harer city is a new planned city that is part of Kuwait's future development strategy in north Kuwait. New city housing there is projected to accommodate 700,000 people.

These massive urban developments in Kuwait have no clear strategy aimed at mitigating urbanization's adverse impacts on biodiversity or, more broadly, on the environment.

2. No legal framework promoting green building concepts in Kuwait

Currently, the framework available to support green building in Kuwait is limited to the energy conservation code put in force in 1983. That code lacked effective monitoring, verification and enforcement, and it was not revised for 27 years. The building sector is a major source of inefficient energy consumption, with a very large stock of energy-inefficient buildings.

Nearly three decades later, a revised version of the code was developed with more stringent requirements for energy efficiency measures in new buildings. This 2010 energy conservation code was updated again in 2014 with even more rigorous standards for the minimum requirements for energy-efficient design of new buildings in Kuwait.

There is no clear framework that sets minimum requirements for green building in terms of material properties, green cover and energy and water-saving measures. Absence of such a framework leads to a weakening of the green market and limits opportunities to having green developments. The framework would provide incentives for green buildings and open the horizon for more awareness about the benefits of green buildings.

3. Absence of green infrastructure concept

Kuwait's infrastructure sector is expected to grow by 15% to 20% as a result of the government's current five-year plan (2015-2020). The development plan focuses on the economic reform and implementation of several long-stalled mega projects and their associated, large infrastructure projects. The plan includes: a number of infrastructure upgrades; a new airport; five new planned cities; and a large number of mega oil projects, including a new refinery. The government is also working to deliver hospital projects as part of its plan to boost the bed capacity of hospitals across the country.

The rising demand for public housing is expected to drive long-term residential construction growth, with the Public Authority for Housing and Welfare announcing plans to build 174,000 housing units by 2020.

Currently, these mega infrastructure projects in Kuwait are not contained under a green infrastructure framework. As a result, the impacts of these projects on the environment are likely to be high if no action is taken to "green the blue" (i.e. infrastructure). The construction and operation of infrastructure generally poses risks to the local environment, which will result in environmental damage if not adequately mitigated.

4. Limited open spaces and green cover

Kuwait's urban areas currently have limited open green spaces, which limits opportunities for physical activities. Absence of distinctive public and open spaces will adversely impact the vegetative cover by reducing the existing vegetation and the opportunities for native plantings to thrive.

There is evidence that urban green spaces can provide adequate resources for vulnerable biodiversity, support high numbers of threatened species and, therefore, play key roles in conserving the unique biodiversity of Kuwait.

Changes in urban density in Kuwait have accelerated the loss of open space and have consequently contributed to a decline in urban biodiversity.

Kuwait lacks shade in many places where it should be provided. Engineering criteria – not the principles of a comfortable street environment – drive street design. New planning criteria for urban streets that favor human comfort, including landscaping and shading, is critical for designing a comfortable city.

VII. Sustanaible water

Water status in Kuwait

Kuwait is one of the world's most water-stressed countries, with the lowest per capita renewable internal freshwater availability of any country[54]. The country is highly water-stressed with internal renewable less than 70 mm/y, and high dependency on trans-boundary aquifers[55]. Groundwater in Kuwait consists of fresh (less than 1,000 mg/l TDS), brackish (1,000 to 7,000 mg/l TDS) and saline (between 7,000 to 20,000 mg/l, PAAF, 2006).

Fresh groundwater is not used for agriculture but is considered as a strategic freshwater reservoir for drinking water purposes. It is mostly available in the two fields of Raudhatain and Umm Al-Eish. These freshwater lenses are formed due to a combination of unique conditions that include high intensity rainfall of short duration, and a geomorphology and lithology that enable rapid infiltration to the underlying groundwater. From historical pumping and water quality variation data acquired between 1963 and 1977, the sustainable extraction rate for Raudhatain and Umm Al-Eish, which would avoid the uplift of deeper saline water, is estimated to be 3,500 and 5,500 m3/day, respectively.

The Rawdatain Bottling Company is currently producing water at a maximum rate of up to 0.5 MIGPD (2275 m3/d) from the Raudhatain field with no production by MEW.

Brackish water is used for agricultural and domestic purposes and as drinking water for cattle. This water is produced from the Al-Shigaya, Al-Qadeer, Sulaibiyah, Wafra and Abdally fields. The production capacity of these fields is about 545,000 m3/day. In general, **ground**

54 FAO AQUASTAT data accessed June 2016.
55 Water resources trends: Hydrol. Earth Syst. Sci., 16, 3101–3114.

water quality and quantity are deteriorating due to the continuous pumping of water. In Wafra in the south, 50% of the wells pumped water that had a salinity level higher than 7,500 ppm in 1989, reaching 75% and 85% in the years 1997 and 2002, respectively. In Abdally in the north, these figures were estimated at 55%, 75% and 90%, respectively. For Wafra, wells were monitored over a similar time period, and results showed that total salinity (TDS) is increasing from 5-14,000 ppm to 8-14,000 ppm in wells.

Desalination

The history of desalination in Kuwait dates to 1951 when the first distillation plant was commissioned. In 2016, the total installed capacity of all desalination plants reached 624.3 million imperial gallons per day, i.e. 2.84 million m^3/d.

Supplies are provided by desalinated seawater (about half the total), groundwater and treated wastewater. On a per capita basis, roughly 900 liters per day are consumed in Kuwait, one of the highest rates in the world[56].

Desalinated water is produced in six multi-stage flash **distillation plants that provide more than 90% of potable water needs**. Kuwait's aquifers are all dependent on trans-boundary recharge from surrounding countries and largely yield brackish water used for agricultural and domestic purposes and as drinking water for cattle. The reuse of treated wastewater in Kuwait is limited mainly to agricultural and landscape irrigation.

The installed capacity of desalination plants in Kuwait in 2014 was 528 MIG/d (2.40 Million m3/d). The average daily demand stood at 398 MIGPD (1.81 Mm3/d) at the same time, with the maximum consumption during September 2014, hitting 450 MIGPD (2.05 Mm3/d).

The average per capita consumption in that year was 442 l/d/capita. Compared with industrialized and other developing countries, the average annual freshwater consumption in Kuwait (450 – 500 l/d/capita) is very high. The freshwater consumption in Kuwait has a strong seasonal variation. During the hottest months of the year (June–September), the consumption of freshwater is on average 15%–25% higher than the yearly average.

Due to the large and continuous increases in population size, urbanization rates, income levels and economic activities, **consumption of potable water in Kuwait has witnessed record increases since the start of production of water desalination plants**. Between 2006 and 2016, potable water consumption increased by 3.3% per year and production of water increased by the same rate.

Groundwater

Brackish groundwater is mainly used for irrigation and landscaping, livestock rearing, construction work, non-potable use in households, and for mixing with desalinated water at ratios of up to 10% of the total volume to make the mixture potable.

The production of brackish water reached its peak in 2006 (36,234 MIGPD; 164.7 Mm3/d), after which there was a gradual decline in response to the availability of treated wastewater for irrigation and the awareness within the Ministry of Electricity and Water (MEW) about the need to preserve this strategic resource for posterity.

56 ESCWA (2011).

As of 2014, MEW and the Kuwait Oil Company (KOC) were producing annually 17,996 MIG (81.8 Mm3) and 1,663 MIG (7.6 Mm3) of brackish water, respectively (MEW, 2015), giving an average daily production of 53.9 MIGPD (244,849 m3/d).

The maximum daily net consumption of brackish water during the summer of 2014 reached 73.8 MIGPD (335,495 m3/d) with a yearly average of 52 MIGPD (236,392 m3/d).

Kuwait's daily brackish water production and consumption have constantly declined. During the same period (2006-2016), consumption of brackish water declined annually by 3.8% while production fell annually by 4.5%.

FIGURE 17

Daily potable water production and consumption in million imperial gallons (2006 – 2016)

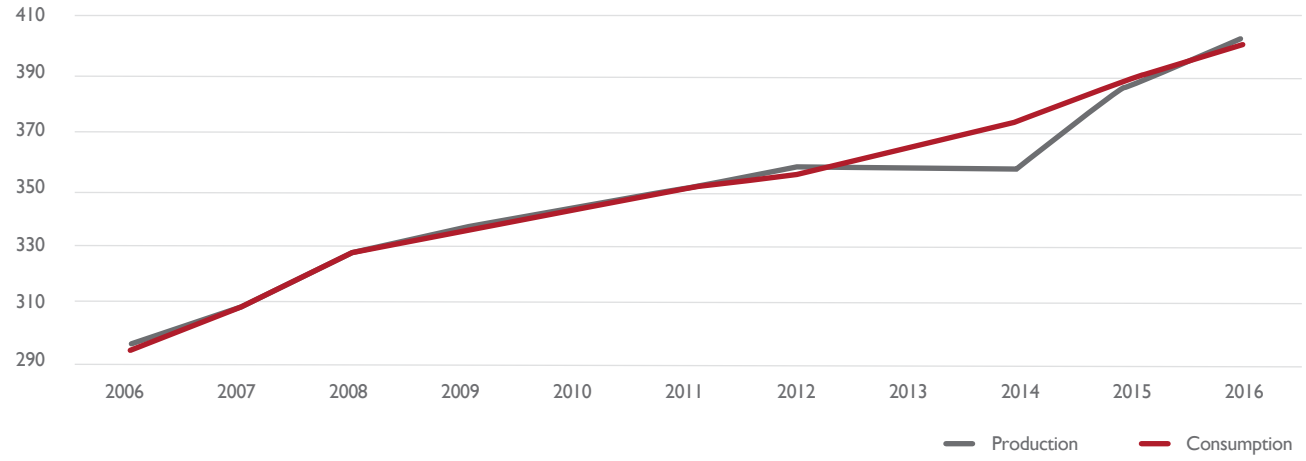


FIGURE 18

Daily brackish water production and consumption in million imperial gallons (2006 – 2016)

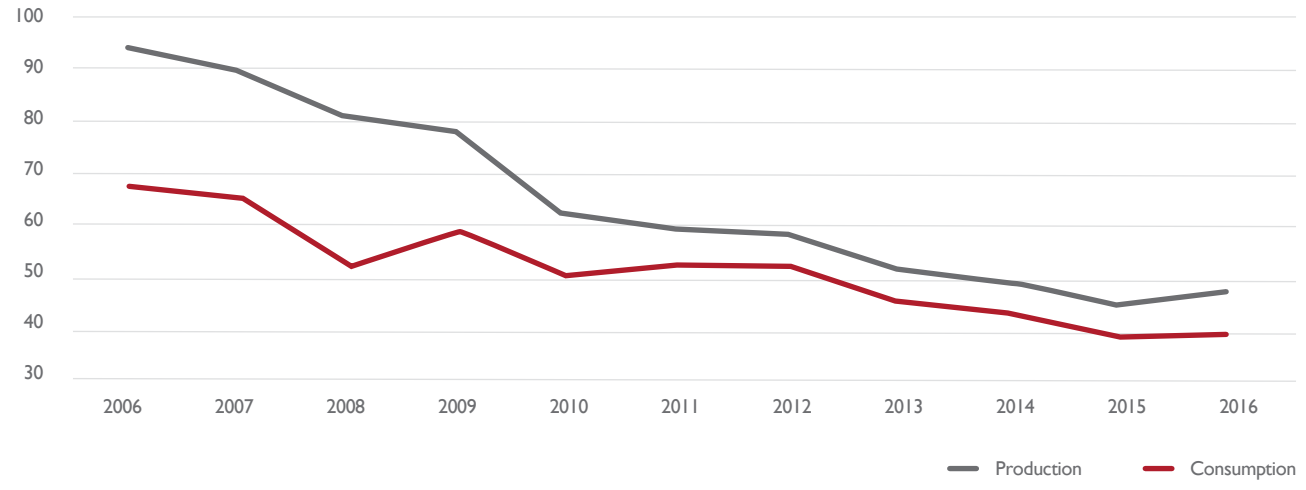
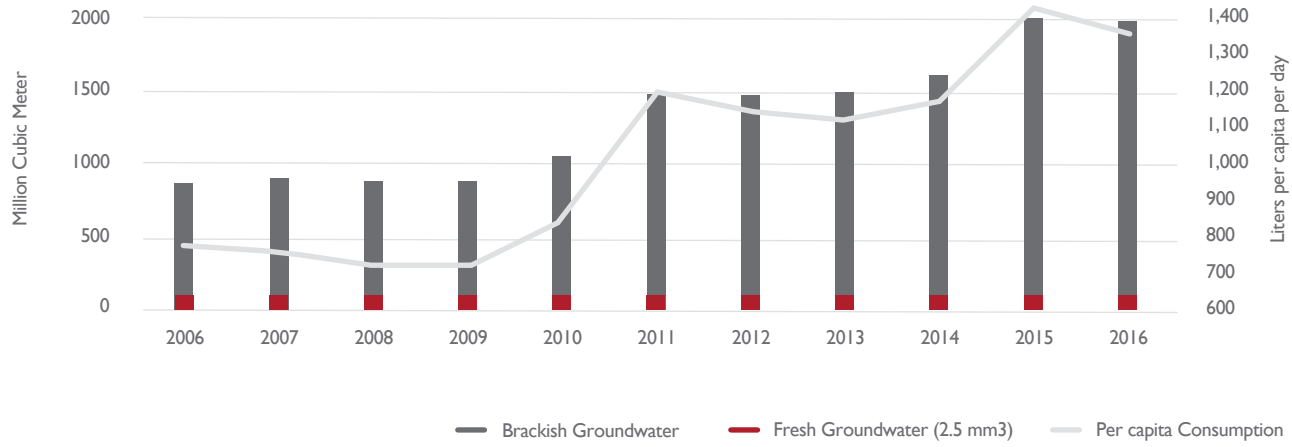


FIGURE 19

Kuwait groundwater use, 2006-2016



Source: Central Statistical Bureau.

Wastewater

Over 90% of the population is connected to a central sewage system. This offers an important potential for treated wastewater (TWW) reuse that can help to alleviate the water shortage problem. The complete plan is to distribute water from the Sulaibiyah treatment plant as follows: 40% to the south for the Wafra agricultural area, 40% to the north to the Abdally agricultural area, with 20% to remain in the Sulaibiyah area. There are GCC guidelines allowing use of quaternary TWW for growing vegetables, fruits and other crops in times of crises. Tertiary TWW is used in landscaping based on the decisions from the Council Ministry number 29-30.

Kuwait has recently implemented a vigorous campaign that aims to reclaim and reuse all treated wastewater. An analysis of the historical records from the wastewater treatment plants has indicated that the reuse of reclaimed wastewater in Kuwait has greatly reduced the amount of pollutants discharged into the sea, from about 65% of treated wastewater in year 2000 to less than 30% in year 2010.

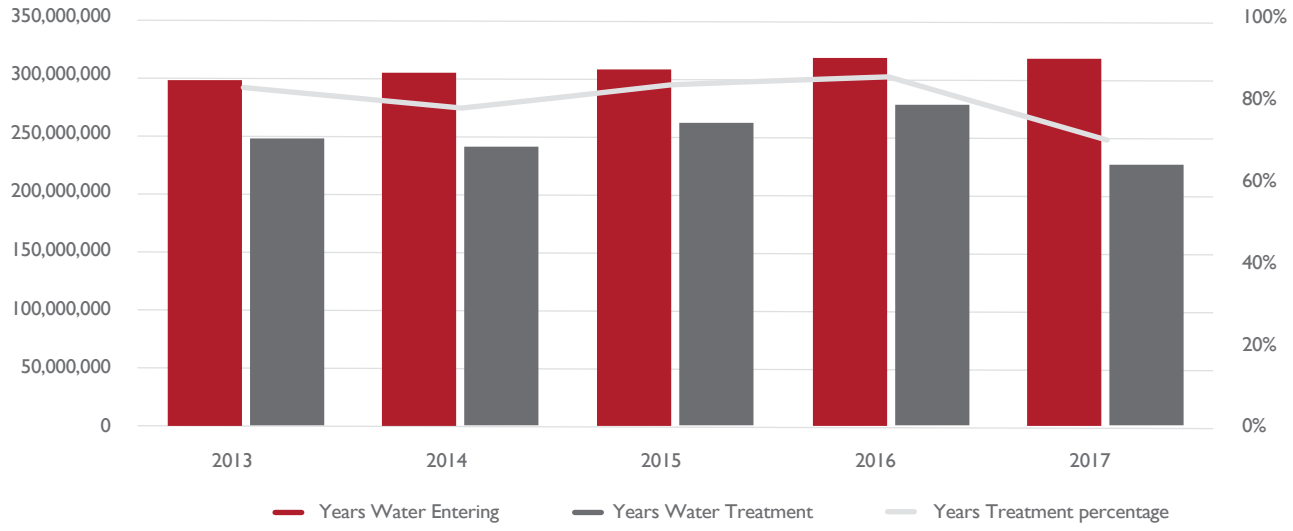
The management of domestic wastewater is one of the tasks of the Ministry of Public Works, which is the responsible authority for operating and conducting the necessary routine and emergency maintenance on domestic wastewater plants. Kuwait established its first sewer system in1965, while its first domestic wastewater treatment plant was commissioned in 1970 - with a capacity of 100,000 m3/day. By 1994, there were three established domestic wastewater treatment plants. To meet the further increase in the rate of water consumption per person (275 liter\day), more domestic wastewater treatment plants were built, raising the total to seven.

More than 80% of the wastewater is treated to advanced levels using ultrafiltration (UF) through reverse osmosis (RO) membranes at the Sulaibiya plant. Each of the other plants treats wastewater to a tertiary level using sand filtration and chlorination. Most of the treated wastewater is pumped to storage reservoirs. There is a distribution network that connects the reservoirs with the main farming areas in Sulaibiya, Abdally and Wafra.

The quality of the treated municipal wastewater in Kuwait is very good[57], and is thus suitable for many reuse applications other than agricultural irrigation. To maximize the benefits of wastewater reuse, the country needs to diversify the applications for which such water is used. Other applications such as: urban domestic supply (e.g., toilet flushing, vehicle washing, and fire protection); industrial supply (e.g., cooling water and boiler feed-water); environmental supply (e.g., irrigation of golf courses, hunting and equestrian clubs); and artificial recharge of groundwater should be encouraged.

FIGURE 20

Total quantities of raw and treated sewage water in treatment plants (m3/year) 2013-2017[58]



57 A. Abusam & A. B. Shahalam, Wastewater reuse in Kuwait: opportunities and constraints Water Research Center, Innovative Technologies for Water Treatment and Reclamation Program, Kuwait Institute for Scientific Research, Kuwait. 2013

58 Source of data is Central Statistical Bureau (CSB)

In fact, several technical, social-economic and cultural factors constrict gray water reuse in Kuwait. For example, there are no quality guidelines or standards for gray water reuse. However, the main problem is of a cultural nature. Many do not accept gray water. This constraint could be overcome through education and by gaining the community's trust in the quality of the treated wastewater.

Kuwait has recently implemented a vigorous campaign that aims to reclaim and reuse all treated wastewater. An analysis of the historical records from wastewater treatment plants has shown that the reuse of reclaimed wastewater in Kuwait has greatly reduced the amount of pollutants discharged into the sea, from about 65% of treated wastewater in year 2000 to less than 30 % in 2010. Results show that more than 50% of the reduction in the volume of wastewater discharged into the sea was achieved from 2000 to 2010[59].

E. coli and enterococci levels are used as indicators of the presence of fecal material in drinking and recreational waters. Both indicate the possible presence of disease-causing bacteria, viruses, and protozoans. Such pathogens may pose health risks to people fishing and swimming in a water body. Sources of bacteria include improperly functioning wastewater treatment plants, leaking septic systems, stormwater runoff, animal carcasses, and runoff from animal manure and manure storage areas.

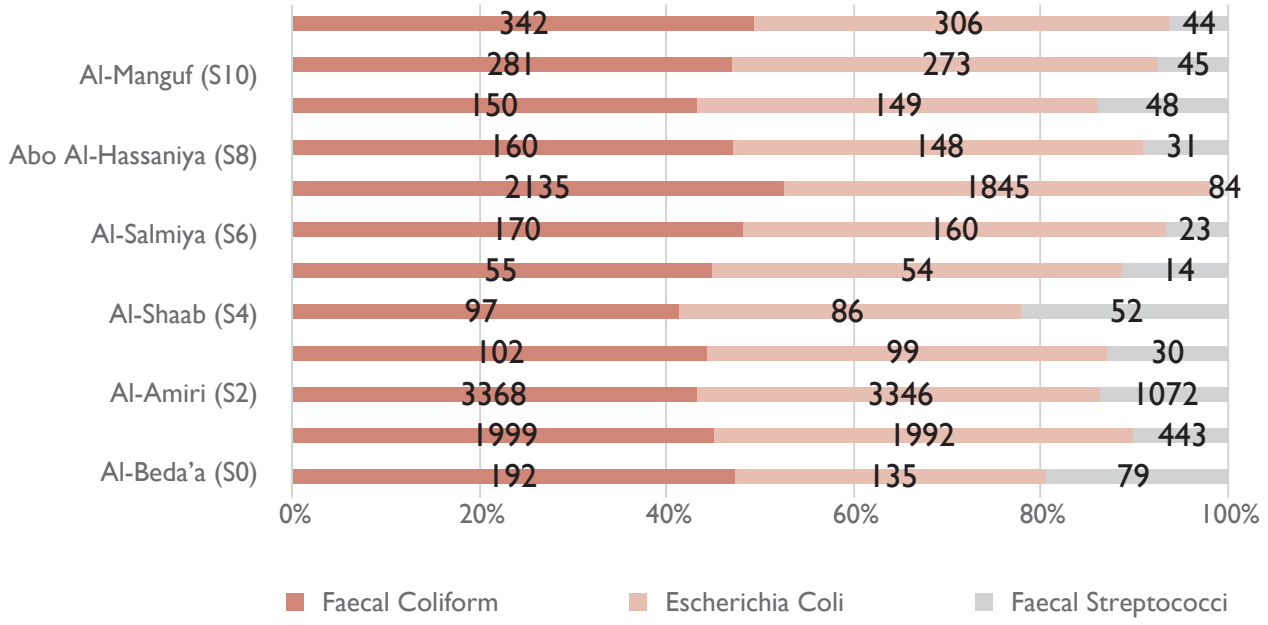
Acceptable levels of E. coli are measured in cfu (colony forming units) and commonly include both a 30-day mean (126 cfu/100ml) and a single sample number (235 cfu/100ml – 575 cfu/100ml).

Figure 21, below, shows the results of the analyses and tests conducted by KEPA on water samples taken from ten extended stations on the southern coast of Kuwait in 2017. The results show the 2017 average results of coastal water pollutants in cfu/100ml, such as fecal coliform, Escherichia coli, and fecal streptococci that potentially come from municipal wastewater leakages. The results show E.coli exceeds the limit of 126 in most sites, which may suggest possible sewage leaks.

59 Al-Anzi et al. Assessment of Waste Water Reuse in Kuwait and Its Impact on Amounts of Pollutants Discharged into the Sea. (2012).

FIGURE 21

Average results of testing coastal water pollutants in 2017 cfu/100ml[60]



60 Source : Environment Public Authority (EPA).

FIGURE 21

Relevant SDG 6: Ensure access to water and sanitation for all

SDG indictors in Kuwait

6.3.1 Proportion of wastewater safely treated (2016)	6.2.1 Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water	6.1.1 Proportion of population using safely managed drinking water services
85	100	100
Total production capacity of ground water in Kuwait (million gallons per day)	**Total production capacity of distilled water in 2018. (million gallons per day)**	**Total consumed fresh water in 2017 (million Imperial gallons)**
145	623	160,205
		Total production capacity of the Rawditeen groundwater aquifer (million Gallon per day)
		2-1

Gaps

1. Water subsidies

Rising per capita income together with government-fixed low prices have caused a steep rise in average per capita water consumption (from around 113 l/d/capita in 1970 to a maximum around 500 l/d/capita in 2002). To rein in this rise in water consumption, the government should earnestly consider a substantial reduction in subsidies.

Following the sharp drop in crude oil prices, which began in the second half of 2014, the government introduced a package of financial and economic reforms that included, among other things, increased fuel, electricity and fresh water prices.

In order to control such extraordinary levels of consumption, the government managed to pass a law in 2016 that reduced public water subsidies (where the production of each gallon of water costs 6 KD and is sold to consumer for 800 fills) by adjusting the cost of water consumption to different consumer segments. The new water tariffs are as follows:

- Investment, trade and government sectors: 4.0 KD per 1,000 imperial gallons
- Industrial and agriculture sectors: 2.5 KD per 1,000 imperial gallons
- Water filling stations: 1.0 KD per 1,000 imperial gallons

However, the private residential housing segment was excluded from the water and electricity price adjustments due to tough opposition by the parliament.

2. High water consumption rate

Rising per capita income together with government-fixed low prices have been responsible for a steep rise in average per capita water consumption (from around 113 l/d/capita in 1970 to a maximum around 500 l/d/capita in 2002). To rein in this rise in water consumption, the government should earnestly consider a substantial reduction in subsidies.

Beside the rise in per capita consumption, the increase in population is another major factor in the rise of Kuwait's water consumption.

In addition, weak adoption of water-saving equipment at the consumer end, including drip irrigation and sprinklers for irrigation of private and public gardens, reduces opportunities to save a large volume of water.

3. Impacts of desalination intakes and brine disposal on marine life

A plant's water intake is critical both to the operation of the plant itself and to the surrounding environment. Loss of biota may result at the water intake zone due to impingement and entrainment effects and the chlorination process. Chlorination is used to combat biofouling in the uptake zone.

The desalinated plant separates the water into two streams - the desalinated water and the brine. The rejected brine is then discharged into the sea. The characteristics of the rejected brine depend on the quality of feedwater used, desalination techniques, percent recovery and chemical additives used for the process.

Most of the desalination plants in Kuwait are located on the coast and their brine is discharged directly into the near shore. There is scarce information available on impacts of these brines on biota in Arabian Gulf.

The most common, inexpensive and least hazardous method of brine disposal is ocean discharge. With this method, the brine - due to its higher density - sinks to the bottom and gets mixed with ocean water with similar physio-chemical characteristic, which is potentially safe for the environment. However this method is of concern in areas like Northern Arabian Gulf where the bathymetry is extremely shallow. In such cases, **the spatial distribution of brine becomes a matter of concern and hydro-dynamics and sea surface temperature and salinity will give a clue as to how much spatial extent is affected during different tidal conditions**. In a typical thermal desalination process, about 4.5 m3 of seawater is used to produce 1 m3 of desalinated water.

The environmental impact of brine discharged in the open sea poses a significant concern. This is true even though the salt discharged is similar to that in the open sea and that in most of the cases, the brine is blended with cooling water before it is released to the sea. This blending of brine with cooling water lowers the salinity of brine to not more than three times that of open sea.

But this effect is extremely important in semi-enclosed areas with very limited fresh water input, shallow bathymetry and weak circulation, like the situation in the Northern Arabian Gulf. Native species in the area can typically tolerate occasional variations in salinity and limited temporal exposures. However, **they may be unable to tolerate continuous exposure to increased salinity, leading to extension or** reduction **of** biodiversity. The issue of hyper-saline conditions is critical for fragile and sensitive ecosystems like the one in study area.

All desalination processes produce large quantities of brine water, which may be at increased temperatures and contain residues of pretreatment and cleaning chemicals, their reaction byproducts, and heavy metals due to corrosion. A high concentration of salt is discharged to the sea through the outfall of desalination plants, which leads to the increased level of salinity of the ambient seawater.

Generally, the ambient seawater salinity in the Gulf is about 45 ppm and the desalination plants **increases this level in its vicinity by about 5 to 10 ppm on average above the ambient condition**.

Enclosed and shallow sites, like the one in Arab Gulf where marine life abounds, can generally be assumed to be more sensitive to desalination plant discharges than exposed, high energy, open-sea locations, which are more able to dilute and disperse the discharges. The desalination process and the type of pretreatment applied have a significant effect on the physio-chemical properties of the discharges.

Every Kuwaiti desalination plant is combined with a power plant where the water temperature of the power plant effluents is high and will increase the ambient temperature of the surrounding seawater. During summer, the ambient seawater temperature is about 35 °C on average and the power and desalination plants cause an increase in the temperature level in its vicinity of about 7 to 8 °C above the ambient condition.

The constant discharge of reject streams with high salinity and temperature levels **can thus be fatal for marine life**, and can cause a lasting change in species composition and abundance in the discharge site. Marine organisms can be attracted or repelled by the new environmental conditions, and those more adapted to the new situation will eventually prevail at the discharge site.

VIII. Recommendations

This report has identified multiple gaps that could be potentially addressed in the new KNDP 2020-2025. Specifically, it is recommended to:

- Strengthen the institutional set-up to support the delivery of the 15% renewable energy target. This can be done through establishing a central organizational body that leads in planning and delivering sustainable energy solutions, and also strengthens coordination among concerned stakeholders.
- Foster greater participation by the private sector in environmental issues, particularly in the advancement of the renewable energy and waste sectors.
- Enhance strategic planning of key environmental sectors mainly renewable energy and waste, through development of national strategies and action plans covering key waste and renewable energy issues.
- Undertake comprehensive Derisking Renewable Energy Investment analysis to identify barriers and to quantitatively compare the cost-effectiveness of different public instruments in promoting renewable energy investment.
- Address the key barriers facing the enhancement of sustainable energy solutions by better managing subsidies and creating incentives schemes to encourage community and private sector participation.
- Increase awareness about key environmental issues such as waste generation, energy efficiency and dealing with air pollution incidents.
- Enhance enforcement and compliance with environmental laws in the country, especially when it comes to pollution incidents.
- Phase out waste-dumping practices and move toward engineered landfilling to reduce land consumption and avoid adverse environmental effects.

- Encourage recycle, reuse and recovery waste resources practices and decrease the amount of waste going to landfills. Governments, industries and communities all have a role to play in waste avoidance. Changing consumer awareness and behavior also is critical.
- Inventory all types of hazardous wastes in the country and identify quantities and treatment methods as appropriate.
- Develop clear emergency plans to address the air pollution incidents in Kuwait, especially in the case of gas leaks.
- Integrate the eco-cities concept into the master planning process to ensure that environmental concerns are addressed early.
- Pilot green infrastructure concepts in new, planned cities.
- Improve and expand the network of open green spaces and green belts.

These recommendations will be further explained and addressed in the policy white paper from a policy development perspective.

مركز الكويت للسياسات العامة
Kuwait Public Policy Center