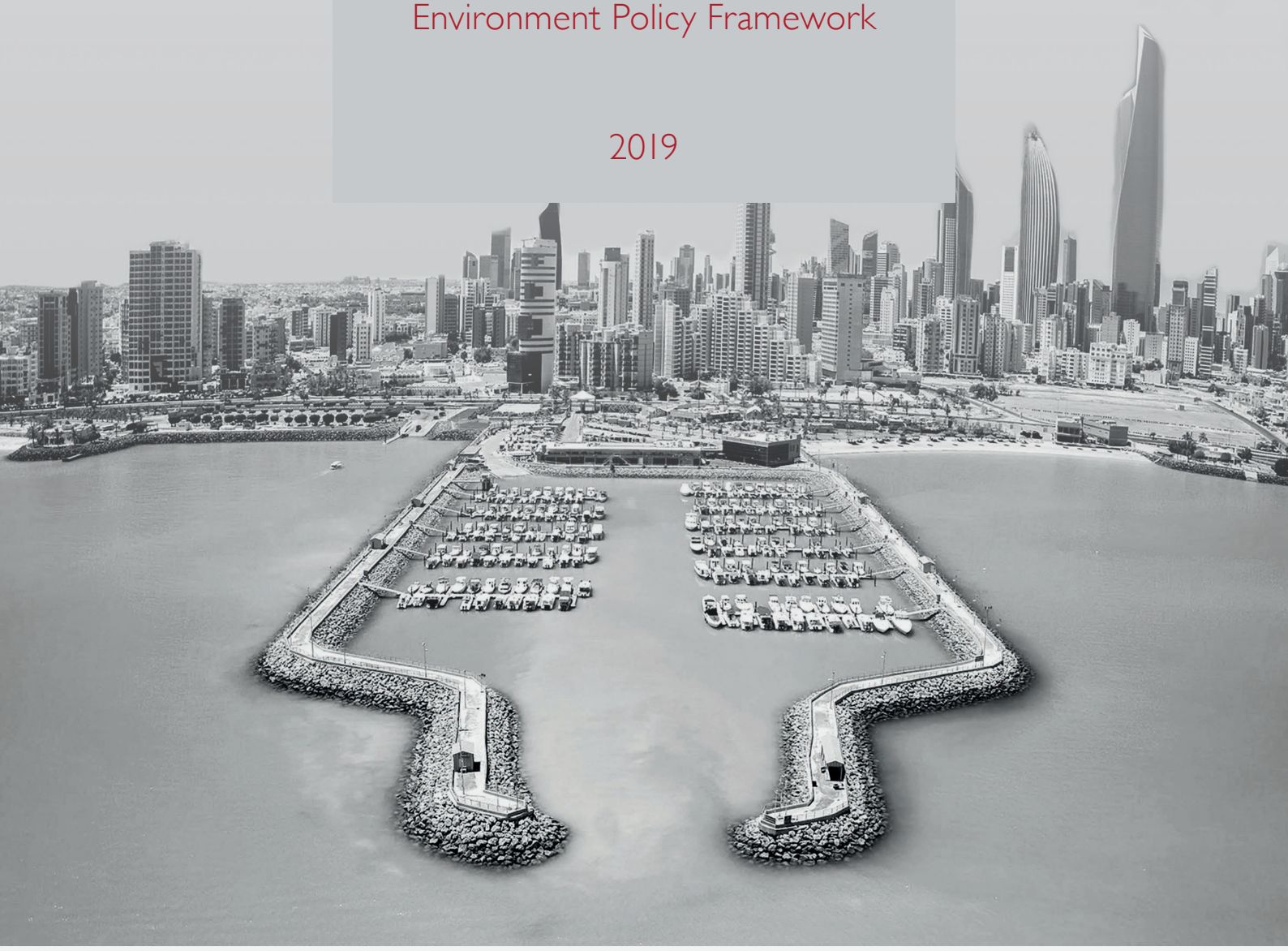
White Paper - 03

White Paper for the Environment Pillar

Towards an Integrated Environment Policy Framework

2019



مركز الكويت للسياسات العامة
Kuwait Public Policy Center

Empowered lives.
Resilient nations.

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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, analyses 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 for 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 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 ($PM_{2.5}$), 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

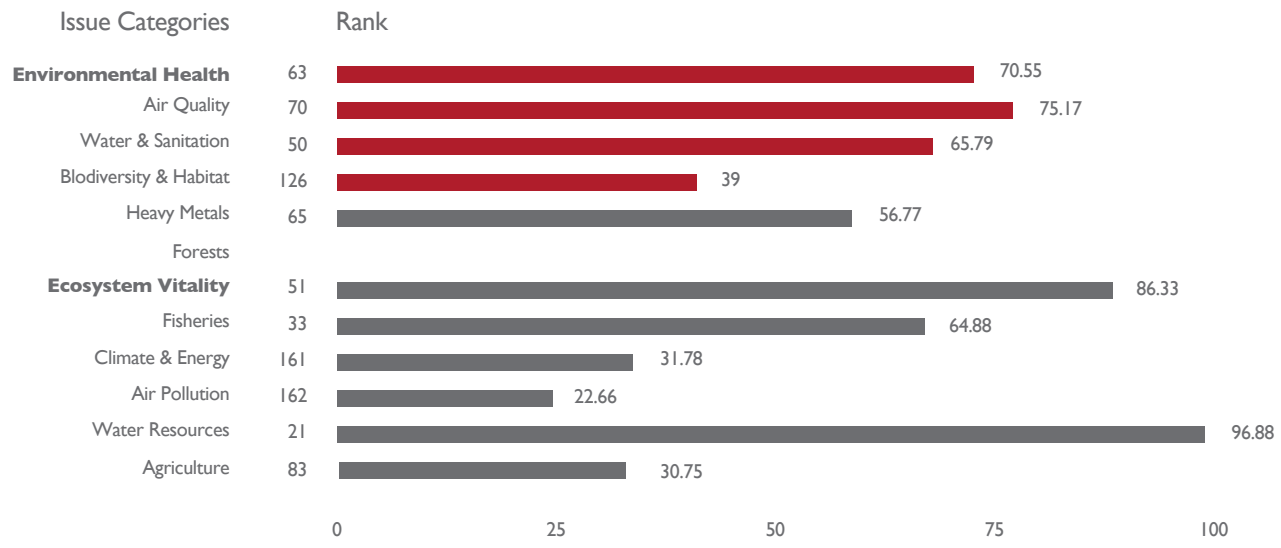
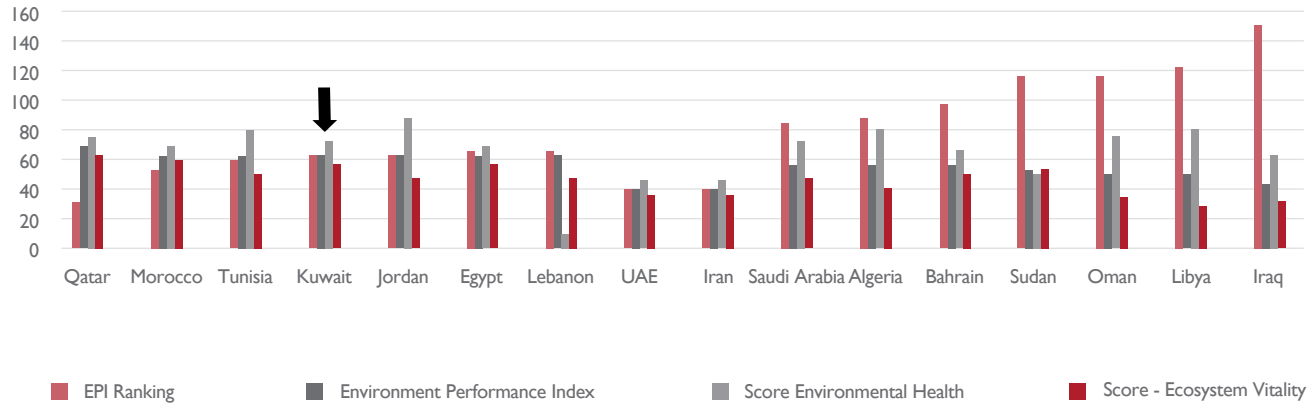


FIGURE 2

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 and propose policy settings 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 were designed to elicit an understanding of the 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 Kuwait context.
- **Use evaluative approach:** rigorous evaluation approach to assess the appropriateness of the policy settings. This includes evidence-based assessments, stakeholders' consultations as well as 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 to 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 per cent 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. 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 217474174800 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. 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 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.

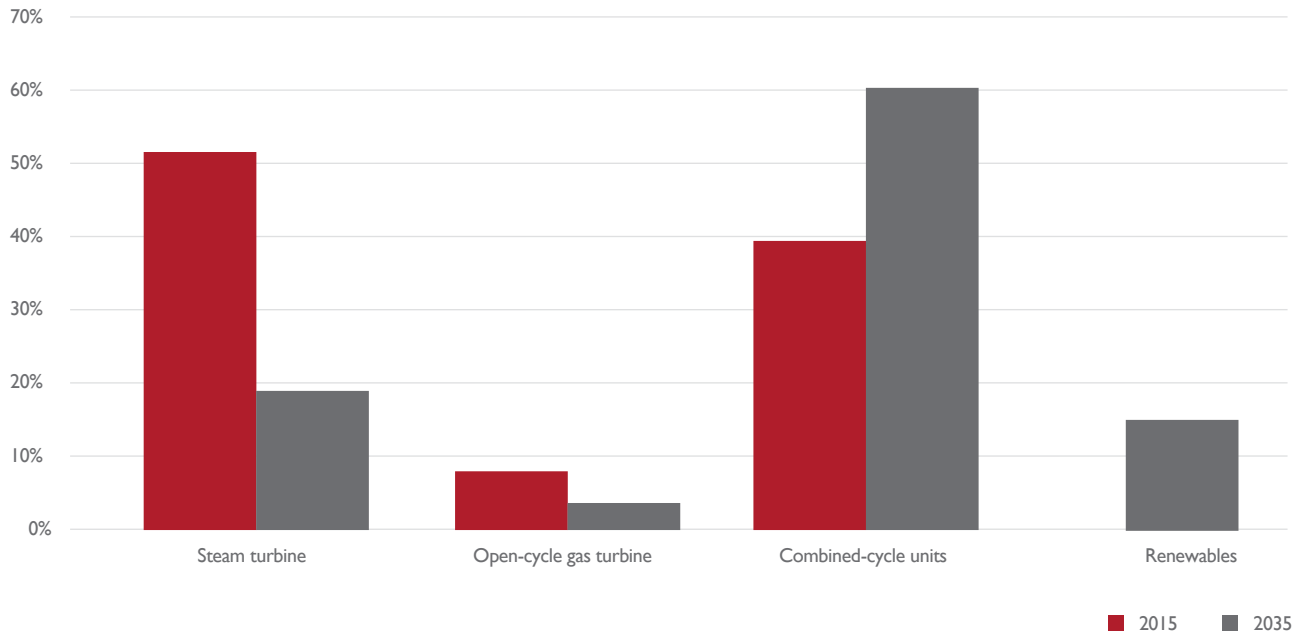
Today, renewable energy capacity at the plants accounts for less than 1% of total generating capacity in Kuwait. Renewable-energy generation capacity is expected to increase to 5 GW; but this capacity will still be insufficient in meeting the Emir's stated goal of 15% of energy demand from renewable 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 the 15% 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, potential for duplication and reduced efficiency in delivering the target.

Kuwait lacks a strong state authority that could champion renewable energy while also influencing existing, powerful institutions, such as 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. The lack of regulatory independence is also a major concern for renewables deployment in the Kuwait.

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

Currently there is no national strategic plan that articulates the way to achieve the 15% target. The lack of strategic planning has led to scattered and uncoordinated renewable energy investments. A strategic plan will help to bridge the legal, institutional, and capacity gaps to ensure the Kuwaiti renewable energy sector is able to meet future targets.

3. *Weak private sector participation*

The shortage of private sector participation in Kuwait's power sector has also 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, the cost of capital and the ability to finance projects. Therefore, risks and uncertainties are serious barriers to 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, investors in renewables face uncertainty where there is no specific renewable policy, as well as after policy incentives are designed and implemented. The pre-implementation uncertainties are factors such 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 a 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: lack of clarity of procurement programs; shifting policies; difficulty in obtaining permits; constraining real estate laws, especially where foreign ownership is not allowed – specifically; lack of clarity on land ownership and leasing laws; and cumbersome labor issues. Some of these factors result in low-carbon investments having high costs for the private sector.

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 the selection of contract holders, granting of contracts, selection of sites, construction and environmental permits and grid access. For example, obtaining all relevant permits for renewable technology can be expensive and time-consuming, increase transaction costs and discourage investors.

A core element is the need for an independent regulator who can design suitable regulatory frameworks for procurement and establish 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 is thus susceptible to political influence.

5. Energy subsidies

Despite reform efforts over the past several years, energy subsidies remain high in Kuwait. The subsidies remained high even after oil price declines and the subsidy reforms undertaken by authorities during 2015–16. They were 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 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).

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

Monitoring, verification and evaluation systems enable the identification of bottlenecks and the tracking of progress; they also provide robust evidence for the effectiveness of renewable energy delivery and offer a means to adjust policy instruments to increase their effectiveness and efficiency.

7. No incentives support schemes

Currently, Kuwait offers no direct or indirect financial incentives to promote investment in renewables. 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]

POLICY INSIGHTS

DEPLOYMENT OF RENEWABLE ENERGY IN THE GCC IS EXPECTED TO CREATE UP TO 140,000 JOBS

IRENA (2016) Renewable energy market analysis

Suggested policy framework

Policy objective

In line with the Emir's vision, the objective of this policy is to promote renewable energy in Kuwait and increase the share of renewables in total energy demand to 15% by 2030.

Specifically, the policy aims to:

- Enable the institutional and regulatory environment to promote renewable energy investments and maximize private sector involvement.
- Boost renewable energy investments in Kuwait at both utility and decentralized scales.
- Increase consumers' participation in achieving the 15% target.
- Establish a government-run, sustainable energy center of excellence to play a leading role in driving renewable energy and energy efficiency in Kuwait and in the entire region on the long term.
- Achieve emissions reductions.

Policy theory of change

Scaling up renewable energy investments sets the foundation for long-term, national, low-carbon development paths that fulfill national priorities for energy security, economic diversification, and climate change mitigation.

Renewable energy creates 0.65 jobs per gigawatt hour (/GWh) compared with just 0.15/GWh from conventional fossil fuel generation[11].

According to the International Renewable Energy Agency (IRENA), investing in renewable energy in the Gulf Cooperation Council (GCC) is expected to create up to 140,000 jobs[12].

The boost of renewable energy investments **aligns with Kuwait's vision of moving toward a non-oil economy**. In fact, renewable energy contributes more economically than just jobs and pollution reduction. An IRENA report includes a reference to how stimulating renewable energy investment can be. "Doubling the share of renewables in the global energy mix by 2030 would increase global GDP by up to 1.1% or USD 1.3 trillion. The report shows that such a transition increases global GDP in 2030 between 0.6% and 1.1%, or between around USD 700 billion and USD 1.3 trillion compared to business as usual."[13]

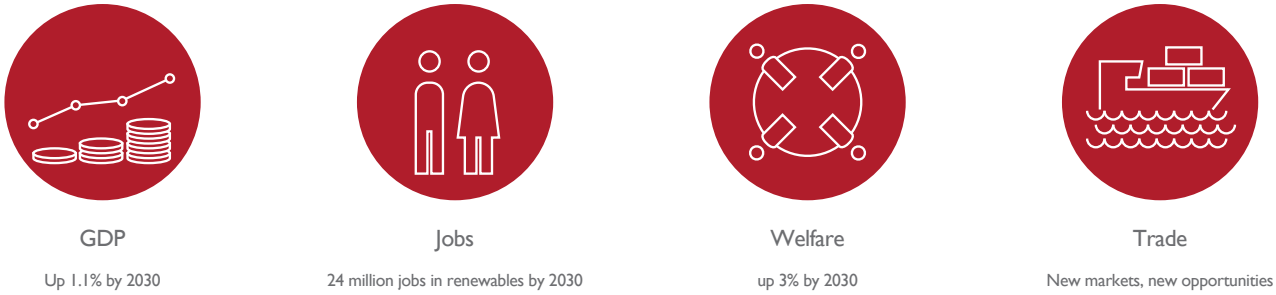
11 Hisham M. Akhonbay, The Economics of Renewable Energy in the Gulf, 2019

12 IRENA (2016) Renewable energy market analysis: the GCC region. IRENA, Abu Dhabi. Accessed 1 Mar 2017. www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=691.

13 IRENA (2016), 'Renewable Energy Benefits: Measuring The Economics'. IRENA, Abu Dhabi.

FIGURE 5

Key economic benefits from renewable energy boost



Source: Irena.

Another key, and very striking, benefit is how renewable energy investment can **impact trade**. "For fossil fuel importers, the switch to a greater share of renewables has potentially favorable trade implications. Reducing fuel imports can improve trade balance and improve GDP".

The renewable energy **technology market is also going to grow** as a result of incentivizing the decentralized investments. Technology availability and acceptance of renewable energy will also increase at both supply and demand sides.

As the renewable energy sector remains underdeveloped in the Middle East, Kuwait is well positioned to take a **steward role** in driving investments in catalyzing renewables across the region. In fact, this could potentially open a new horizon for leading innovation in the **renewable energy market** locally and regionally.

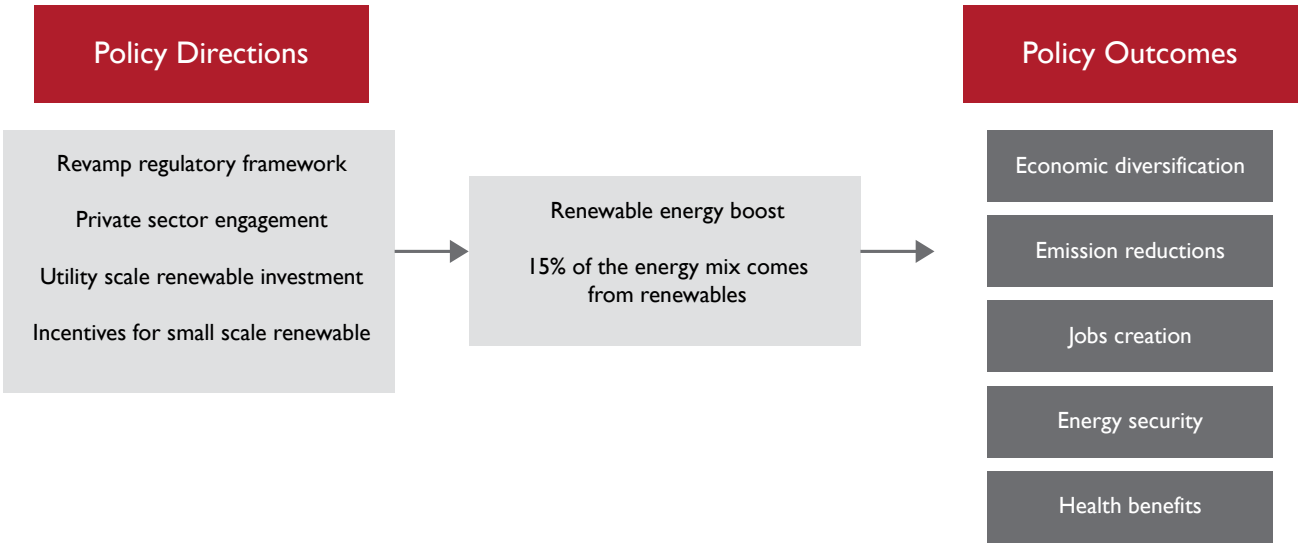
The **air pollution** emitted by industries and oil plants is linked with breathing problems, neurological damage, heart attacks, cancer, premature death, and a host of other serious problems.

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 plants 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, as shown elsewhere in the United Nations Framework Convention on Climate Change (UNFCCC) report, especially because of the country's 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 such weather events.

FIGURE 6

Policy Directions and outcomes I



Policy directions

1. Establish a new renewable energy and energy efficiency center of excellence

Achieving the national development plan targets in Kuwait will require **efficient engagement and effective coordination** among the national partners and stakeholders in the energy sector, as well as other relevant sectors. One way to manage the energy stakeholders would be to establish a platform that periodically assesses all domestics and regional energy concerns, analyzes potential future scenarios, tracks progress, supports sustainable energy solutions and provides policy implications and recommendations involving technology, economics, environment and geopolitics.

Effective institutions need to reduce to a minimum the administrative burden of **procurement, selection of contract holders, granting contracts, site selection, construction and environmental permits and grid access**. While dedicated renewable energy agencies or departments are necessary to enable coordination among stakeholders, independent regulators are critical to ensuring transparency and engendering stability in the implementation of policies.

The center can play a key role in developing and **implementing national policies** and building public-private partnerships (PPPs) to reduce the carbon footprints and energy intensity of sectors such as building, power and transport. Furthermore, the stability that such an agency brings would add a great deal of value to the market and therefore increase private sector confidence in investing in Kuwait.

As an oil country, **Kuwait's reputation and commitment** to address sustainability in the energy sector will further be affirmed through establishing a national center concerned with the suitability of the energy sector in Kuwait. Bringing public and private players together under the framework of national centers of excellence in Kuwait is an effective means of tackling priorities that are specific to Kuwait or shared across the GCC region.

Several centers have already been established and can provide models for setting up others. In partnership with UNDP, **Saudi Arabia launched the National Energy Efficiency Program**, now the Saudi Energy Efficiency Center (SEEC). It is the country's first center of excellence to scale up energy-efficient technologies that can curb the pace of energy demand growth in key sectors while also reducing emissions. The UNDP has also been a key partner in the formation of the Bahrain Sustainable Energy Unit, the Dubai Carbon Center and the proposed Kuwait Energy Center, all of which are based on PPPs.

For instance, Bahrain's Sustainable Energy Unit (SEU), established in 2014 as a joint initiative between the Office of the Minister of Electricity and Water Affairs and the United Nations Development Program (UNDP), aims to develop a cohesive and sustainable energy policy and to promote renewable energy and energy efficiency in the Kingdom of Bahrain. The unit also works toward bridging legal, institutional, and capacity gaps to ensure that Bahrain's energy sector is able to meet the future challenges.

SEU developed two key policy documents for Bahrain: the **National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP**). These plans were endorsed by the Cabinet and are currently in the implementation phase.

BEST PRACTICE BOX:
EXAMPLES OF INSTITUTIONS FOR RENEWABLES DEPLOYMENT

- Saudi Arabia: King Abdullah City for Atomic and Renewable Energy
- (KACARE)
- Iran: Renewable Energy Organization of Iran (SUNA) in collaboration with Ministry of Energy
- United Arab Emirates Abu Dhabi: Clean Energy and Climate Change Department at Ministry of Energy
- Bahrain: Sustainable Energy Unit
- Jordan: Jordan Renewable Energy and Energy Efficiency Fund (JREEEF)
- Egypt: New and Renewable Energy Authority

The sustainable energy center may have the following mandate:

- Develop cohesive and renewable energy and energy-efficiency policies.
- Promote renewable energy and energy efficiency in the Kuwait.
- Bridge the legal, institutional, and capacity gaps to ensure Kuwait's energy sector is able to meet future challenges and targets.
- Lead and promote energy-efficiency practices, transfer and diffuse renewable energy technologies.
- Develop a national renewable energy strategy and regulatory framework in close coordination with stakeholders and partners in Kuwait.
- Facilitate private sector engagement including procurement, selection of contract holders, granting contracts, site selection, construction and environmental permits and grid access.
- Report to the higher committee for renewable energy in Kuwait.
- Develop regulatory framework with aim to incentivize the consumers and private sector participants in achieving the target.
- Design and undertake regular monitoring and evaluation of sustainable energy policies in Kuwait.

Over the long-term, the proposed center has a good chance of playing a leading role in the GCC region; but during the upcoming five years, the center's focus would be local.

2. National Renewable Energy Action Plan (REAP)

Currently, Kuwait lacks a national strategic plan that outlines a strategy for achieving the 15% target. Lack of strategic planning may lead to scattered and uncoordinated renewable energy investments. A strategic plan would help to bridge the legal, institutional, and capacity gaps, and thereby ensure that Kuwait's renewable energy sector is capable of achieving future targets.

The National Renewable Energy Action Plan (REAP) seeks support for renewable energy and energy-efficiency projects to meet the 2030 targets and beyond, adheres to the renewable energies methodology and conforms to the template for national renewable energy action plans adopted by Kuwait.

The REAP establishes the mix of projects that is expected to deliver Kuwait's 15% target by 2030, the trajectory toward 2030, and the measures to deliver results. The principles that guided these choices also will be explained.

3. Establish a new legal framework to promote private sector participation

As mentioned above, **renewable investors face uncertainty** where there is no specific renewable policy as well as after policy incentives are designed and implemented. The pre-implementation uncertainties are factors such 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.

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

To stimulate investment in renewable energy in Kuwait, the **current legislation needs to allow private deployment of renewable energy plants** without an extensive prior authorization process from the government. However, renewable energy systems would still be subject to all necessary building code requirements, grid connection rules and other administrative safety regulations.

Under the current legal framework and market structure, the Ministry of Electricity and Water (MEW) is the sole buyer and distributor of electricity in Kuwait. To motivate private developers to invest in renewable energy, **a mechanism is needed to allow private investors to sell the power produced from renewable sources and generate income**. The key components of such a mechanism are price and a guarantee of purchase of electricity from renewable sources. Thus, it is important to set a policy that will define a purchase price for electricity from renewable sources and guarantee the purchase of such electricity. Such policies can be either a feed-in tariff policy, auctions or public competitive tenders.

4. Establish incentives support scheme

As part of the 15% target, Kuwait aims at establishing around 1 gigawatt capacity at the decentralized scale. An important part of this target would be comprised of small-scale renewable energy generation from sources such as solar and wind, which could be used at the consumer level as a power source for homes and businesses.

High subsidies on fossil fuels result in their underpricing, which incentives their consumption at the expense of renewable energy; this dampens the motivation to achieve the decentralized target. In addition, other barriers exist including a lack of financial incentives to overcome the capital cost and outdated building codes.

In response to these problems, Kuwait will need to promote small-scale renewable energy development through amendments to comprehensive planning and zoning laws, as well as through utility regulations and various financial incentives.

Governments can choose from among a wide range of schemes, some of which can be implemented alongside fossil fuel subsidies. Incentives could include feed-in premiums, tradable green certificates, tendering production or investment and preferential loans and grants.

The type of schemes that can be adopted depends on various factors such as: project scale; degree of maturity of renewable technology; size of renewable targets; extent of financial resource constraints; risk attitude; and stage of electricity market.

In Kuwait, a fully subsidized renewable program can incentivize investment in renewables by offering various forms of direct and indirect financial incentives. This approach requires the heavy involvement of government in the process of renewables deployment, beginning with design and continuing on to implementation and management of support schemes.

The incentives can take various forms, such as production feed-in-tariffs (FiT), feed-in-premiums (FiP) and net metering at retail prices. The exact form of this scheme varies, but the general principle is that the net consumption (which can be positive or negative) is tracked through a bi-directional meter. The consumer pays a retail electricity tariff when the net consumption is positive during the billing period. On the other hand, when the net consumption is negative the consumer will be compensated at retail tariff (or wholesale price) or can bank the surplus energy credit for in the following period.

The renewable support scheme can be based on investment rather than production. Preferential loans are mechanisms in which the government provides direct financial support to establish the renewable system. Where third party financing agency is available, the government may cover part of the interest rate (e.g., 50%) for the finance provided by commercial banks or other financial institutions for renewable energy technologies. If the perceived project risk is high, the government may provide a guarantee to cover a share of the outstanding loan principal in order to lower the capital cost to investors.

5. Mandatory solar panels for new buildings

Kuwait has a fast-growing building sector driven by factors like population growth, economic and infrastructure development and modernization. Buildings, owing to their energy-intensive operation, are imposing significant energy, environmental and economic burdens on the country. To overcome these challenges and improve the sustainability levels in the building and energy sectors, the building codes need to be updated to **include mandatory requirements for solar-ready buildings**.

Improving the efficiency of Kuwaiti buildings offers enormous potential to save energy. The Ministry of Electricity and Water has enforced the minimum requirements for efficient energy use in buildings since 1983 through an energy conservation code of practice. In 2010, a revised version of the code was developed with more stringent requirements for energy conservation in new buildings. Neither the 1983 version nor the 2010 update covers solar as a key energy measure in buildings.

6. Undertake a Derisking Renewable Energy Investment Analysis

In seeking to create an enabled environment for private sector renewable energy investment, policy makers typically implement a package of public instruments. From a financial perspective, the public instruments package aims to achieve a risk-return profile for renewable energy that can cost-effectively attract private sector capital.

In 2013, UNDP issued the Derisking Renewable Energy Investment report[14]. The DREI report introduced an innovative methodology (the "DREI methodology"), with an accompanying financial tool in Microsoft Excel, to quantitatively compare the cost-effectiveness of different public instruments in promoting renewable energy investment.

These instruments utilize policy and programmatic interventions to address the underlying barriers that are the root causes of investment risks. An example might involve a lack of transparency or uncertainty regarding the technical requirements for a renewable energy project developers want to connect to the grid. The implementation of a transparent and well-formulated grid code can address this barrier, reducing risk. The DREI methodology terms this type of instrument "policy derisking."

14 Waissbein et al., 2013

BEST PRACTICE BOX:
EXAMPLES OF INSTITUTIONS FOR RENEWABLES DEPLOYMENT

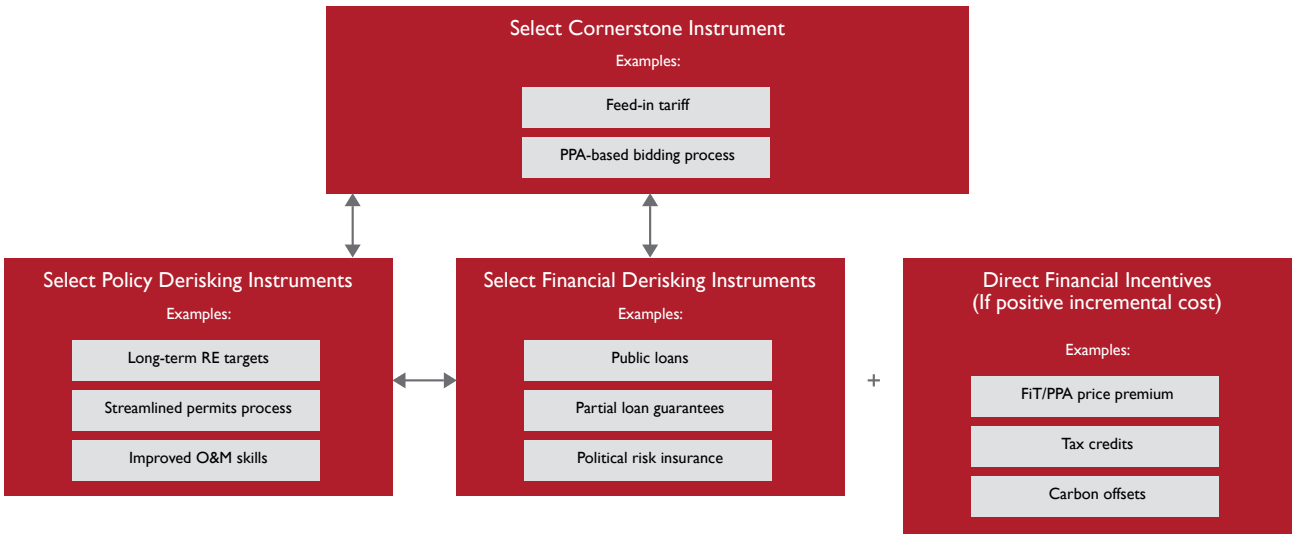
The California Building Standards Commission Has Approved A New Rule Starting In 2020 That Requires All New Homes Built In The State To Include Solar Panels. The New Rule Includes An Incentive For Homeowners To Add A High-Capacity Battery To Their Electrical System.

CALIFORNIA BUILDING STANDARDS COMMISSION

A derisking approach suggests three core types of public instruments to deal with renewable energy risks. These are instruments to reduce risks, instruments that transfer risks, and instruments that compensate for risks by providing a financial incentive to investors in renewable energy projects when risks cannot be reduced or transferred.

FIGURE 7

Typical components of a public instrument package for large-scale renewable energy[15]



15 Source: Derisking Renewable Energy Investment (UNDP, 2013).

The DREI methodology could help Kuwait more quickly mobilize available private sector investment for a low-carbon pathway that includes action to expand renewable energy, which would help achieve the 15% target. Specifically, the DREI methodology **can help Kuwait analyze existing derisking instruments, identify what needs to be improved or added, explore the most effective options and implement the most effective package of public policy actions**.

Using the DREI methodology as a tool to foster innovative public policy development and to attract low carbon investments could facilitate the establishment of renewable energy centers of excellence in Kuwait.

The DREI methodology can be applied to attract and leverage private sector investments and reinforce a stronger foundation for long-term, low-carbon development paths. Innovative partnerships with stakeholders to enhance policy and capacity development are key to creating momentum.

7. Develop renewable energy monitoring, verification and evaluation capacities

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

Monitoring, verification and evaluation systems enable the identification of bottlenecks and the tracking of progress; they also provide robust evidence for the effectiveness of renewable energy delivery and offer a means to adjust policy instruments to increase their effectiveness and efficiency.

The monitoring, verification and evaluation function needs to be established within the Kuwaiti government, the proposed **center of excellence could potentially be an effective host for this function**.

8. More renewable energy projects (1 megawatt every day until 2030)

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 considering the hard pipeline projects and growth in demand and generation over the next 10 years[16].

In terms of capacity, the 15% target by 2030 means approximately 4.9 gigawatts, according to the pipeline projects, of which 2.3GW is expected by 2025. Pipeline projects are those whose confirmation has been confirmed to start in the near future. This would leave a gap in capacity of 2.6 GW that would need to be filled in order to meet the Emir's vision.

The proposed renewable energy strategic action plan should cover the 4.9 GW delivery toward the 2030 vision. This requires diversification of renewable sources, private investment and a focus on the utility-scale programs.

16 Kuwait Energy Outlook, 2019.

Policy delivery principles

The key principles underpinning the delivery of a renewable energy policy are:

- The government of Kuwait is committed to the international sustainable energy agenda and associated environmental outcomes and agreements.
- The government of Kuwait is accountable for achieving the 15% target.
- The policy design, delivery and evaluation will be evidence-based.
- Renewable energy development is a unique area in which to achieve effective partnerships with the private sector.
- Encourage consumers' participation in delivering renewable energy outcomes.
- Stakeholder coordination is intrinsic to achieve the policy targets.
- The government of Kuwait will follow best practices to achieve policy targets.

Policy Targets

TABLE 1

Renewable energy quantitative and qualitative targets

Policy area	2025 targets	2030 aspirations
Share of renewables in total energy demand	• 7%	• 15%
Renewable energy capacity	• 2.3 gigawatt by 2025 tCO2e reduction	• 4.9 gigawatt • tCO2e reduction
Enable coordination among stakeholders, offering independent regulatory body	• Renewable energy and energy efficiency center of excellence established by 2021	• Ongoing stakeholders' engagement
National Renewable Energy Planning	• National Renewable Energy Action Plan (REAP) developed by 2020	• National Plan reviewed periodically
Private sector participation	• A new legal framework to promote private sector participation established by 2022 • Increased private sector confidence to invest in renewable energy	• Utility scale renewable energy is financed and operated by private sector • Private investors have limited barriers and uncertainties to invest in renewables in Kuwait
Consumers participation in renewables	• 0.3 GW of renewable capacity comes from consumers • Incentives support schemes established by 2022 • Number of households & number of businesses have solar panels installed on their facilities by 2025(Numbers are to be determined)	• 1 GW of renewable capacity comes from consumers • Number of households & number of businesses have solar panels installed on their facilities by 2025 (Numbers are to be determined)
Mandatory solar panels for new buildings	• Legislation mandates solar panels in new buildings by 2025;	• 100% of new buildings have solar panels
Derisking Renewable Energy Investment Analysis	• Derisking Renewable Energy Investment Analysis complete by 2020 • Key risks facing renewable energy identified by 2020 • Key risks facing renewable energy identified	• Derisking Renewable Energy Investment Analysis is a common practice and done every four years • Key risks facing renewable energy identified and treated
Renewable energy monitoring, verification and evaluation capacities	• Renewable energy monitoring, verification and evaluation system in place by 2023	• Ongoing renewable energy monitoring, verification and evaluation process

FIGURE 8

Shows what success looks like in 2025

Monitoring and evaluation

Policy monitoring and evaluation can offer an assessment of the degree of effectiveness and efficiency of a policy throughout its implementation in order to determine whether its anticipated objectives have been attained[17]. Policies must be monitored and evaluated to determine which ones remain relevant yet have not met their full potential. Then, they must either undergo moderate to substantial revisions, or they must undergo further analysis. That analysis would determine which policies are no longer relevant or are too far out of scope to successfully be revised, and thus should be retired).

17 European Commission (2015), Better Regulation "Toolbox", available here https://ec.europa.eu/info/index_en

IMPORTANCE OF POLICY M&E

- Challenges assumptions and strategy
- Provides information and new insights
- Increases likelihood that policy will make a positive difference
- Helps identify problems and causes
- Encourages acting on information/insight
- Measures policy effectiveness and feeds into new policy design
- Offers accountability for resources used

The following are key monitoring and evaluation activities suggested for this framework:

- Kuwait's renewable energy policy framework will be reviewed every four years to ensure validity and applicability.
- Regular monitoring to check progress to date in achieving aforementioned targets.
- Establish a modeling study to forecast, track and evaluate progress toward the 15% target considering population growth and urbanization, along with industrial growth and power demand.
- Conduct a Policy Impact Evaluation in 2024 to assess environmental, social and economic benefits from renewable energy programs.
- Regular inspection of the implemented project to ensure effectiveness in generating power.

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 a policy framework for Kuwait's energy efficiency agenda using low-emissions innovations.

Improvements in energy efficiency have been shown to directly affect economic growth. In a 2013 report, Vivid Economics found that a 1% improvement in energy efficiency leads to a 0.1% increase in the annual growth rate of GDP per capita[18], based on a statistical analysis of historical data for 28 Organization for Economic Cooperation and Development (OECD) countries.

18 Vivid Economics 2013.

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 million 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[19].

Empirical evidence suggests that the asset value of sustainable buildings is higher than that of conventional structures[20]. 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[21].

Gaps

One model for guiding innovation investment and policy decisions is "systems innovation." Recent work by the OECD shows that policies aimed at transitioning socio-technical 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 what technologies are likely to play a role, what 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; co-ordinate 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 the 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 focus areas:

19 Gonand (2016).

20 International Monetary Fund (2018).

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

- 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
- 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 onward
- 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 0.1° Celsius per year over the projection period.

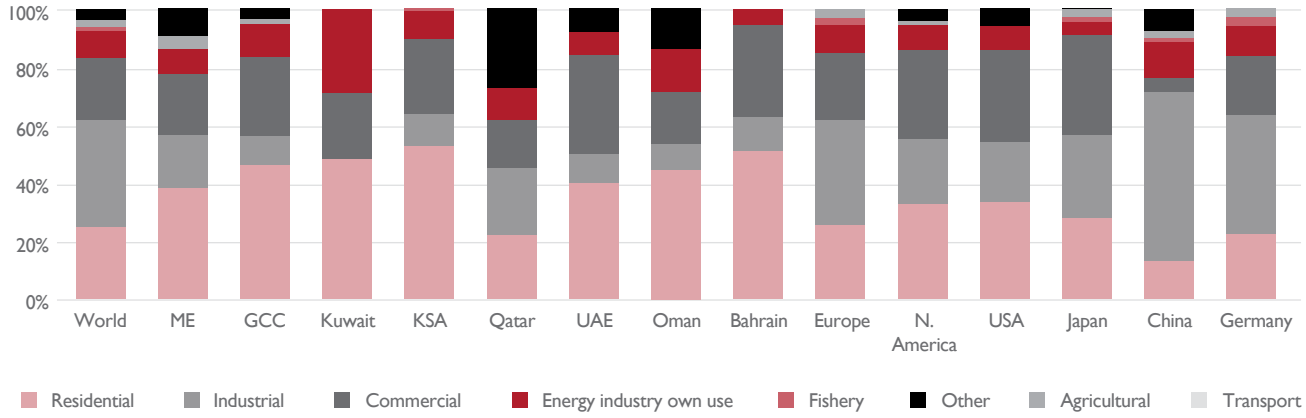
Per capita energy consumption in Kuwait is among the highest in the world. Due to historically lax energy-efficiency regulations and codes along with its hot climate, demand for air conditioning services in Kuwait accounts for some 70% of residential electricity demand. This is the highest in GCC region – see Figure 9 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[22].

22 Deloitte, 2017, Energy on demand: the future of GCC energy efficiency Middle East Energy and Resources Managing scarcity for the future.

FIGURE 9

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 reductions. 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 the residential sector.

1. Weak institutional and regulatory frameworks

The lack of coordination among various institutions and the lack of a strong state authority that can champion energy efficiency are key barriers to moving 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 the Kuwait.

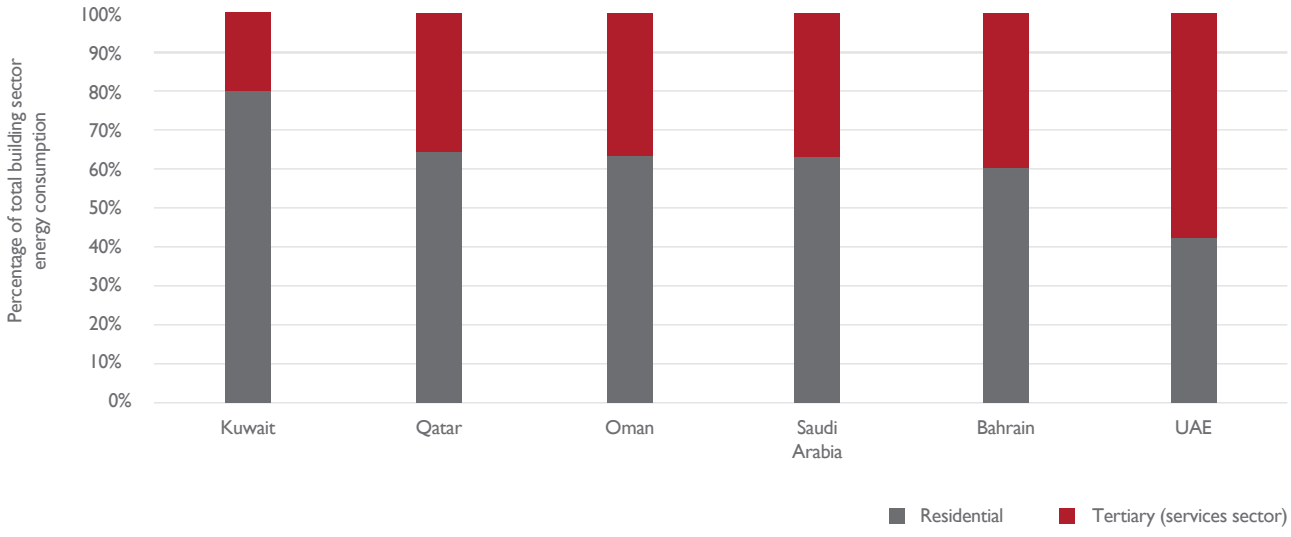
Kuwait has plans to construct 128,000 new houses, all **subject to the more rigorous standards of the recent energy conservation codes and regulations**. Three government entities will be responsible for enforcing the building codes.

The 1983 energy conservation code was not revised for 27 years, and the building 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 10 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 building 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 10

2016 energy consumption in the building 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

Development of a National Energy Efficiency Action Plan (NEEAP) is a common practice in developing and developed countries to build on existing achievements, and includes a comprehensive set of initiatives to unlock further energy-efficiency potential. NEEAP identifies specific programs and new initiatives across various sectors, and encompasses energy-efficiency plans that have been developed by individual institutions. NEEAP sets a national target for energy savings, identifies implementation 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 the ESCO industry's slow

development in Kuwait are numerous. In order for an ESCO market to flourish, several factors are necessary, including available financing, expertise and a mature legal system. 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.

Suggested policy framework

Policy objective

The overall objective of this policy framework is to unlock further energy-efficiency potential in Kuwait and achieve energy and monetary savings by 2030.

Specifically, the policy aims to:

- Enable the institutional and regulatory environment to promote energy-efficiency innovation investments
- Boost energy-efficiency investments in Kuwait targeting residential, industrial and government streams
- Increase consumers' participation in achieving energy-saving targets
- Establish sustainable energy center of excellence to play a leading role in driving renewable energy and energy-efficiency in Kuwait and in the entire region over the long-term
- Achieve emissions reductions

Policy directions

1. Set up Minimum Energy Performance Standards (MEPS) for low-emissions products

A Minimum Energy Performance Standard (MEPS) is a specification, containing a number of performance requirements for an energy-using device that effectively limits the maximum amount of energy that may be consumed by a product in performing a specified task. A MEPS is usually made mandatory by a government energy efficiency body. It may include requirements not directly related to energy; this is to ensure that general performance and user satisfaction are not adversely affected by increasing energy efficiency.

Kuwait currently lacks a MEPS for key energy-consuming products such as air conditioners (AC) and other appliances. In order to encourage efficient domestic use of electricity, Energy-Efficient Appliances and Equipment Standards, accompanied by a labeling program, will help Kuwait grow its competitive energy-efficiency market, reduce energy consumption, achieve bill savings and GHGs reductions. More than 70 countries have adopted a MEPS policy and have seen significant economic and environmental benefits.

There are a wide range of appliances that would benefit from national standards and a labeling system in Kuwait. It is, however, important that appliances are prioritized according to degree of energy consumption, size of the market and potential savings. Obviously, AC

sits on the top of the list as far as residential appliances are concerned.
A MEPS generally requires use of a particular test procedure that specifies how performance is measured.

2. Improve fuel efficiency standards

Kuwait needs to define a fuel efficiency standard that would stimulate energy efficiency, encourage resource conservation and contribute to the environment by reducing emissions. This will enable consumers to save money, reduce fossil fuel consumption and strengthen Kuwait's role in the fight against climate change.

Fuel standards would mean that light-duty vehicle manufacturers would be required to sell only the cars that were in compliance with Kuwaiti standards. Standards offer automobile manufacturers a double dividend - they incentivize manufacturers to introduce up-to-date efficiency technologies and they decrease the supply of low-efficient technologies on the Kuwaiti market.

BEST PRACTICE BOX

The Saudi Energy Efficiency Center (SEEC) has registered great improvement in Saudi fuel consumption in the transportation sector over the period of 2015-2017. Fuel efficiency in new vehicles has improved by 3.5% and by 6.5% for previously owned vehicles.

The program spotted an upward trend, estimated at 14.1%, in the usage of fuel-efficient cars between years 2016-2017.

The Saudi CAFE standard targets an improvement in the overall fuel economy with an average of 4% annually. This would lift up the Kingdom's fuel economy LDVs from their current level of 12 km per liter to 19 km per liter by 2025.

3. Improve and enforce energy-efficiency building codes

Improving the efficiency of Kuwait buildings offers enormous potential to save energy. Doing so will require a clear, long-term government commitment, combined with well-designed packages of efficiency standards reinforced by an adequate capacity for implementation and sufficient enforcement.

Kuwait's 1983 energy conservation code lacked effective monitoring, verification and enforcement. The 1983 code was not revised for 27 years and as a consequence, the building sector is a major source of inefficient energy consumption due to the country's 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. A 2017 code for government and commercial buildings, which sets minimum requirements in terms of power densities, material properties and the use of efficient air-conditioning systems, is awaiting final approval.

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

Grow the energy-efficiency services market

Above policy directions are mostly concerned with energy efficiency in the residential sector. By contrast, the energy services market will help industries to identify and implement opportunities for energy and cost savings.

An energy market will provide a broad range of energy solutions to Kuwaiti industries including: the design and implementation of energy savings projects; retrofitting; energy conservation; energy infrastructure outsourcing; power generation and energy supply; and risk management.

The government could support the ESCOs in many ways including: creating incentive schemes for them and for participants from industries; removing institutional barriers by allowing multi-year procurements; and piloting ESCO projects to better identify and address the barriers.

4. Implement Energy-Efficiency Incentive Schemes

In response to the above gaps, Kuwait will need to promote energy-efficiency development through a wide range of schemes that governments can choose among, some of which can be implemented alongside fossil fuel subsidies.
The type of schemes that can be adopted depends on a variety of factors such as the scale of project, degree of maturity of energy-efficiency technology, the size of the energy-savings target, the extent of financial resource constraints, risk attitude and the stage of the electricity market.

Incentives could include:

- Incentivize organizations to adopt the energy management system (i.e. ISO 50001)
- Provide incentives to industrial organizations to perform energy audits
- Direct subsidies of energy-efficient appliances
- Provide zero-interest loans
- Offer a mix of more than one option, depending on the desired outcomes

5. Development of a National Energy Efficiency Action Plan (NEEAP)

Development of a National Energy Efficiency Action Plan (NEEAP) is a common practice in developing and developed countries to build on existing achievements, and includes a comprehensive set of initiatives to unlock further energy-efficiency potential. The plan identifies specific programs and new initiatives across various sectors, and encompasses energy-efficiency plans developed by individual institutions. The plan 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.

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The key principles underpinning the delivery of energy-efficiency policy are:

- The government of Kuwait is committed to the international sustainable energy agenda and associated environmental outcomes and agreements.
- The government of Kuwait is accountable for achieving energy and emissions reductions.
- The policy design, delivery and evaluation will be evidence-based.
- Energy efficiency development is a unique area in which to achieve effective partnerships with the private sector.
- Encourage consumers' participation in delivering energy-efficiency outcomes.
- Stakeholder coordination is intrinsic to achieve the policy targets.
- The government of Kuwait will follow best practices to achieve policy targets.

Policy targets

TABLE 2

Energy consumption - GCC countries vs. selected regions

Policy area	2025 targets	2030 aspirations
Overall	• 3% efficiency (savings target) achieved by 2025 comparing to 2018 base year consumption	• 6% efficiency (savings target) achieved by 2025 compared to 2018 base year consumption
Set up low-emission energy Minimum Energy Performance Standards (MEPS)	• MEPS developed for ACs and key home-based appliances	• MEPS developed for all home-based appliances
Improve fuel efficiency standards	• Fuel consumption for private vehicles is 3% less than 2018 baseline	• Fuel consumption for private vehicles is 6% less than 2018 baseline
Improve and enforce energy efficiency building codes	• By 2025, 50% of new homes comply with the new codes	• By 2030, 90% of new homes comply with the new codes
Grow Energy-Efficiency services market	• New ESCOs established	• Double up the market size measured by number of operating ESCOs
Implement Energy-Efficiency Incentive Scheme	• A new Energy-Efficiency Incentive Scheme is established	• Residential and industrial participants are benefiting from the scheme
Development of a National Energy Efficiency Action Plan (NEEAP)	• A National Energy Efficiency Action Plan (NEEAP) is developed	• A National Energy Efficiency Action Plan (NEEAP) is periodically reviewed and updated

Monitoring and evaluation

Policy monitoring and evaluation can offer an assessment of the degree of effectiveness and efficiency of a policy throughout its implementation in order to determine whether its anticipated objectives have been attained[23]. Policies must be monitored and evaluated to determine which ones remain relevant yet have not met their full potential. Then, they must either undergo moderate to substantial revisions or they must undergo further analysis. That analysis would determine which policies are no longer relevant or are too far out of scope to successfully be revised, and thus must be retired.

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The following are key monitoring and evaluation activities suggested for this framework:

- Kuwait's energy-efficiency policy framework will be reviewed every four years to ensure validity and applicability.
- Regular monitoring to check progress to date in achieving aforementioned targets.
- Establish a modeling study to forecast, track and evaluate progress toward the savings target considering population growth and urbanization, along with industrial growth and power demand.
- Conduct a Policy Impact Evaluation in 2024 to assess environmental, social and economic benefits from energy-efficiency programs.
- Regular inspection of the implemented projects to ensure their effectiveness in generating power.

23 European Commission (2015), Better Regulation "Toolbox", available here https://ec.europa.eu/info/index_en

IV. Air pollution

Existing policies

The main objective under the KNDP in addressing air pollution is to **protect ambient air quality**. 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 to surveillance systems that monitor gas leaks in industrial areas; through restricting persistent and moving pollutants, estimate quantities. Provide ongoing monitoring of industrial pollution - including noise[24].

The short-term development plan 2015/16-2019/2020 defines the following targets of key air quality parameters[25].

TABLE 3

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

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

25 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 the executive regulation No. 8 far exceed the WHO guidelines for PM10 and PM 2.5 on a 24-hour basis. The executive regulations quoted an ambient standard for 24 hours for PM10 to be 350 µg/m3 compared to WHO guidelines of 50 µg/m3. The ambient standard for PM2.5 for 24 hours was quoted to be 75 µg/m3 compared to WHO guidelines of 25 µg/m3. There were no annual air quality standards for PM2.5, PM10 or SO2

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 country's 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 such weather events[26].

Industries, including the 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.

26 Kuwait Second National Communication on Climate Change , 2019.

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 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**[27].

These frequent dust events significantly contribute to an increase in air quality 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)[28]. The high number of days in Kuwait with suspended low particulate matter dust represents an extended period of exposure to presumably hazardous air pollution.

In the 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)[29]. 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[30].

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)[31].

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[32].

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

27 Kuwait Second National Communication on Climate Change , 2019.

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

29 Al Bassam; and Khan, 2004.

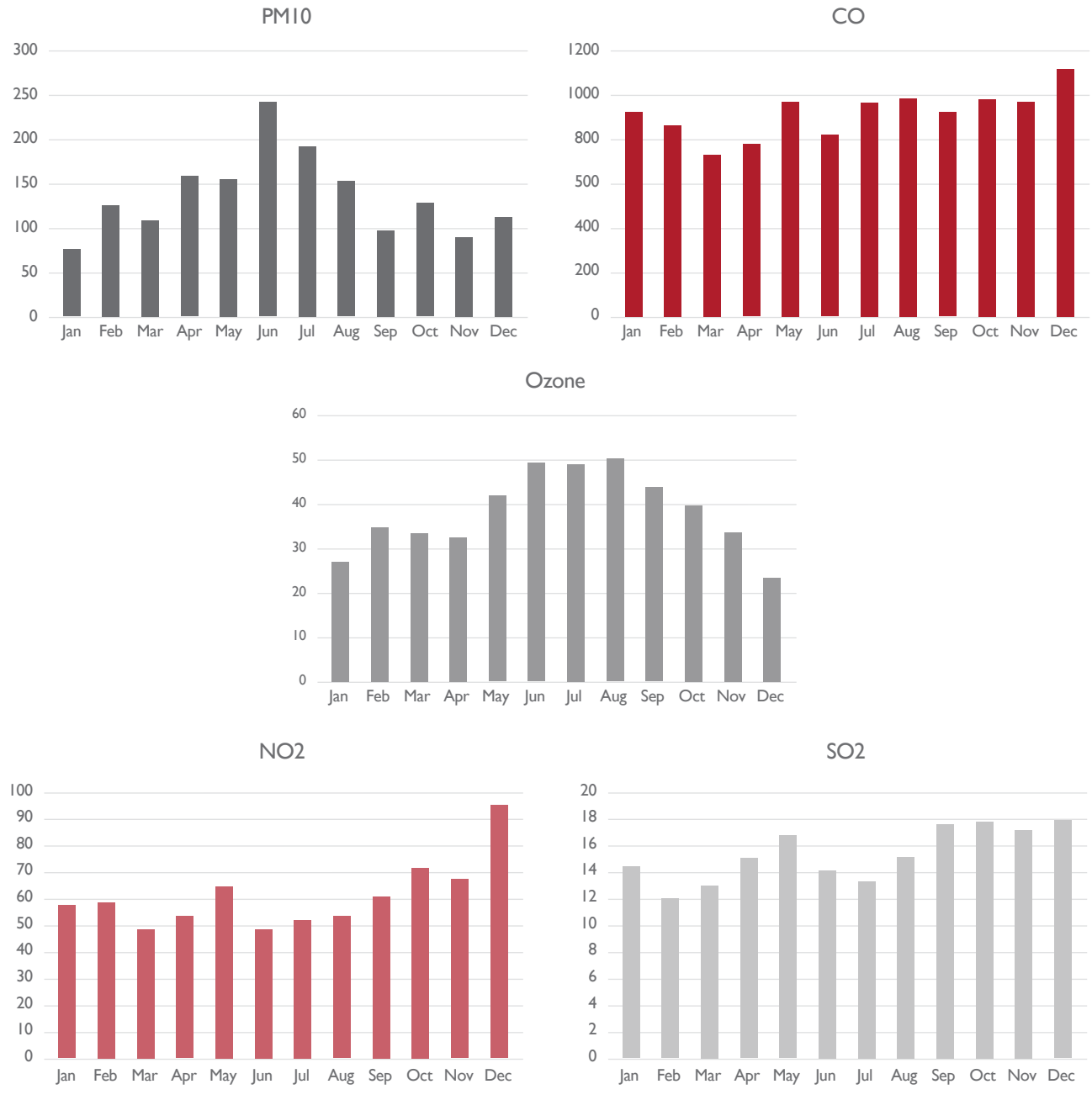
30 Ward Brown et al., 2008.

31 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.

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

FIGURE 11

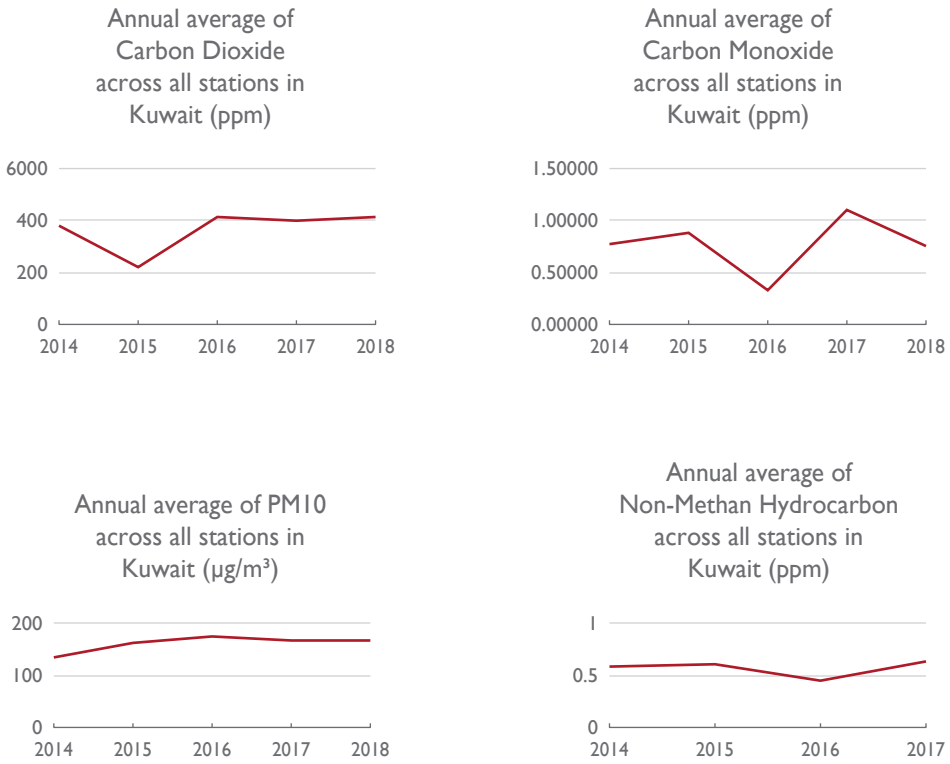
Average concentrations for all stations by month for the period of 2004 to 2012[33]



33 EMISK data.

FIGURE 12

Average annual concentrations for all stations for the period of 2014 to 2018[34]



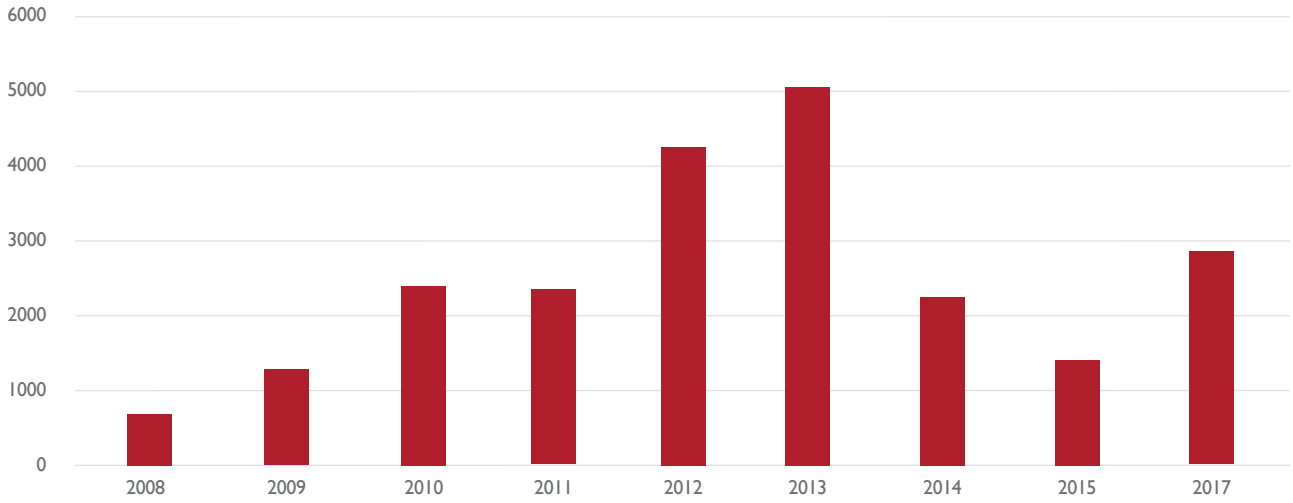
The World Health Organization guideline for ambient PM10 concentrations is 20mg/m3, **which Kuwait exceeds most of the year**. Over the summer months, the highs reach up to 4,000mg/m3 due to regional dust storms, which can linger for five to ten days in the upper atmosphere and further exacerbate ground-level 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 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 at 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[35].

34 EMISK data.

35 The World Bank, POLLUTION LOAD ASSESSMENT, 2013.

FIGURE 13

Number of hourly exceedances of NO2 all stations in Kuwait 2008-2017[36]



36 Source of data: KEPA.

TABLE 4

Number of hourly exceedances of NO2 all stations in Kuwait 2008-2017[37]

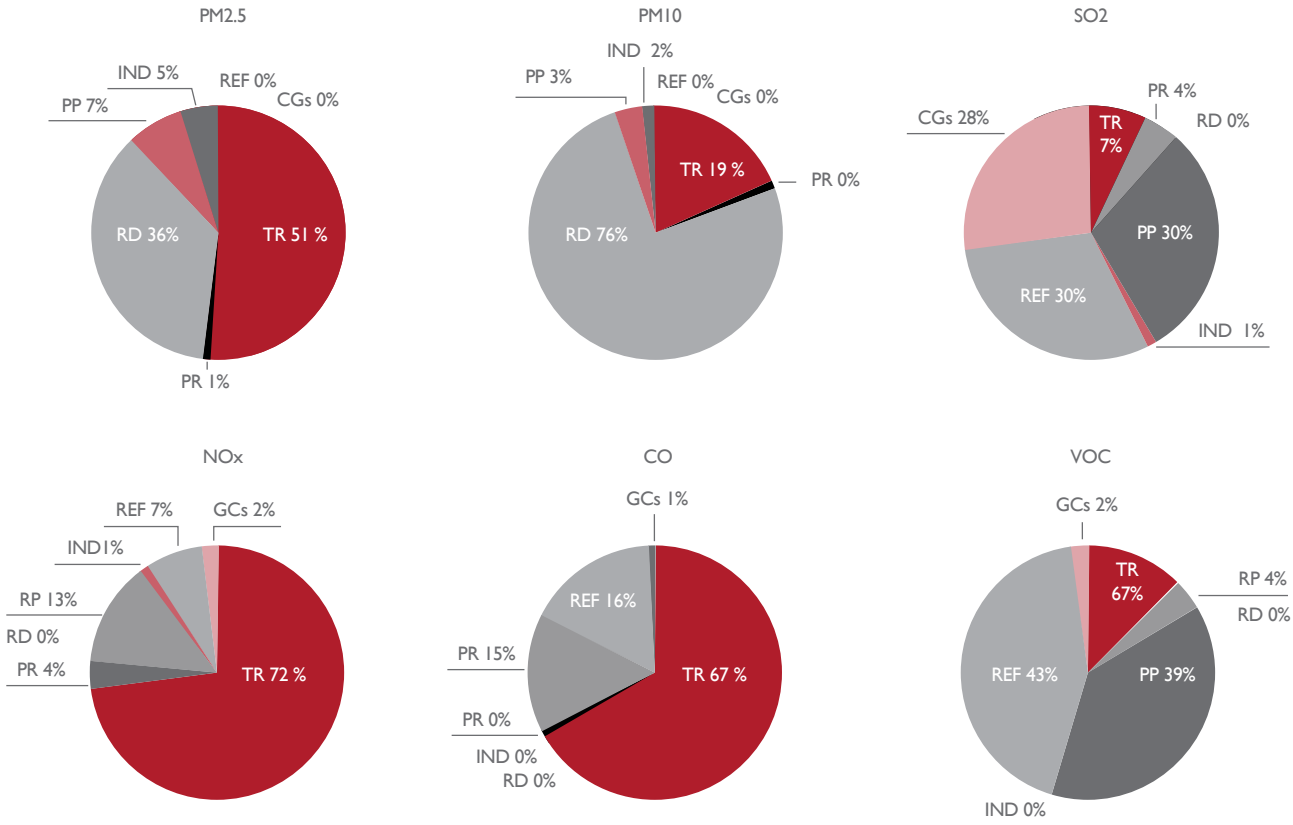
		PM2.5	PM10	SO2	NOx	CO	VOC
Transport	TR	9,720	11,440	5,040	126,060	285,860	69,140
Aviation	AV	20	20	140	1,880	2,260	760
Port	PR	160	200	2,660	6,720	560	22,020
Road dust	RD	7,000	46,640	-	-	-	-
Power Plants	PP	1,360	1,700	20,180	22,900	62,960	228,920
Industries	IND	880	1,100	540	2,320	340	220
Refineries	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 sectors 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 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 the total PM emissions. The emission sources of SO2, CO, and VOCs are mixed, with industries, power plants, and refineries dominating the totals.

37 Source: EMISK.

FIGURE 14

Share of sectors in the annual total emissions for 2010 in Kuwait city[38]



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.

38 Source of data: EMISK

TABLE 5

Total emissions from all known sources for 2030 in Kuwait city (tons/yr)[39]

		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)[40]. There is a high prevalence of asthma in Kuwait where 15% of adults and 18% of children are affected (Khadadah, 2012)[41]. Air pollution may be a significant factor in the exacerbation of symptoms of existing diseases and sensitization of new cases (Guarnieri, 2014)[42]. The prevalence of illness in a population that is highly exposed to air pollution can lead to significant health and economic costs.

39 Source: EMISK.

40 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 disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. Lancet.;389:1907–18.

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

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

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.

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[43].

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 responsible person/company who has committed 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 followed and enforced. At present, KEPA **does not have a set of indicators that measures performance** and maximizes the results of environmental regulations 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**.

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

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) A diminishing likelihood of reaching compliance

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

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 leaks 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 within the 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 normally 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 consequence 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 airborne 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 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[44]. 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.[45]

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

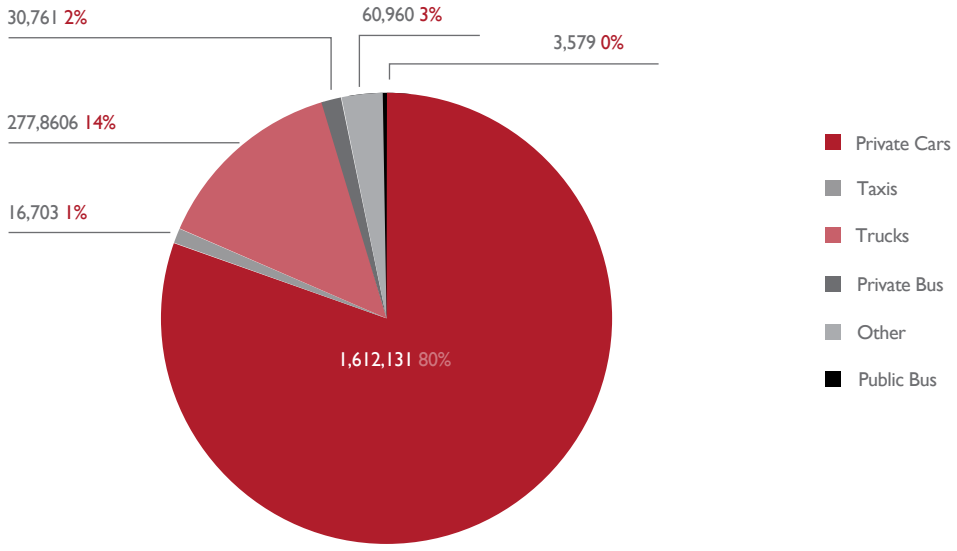
45 Jallad, K.N. and E.-J. Cyntia, "Analysis of ambient ozone and precursor monitoring data in a densely populated residential area of Kuwait", Journal of Saudi Chemical Society, 14, 4, (2010), 363-372.

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)[46]. 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.[47]

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 15 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 emission.

FIGURE 15

Distribution of vehicles by type (2016)[48]



46 Al Bassam; and Khan, 2004.

47 Ward Brown et al., 2008..

48 Source: CSB, the annual statistical abstract 2015/2016.

The rapid growth of motorized vehicle 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.

Suggested policy framework

Policy objective

The objectives of the Air Quality Policy are to ensure that the air quality in Kuwait at least meets national standards for ambient air and to minimize environmental harm from local emissions of air pollutants in Kuwait consistent with the requirements and objectives of the EPL.

The specific objectives of this policy are:

- Enhance compliance to and enforcement of the air quality laws and standards
- Reduce environmental harm from local emissions of air pollutants on Kuwait
- Develop the capacity to deal with and control air pollution incidents instantly
- Encourage innovation and technology aimed at reducing industrial emissions

Policy theory of change

The latest World Health Organization (WHO) health and environment progress report for Europe (2010) states that **urban air pollution, especially particulate matter, causes significant health problems** throughout the region, reducing the life expectancy of residents of more polluted areas by more than one year[49]. In the same vein, the European Environment Agency's (EEA) latest State of the Environment Report (SOER2010)[50] shows that **exposure to particulate matter (PM) and ozone (O3) remains a major environment-related health concern**, linked to a significant drop in life expectancy, increased acute and chronic respiratory and cardiovascular effects, impaired lung development in children, and reduced birth weight.

There is substantial research evidence from around the world that both indoor air pollution and outdoor/urban air pollution have significant negative impacts on public health and result in **premature deaths, chronic bronchitis, respiratory disorders and even cancer**. Indoor air pollution, especially in rural areas, can be even higher than outdoor/ urban air pollution due to the indoor use of biomass fuels for cooking and heating. The most significant air pollutant in terms of impacts on health is most commonly found to be particulate matter, especially fine particulates (PM10 or smaller).

It is well known that some air pollutants, such as sulfur dioxide and sulfur compounds, **can harm natural resources** (agricultural production, ecosystems and lakes) and subsequently increase the **environmental degradation costs**.

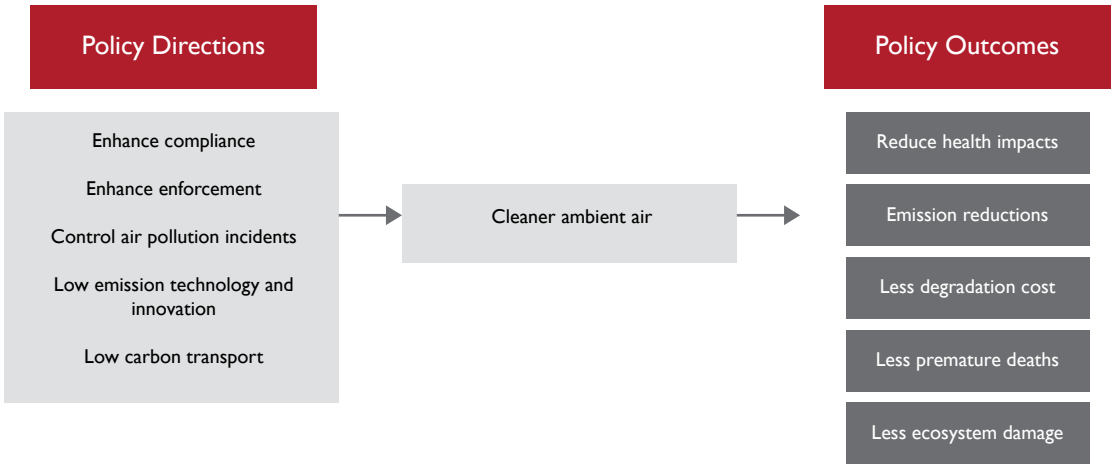
49 WHO-Health and Environment in Europe: Progress Assessment (2010), ISBN 978 92 890 4198 0.
50 European Environment Agency, 2010.

BEST PRACTICE BOX

EU air quality policy review stated that health benefits alone will save society €40-140 billion in external costs and provide about €3 billion in direct benefits due to higher productivity of the workforce, lower healthcare costs, higher crop yields and less damage to buildings[51].

FIGURE 16

Policy Directions and outcomes II



51 Source, EU air quality policy review.

Policy Directions

1. Enhance enforcement of environmental standards and measures of emission sources

Enhancing enforcement of and compliance with the EPL legislation is critical to achieve cleaner air outcomes. The KEPA will employ best practice regulatory principles and tools and robust processes to:

- Support and enable the **willingness to comply or go beyond compliance.**
- Tackle the important environmental issues with a proportionate, risk and evidence-based approach.
- **Take decisive, timely and strong enforcement action** when needed.
- **Raise awareness** to increase understanding of the EPL law and its executive regulations.

Much of this is achieved by providing advice and guidance, partnering with other organizations, offering education and establishing regulations. However, in some circumstances, KEPA shall use its enforcement powers.

The aim is that the balanced and principled use of compliance and enforcement tools will ensure that actions are consistent, fair and effective, and will provide assurance to the community that KEPA is working to fulfill its role of protecting the environment.
In order to overcome the issue of scattershot compliance and enforcement efforts, it is recommended to **establish a compliance department** within KEPA that will act as a user-friendly compliance liaison office to:

- Provide technical support on pollution control technologies and their costs to the industry.
- Develop an information system on polluting enterprises with e-MISK.
- Conduct inspections on the basis of the informed decision matrix (IDM) and issue appropriate advisory, orders, notices of violation and preparation of CAP.
- Negotiate the CAP, and provide an environmental compliance certificate for three to five years during which no inspections or investigations will be undertaken.
- Monitor and follow up on the Compliance Action Plans and in case of noncompliance, request that the enforcement department take appropriate administrative and legal actions.

Establish criteria to assess the variability and severity of the factors that influence the selection of compliance and enforcement. **Use the informed decision matrix tool for assessing the variability and severity** of the factors that influence the selection of compliance and enforcement tools.

Develop a course of advisory actions, warning, compliance assistance and compliance incentives that will help achieve greater compliance.

Build the capacities of KEPA inspectors to perform quality inspection on facilities that potentially violate air quality laws.

Develop **appropriate monitoring and evaluation** of the compliance and enforcement indicators.

2. Develop and implement plans to control air pollution incidents

Activities that help the KEPA to effectively respond to a hazardous material incident include:

- Regular communication with other agencies on programs to improve a government response to incidents.
- Periodic response and recovery exercises offered both to single agencies and multiple agencies.

Industries that use or store hazardous materials should consider whether they have adequate pollution insurance coverage in the event of a pollution incident.

KEPA shall require all industries (emitters) to **prepare and implement pollution incident response management plans** that:

- Ensure comprehensive and timely communication about a pollution incident to facility staff, the KEPA, other relevant authorities.
- Minimize and control the risk of a pollution incident at the facility by requiring identification of risks and the development of planned actions to minimize and manage those risks.
- Identify trained staff members who are responsible for implementation.
- Test regularly for accuracy, currency and suitability.

Major Hazard Facilities are required to undertake detailed risk management evaluations and implement appropriate control strategies and emergency plans.

3. Encourage innovation and technology aimed at reducing emissions from industries

The industrial processes in Kuwait and the product use sector include emissions generated from production processes involving the use of chemical industry processes, and production and use of synthetic gases. Greenhouse gas emissions from industrial processes and product use are primarily byproducts of production.

New and innovative technologies help to tackle air pollution, including lower-emission vehicles (including electric, hybrid and LPG), and lower-emission sources of heat and power. There are also numerous other emerging technologies that could also play a role in the future.

KEPA needs to **educate industries on low-emission technology (LET) alternatives** available to them that would help reduce or avoid airborne emissions at the source. In addition, KEPA should develop technical guidance on the emerged technologies available to pollutant-emitters.

The government should also seek to increase the efficiency of the transport network and reduce traffic congestion. This would include advocating for low-carbon vehicles, revamping the public transport system and shortening the distance between key landmarks through bridges and tunnels.

Policy targets

TABLE 6

Air quality quantitative and qualitative targets

Policy area	2025	2030 aspirations
Overarching air quality targets	• (SDG target) Reduce annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted) • Positive trends in concentration of key pollutants • Fewer premature deaths[52] attributed to air pollution • Reduce percentage of urban population exposed to exceeding pollutant limits • Improved community awareness	• (SDG target) Enhanced annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted) • Positive trends in decreasing the concentration of key pollutants • Fewer premature deaths attributed to air pollution • Enhanced percentage of urban population exposed to exceeding pollutant limits • Improved community awareness
Enhance enforcement of environmental standards and measures on emission sources	• 20% enhancement in compliance rate • 20% fewer violations of air quality standards • 60% of facilities complied with the EPL • 40% of facilities remediate the violation	• 50% enhancement in compliance rate • 50% fewer violations of air quality standards • 90% of facilities complied with the EPL • 60% of facilities remediate the violation
Develop and implement plans to control air pollution incidents	• Management response plans developed for **key** emissions facilities in Kuwait • 60% of air pollution incidents are properly responded to instantly • Key staff of 40% of the industries are trained and educated on how to implement response plan	• Management response plans developed for **all** emissions facilities in Kuwait • 90% of air pollution incidents are properly responded to instantly • Key staff of 70% of the industries are trained and educated on how to implement response plan
Encourage innovation and technology aimed at reducing emissions from industries	• Technical guidance on the emerged technologies available to pollutant-emitters • 40% of the industries are trained and educated on alternative technologies	• Continuous improvement of the technical guidance on the emerged technologies available to pollutant-emitters • 80% of the industries are trained and educated on alternative technologies

52 Death that occurs before the average age of death in a certain population.

Policy delivery principles

The key principles underpinning the delivery of waste policy are:

- The government of Kuwait is committed to addressing air pollution problems in the country.
- Human health is central to the issue of addressing air pollution.
- The government of Kuwait is accountable for achieving the policy target.
- The policy design, delivery and evaluation will be evidence-based.
- Emitters will be encouraged to participate in reducing pollution.
- Stakeholder coordination is imperative to achieving the policy targets.
- The government of Kuwait will follow best practices to achieve policy targets.

Monitoring and evaluation

Policy monitoring and evaluation can offer an assessment of the degree of effectiveness and efficiency of a policy throughout its implementation in order to determine whether its anticipated objectives have been attained[53]. Policies must be monitored and evaluated to determine which ones remain relevant yet have not met their full potential. Then, they must either undergo moderate to substantial revisions or they must undergo further analysis. That analysis would determine which policies are no longer relevant or are too far out of scope to successfully be revised, and thus must be retired.

IMPORTANCE OF POLICY M&E

- Challenges assumptions and strategy
- Provides information and new insights
- Increases likelihood that policy will make a positive difference
- Helps identify problems and causes
- Encourages acting on information/insight;
- Measures policy effectiveness and feeds into new policy design
- Offers accountability for resources used

The following are key monitoring and evaluation activities suggested for this framework:

- Kuwait air quality standards and legislative framework will be reviewed every four years to ensure validity and applicability.
- Regular monitoring to check progress to date in achieving aforementioned targets.
- Establish a modeling study to forecast, track and evaluate health impacts from air pollution, particularly premature deaths.
- Conduct Policy Impact Evaluation in 2024 to assess environmental, social and economic benefits from air quality policies.
- Inspect implemented projects regularly to ensure effectiveness in reducing adverse air pollution impacts.

50 European Commission (2015), Better Regulation "Toolbox", available here https://ec.europa.eu/info/index_en

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 17

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 2012-2016 (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

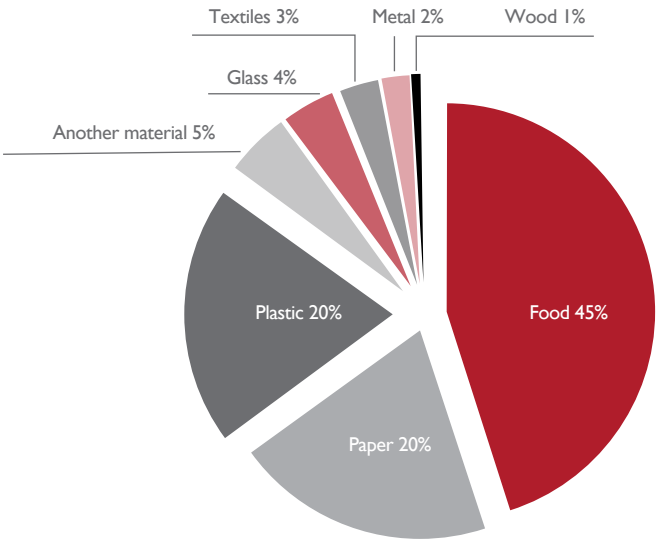
The State of Kuwait has one of the globe's highest rates of solid waste per capita at 1.32 kg/day, an amount that is challenging to manage. Although Kuwait comprises a small geographical area and has a relatively small population, it has a constant need for urban expansion and the consequent development 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 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, the State of Kuwait encourages private companies to work with the recycling industry to reduce the quantity of wastes. Figure 18 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 18

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.[54] This far exceeds the global average of 0.74kg/capita/day, and the regional (MENA region) average of 0.81 kg/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 7, namely: Mina Abdullah; Al-Jahra; and South of 7th Ring Road. The total area of the aforementioned landfills is estimated at 9.44 Km2.

TABLE 7

Municipal solid waste generated during 2016

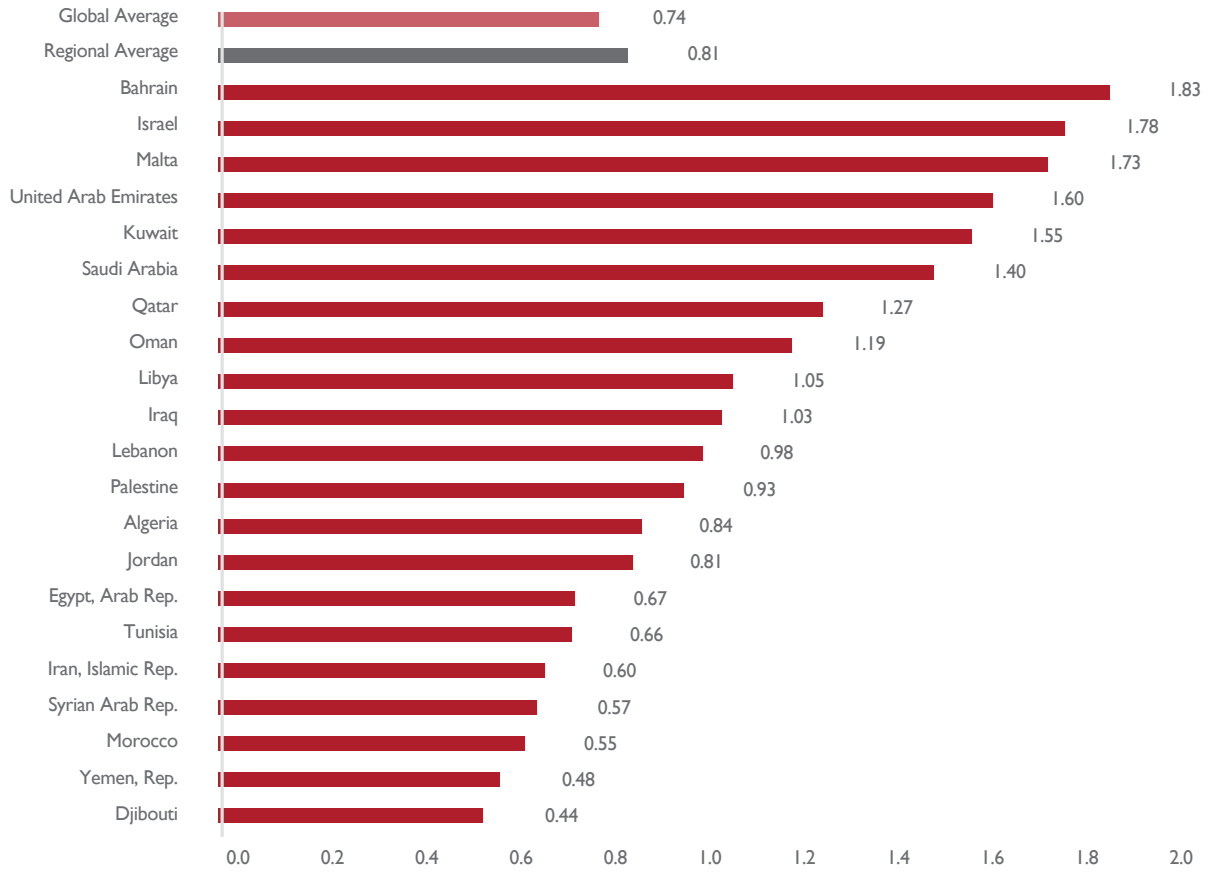
Landfill	Area size km2	Solid waste -ton (for year 2016)
Mina Abdullah	2.42	478,254
South of 7th ring road	5.35	1,381,745
Al-Jahra	1,67	465,205
Total	9.44	2,325,204

54 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.

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 19

Waste generation rates: Middle East and North Africa region[55]



55 World Bank, What A waste, 2018.

TABLE 8

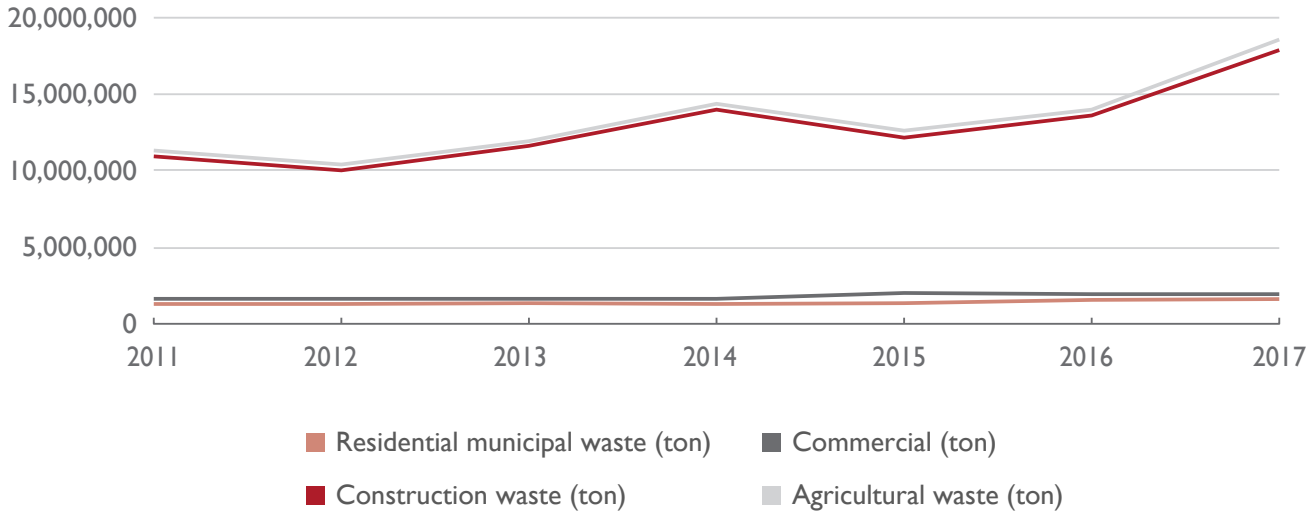
Kuwait population and amount of waste arriving final dumping sites[56]

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

56 Source of data is Central Statistical Bureau (CSB)

FIGURE 20

Trends waste amounts arriving at final dumping sites 2011-2017



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.

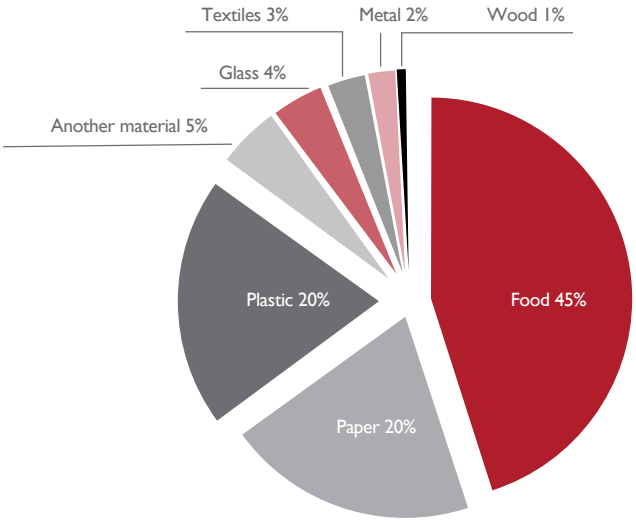
In 2010, an industrial wastewater treatment plant was established in Al-Wafra area with a capacity of 8,500 cubic meters per day, with the possibility of increasing the received load to about 15,000 cubic meters per day. Furthermore, Article (35) of the environment law No. (99) (amendment of the law 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.

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.

FIGURE 18

Amounts of hazardous medical waste in Kuwait



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.

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, and 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%[57]. Both the population growth and the economic growth are strongly correlated with the MSW in Kuwait, R2 =0.87 and 0.81 respectively[58].

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

58 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.

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 why 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.

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 distinctive effect 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[59] 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 only 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 continues 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.

59 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.

BEST PRACTICE BOX

GCC countries have invested or have 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 the UAE, the Federal National Council passed new legislation aimed at recycling 75 percent 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.

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.

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[60].

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.

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

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.

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 system 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

Suggested policy framework

Policy objective

In order to ensure that the above environmental issues continue to receive attention and that long-term, sustainable solutions are developed to address the underlying causes, the waste policy aims to **develop an effective waste management system** that minimizes and manages the adverse effects of waste generation 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 resources.

The specific objectives of this policy are:

- Moving toward environmentally sound management methods and technologies to mitigate negative effects on human health and the environment.
- Moving toward a waste management system that implements the five-step waste hierarchy in order to stimulate resource efficiency.
- Encouraging private sector participation in waste management based on clear legal and institutional frameworks.
- Enhancing institutional and individual capacities in implementing high standards of waste management through knowledge, skills, equipment and technologies.
- Ensuring that sufficient information and data for sound decision making in the waste management system is available.

FIVE-STEP WASTE HIERARCHY

The European waste hierarchy refers to the five steps included in Article 4 of the Waste Framework Directive:[6]

- **Prevention**

preventing and reducing waste generation.

- **Reuse and preparation for reuse**

giving the products a second life before they become waste.

- **Recycle**

any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes composting and it does not include incineration.

- **Recovery**

some waste incineration based on a political, non-scientific formula that upgrades the less-inefficient incinerators.

- **Disposal**

processes to dispose of waste including landfill placement, incineration, pyrolysis, gasification and other terminal solutions. According to the Waste Framework Directive, the European Waste Hierarchy is legally binding except in cases that may require specific waste streams to deviate from the hierarchy. This should be justified on the basis of lifecycle thinking.

FIGURE 22

Five-step waste hierarchy

Prevention

Preventing and reducing waste generation

Reuse and preparation for reuse

Giving the products a second life before they become waste

Recycle

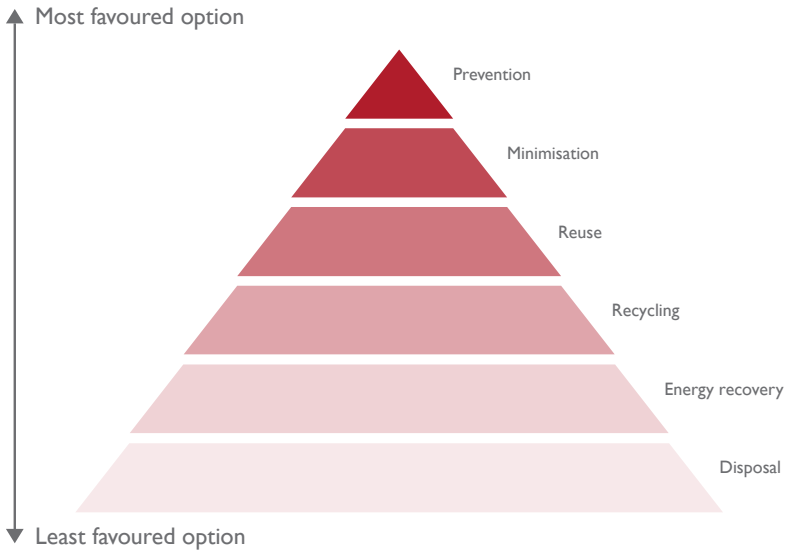
Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes composting and it does not include incineration

Recovery

Some waste incineration based on a political non-scientific formula (citation needed) that upgrades the less inefficient incinerators

Disposal

Processes to dispose of waste including landfill placement, incineration, pyrolysis, gasification and other terminal solutions. According to the Waste Framework Directive, the European Waste Hierarchy is legally binding except in cases that may require specific waste streams to deviate from the hierarchy. This should be justified on the basis of lifecycle thinking



Policy theory of change

Applying Environmentally Sound Management (ESM) principles of waste management reduces the risks posed by different types of waste (including hazardous waste) on **human health**. Waste poses a risk to health when waste-related emissions are inhaled, an action that may cause disease and death. When waste emissions are inhaled, they can lodge in lung tissue and cause inflammation, scarring and sometimes even more serious, related diseases. These problems usually take many years, if not decades, to develop.

An additional health impact is in the form of air pollution from **emissions of pollutants** as constituents of flue gases from the incineration of clinical waste.

ESM of waste reduces the impacts from waste on the environment. Historically, waste spills have had catastrophic impacts on local ecosystems and have led to **soil contamination and ground water pollution**.

ESM helps to improve and maintain **productive soils,** stimulate plant growth, and reduce major environmental risks of groundwater infiltration and the subsequent contamination of aquifers.

Supporting better and repeated use of our resources helps the **circular economy** retain the value of materials in the economy for as long as possible, reducing the unsustainable depletion of natural resources and impacts on the environment. **A circular economy has economic benefits, creating new industries, markets and products, and leading to new revenue streams and creation of jobs**.

BEST PRACTICE BOX

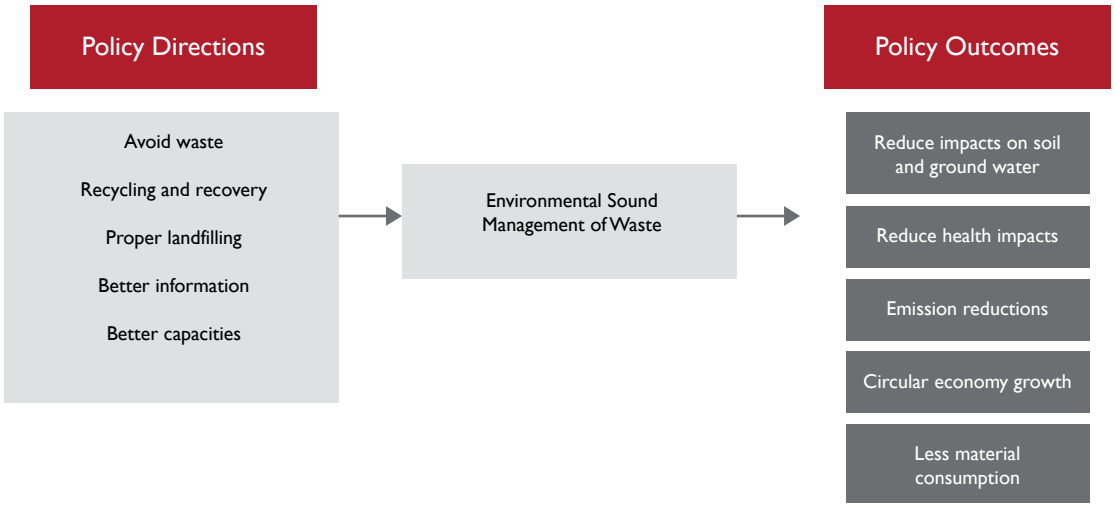
There is a global movement toward applying circular economy principles. For example, in 2015 the European Commission committed to a Circular Economy Action Plan. Better management of waste, including application of the waste hierarchy, is a key part of the transition to a circular economy.

Applying the circular economy principles to waste management in Kuwait requires changes across all stages, from production, use and reuse, recycling and disposal. It is a whole-of-system approach that requires accounting for the full cost and lifecycle of materials. It is also an approach that will help to **minimize reliance on virgin materials** and maximize the economic value of resources.

Generating less waste and increasing recycling and recovery means a decreased use of landfills and a subsequent **reduction of the environmental impacts and operational costs of using landfills -** including lower rehabilitation costs.

FIGURE 23

Policy Directions and outcomes III



Policy directions

1. Avoid waste: encourage efficient use, reuse and repair

The amount of waste that Kuwait generates has been growing. This is driven partly by population growth and partly by changes in our economy and society, such as increased consumption and increased packaging.

The simplest way to manage waste is to create less in the first place. The waste hierarchy calls for prioritizing waste avoidance and minimization, including through product and packaging design, and reusing or repairing products and items.

Avoiding waste and reducing the amount of waste generated will reduce pollution, reduce greenhouse gas emissions, reduce the pressure on our recycling infrastructure and protect our oceans. It will also curb unsustainable use of raw materials.

Governments, industries and communities all have a role to play in waste avoidance. **Changing consumer awareness and behavior is also critical**. By repairing or reusing items rather than throwing them away, and buying products containing recycled content that can be used multiple times and have a long useful life, we can avoid creating waste.

Prioritize waste avoidance, encourage efficient use, reuse and repair. Design products so that waste is minimized, they are built to last and we can more easily recover materials.

2. Improve waste recycling and resource recovery

To improve recycling and resource recovery, Kuwait must: improve access to waste management processes; **ensure that the right infrastructure**, **facilities and rules are in place**; and ensure they are financially sustainable. This includes developing common **approaches in regulations and standards**.

This policy can increase the overall recycling rate and return of resources to the economy by increasing the capacity of the recycling and resource recovery sector, reducing contamination of materials that go into resource recovery processes, introducing sustainable packaging; and developing markets for recycled goods.

Improved materials collection systems and processes will help to achieve a higher degree of recycling. This requires **introducing new recovery technologies** in Kuwait such as waste to energy, and **developing incentive schemes** to encourage waste recycling, including by engaging the private sector.

3. Move from dumping into engineered landfill

Dumping is – and historically has been - the dominant method of solid waste management in Kuwait. Despite its limited area, Kuwait used to have a relatively large number of landfills sites (18 in total), of which 12 were closed long before achieving their capacities, because of improper disposal methods and concerns related to public health and the environment.

In order to avoid adverse environmental impacts and associated economic costs, Kuwait needs to **move away from its current dumping practices and toward engineered sanitary landfills**. This will reduce disposal costs, land consumption and also avoid negative health and environmental consequences.

Making this happen would require **building in-house capacities to establish and manage landfills** by bringing in specialized engineers and experts.

The government of Kuwait needs to expedite the procurement processes to be able to purchase the services of experts who are highly skilled in designing and constructing landfills.

All dumping sites in Kuwait are unsafe, poorly designed and operated, and most of them are also uncontrolled. These issues significantly impact public safety (fires at closed sites), health and the environment (general population exposure to migrating landfill gases and groundwater contamination), and also represent an inefficient use of scarce land resource.

The old (not used anymore) dumping sites pose a high risk to human health and the environment. The government shall **initiate a rehabilitation process of all old dumping sites** to avoid environmental, health and physical risks.

In order to handle those risks, the government needs to **develop contingency plans** to deal with serious risks such as fire and methane gas leaks in case they happen in the old dumping sites.

4. Improve information to support innovation, guide investment and enable informed consumer decisions

Good decisions are based on good information. To ensure that efforts to improve Kuwait's waste management issues result in the best outcomes, we need better information about where Kuwait's waste comes from and where it goes.

Developing high-quality information about the flow of resources and materials, and the markets available for recycled materials and products is critical to business investment and the development of targeted strategies to influence consumer behavior.

By increasing the detail and regularity of reporting, more contemporary and accurate information will be available to inform government, business and industry decisions.

The government of Kuwait will establish a comprehensive, **centralized database about waste** that brings together all data and information on the waste sector, including quantities of waste identified, collected, recycled, treated, disposed of, and put into a landfill. That same information also would enable decision makers to make informed decisions about future policies. On the other side, a reliable data source based on clear information would be helpful in attracting private sector investment in waste projects.

5. Identify, plan for, treat and safely dispose of hazardous waste

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.

As an underdeveloped sector, the first step is to understand what hazardous waste exists in the country. Such an undertaking would require **comprehensive inventories of key hazardous** wastes in Kuwait, and the subsequent development of a national implementation plan, as per the Multilateral Environmental Agreements' obligations.

Once identified, the Kuwaiti government will **treat or dispose of hazardous waste in an environmentally sound manner**.

Policy targets

TABLE 9

Waste quantitative and qualitative targets

Policy area	2025 targets	2040 aspirations[61]
1. Avoid waste: encourage efficient use, reuse and repair	• Waste generation per capita reduced 5%	• Waste generation per capita reduced 15%
2. Improve waste recycling and resource recovery	**Municipal waste:** • Only 50% of the generated goes to landfill • 8% recycling rate • 25% recovery rate **Construction and demolition:** • 8-10% recycling rate • 60-90% recovery rate	**Municipal waste:** • Less than 33% of the generated goes to landfill • 13% recycling rate • 39% recovery rate **Construction and demolition:** • 10-12% recycling rate • 81-87% recovery rate
3.Move from dumping into engineered landfill	• A new sanitary landfill is established and operated • % of Municipal waste is safely landfilled (percentage yet to be decided) • 3 old landfills rehabilitated • Contingency plans to deal with risks are in place	• A new sanitary landfill is established and operated • % of Municipal waste is safely landfilled (percentage yet to be decided) • 12 old landfills rehabilitated • Contingency plans to deal with risks are in place
4. Improve information to support innovation, guide investment and enable informed consumer decisions	• Waste data bank established • Robust evidence informs decisions	• Waste data bank established • Robust evidence informs decisions
5.Identify, plan for, treat and safely dispose hazardous waste	**Industrial HW** • Co-incineration in rotary kiln of cement production, after pre-treatment (7 %) • Landfill (66 %) • Export (4 %) • Mono hazardous waste incinerator (rotary kiln) (26 %) **Oil industry HW** • Bioremediation (%) • Landfill rate % • Export (%) • Mono hazardous waste incinerator (rotary kiln) (%) **WEEE[62]** • Collection rate 33% • Recycling rate 48% • Recovery rate 88%	• Co-incineration in rotary kiln of cement production, after pre-treatment (6.294 t; 13 %) • Landfill (28.048 t; 56 %) • Export (2.706 t; 5 %) • Mono hazardous waste incinerator (rotary kiln) (13.231 t; 26 %) **Oil industry HW** • Bioremediation (74.766 t; 82 %) • Landfill rate 1% • Export (7.565 t; 8 %) • Mono hazardous waste incinerator (rotary kiln) (10.574 t; 12 %) **WEEE[63]** • Collection rate 53% • Recycling rate 65% • Recovery rate 93%

61 2040 time frame aligns with the national strategy aspiration.
62 WEEE is waste electrical and electronic equipment.
63 WEEE is waste electrical and electronic equipment.

Policy delivery principles

The key principles underpinning the delivery of waste policy are:

- The government of Kuwait is committed to the international sustainable development agenda and environmental agreements and conventions to achieve safe management of waste in Kuwait.
- The government of Kuwait is accountable for achieving the policy target.
- The policy design, delivery and evaluation will be evidence-based.
- Waste recycling and recovery development are unique areas to achieve effective partnerships with the private sector.
- Encourage consumers' participation in reducing waste generation.
- Stakeholder coordination is intrinsic to achieving the policy targets.
- The government of Kuwait will follow best practices to achieve policy targets.

Monitoring and evaluation

Beginning from the time of implementation, policies must be monitored and evaluated to assess the degree of their effectiveness and efficiency to determine whether their anticipated objectives have been met[64]. Policies that are still relevant but that are not reaching their full potential must be thoroughly monitored and evaluated so that they may undergo moderate to substantial revisions. Policies determined to no longer be relevant or too far out of scope to be revised must be retired.

IMPORTANCE OF POLICY M&E

- Challenges assumptions and strategies
- Provides information and new insights
- Increases likelihood that policy will make a positive difference
- Helps identify problems and causes
- Encourages acting on information/insight
- Measures policy effectiveness and feeds into new policy design
- Accountability for resources used

The following are key monitoring and evaluation activities suggested for this framework:

- Kuwait's waste policy framework will be reviewed every four years to ensure validity and applicability.
- Regular monitoring to check progress to date in achieving aforementioned targets.
- Establish a modeling study to forecast, track and evaluate progress toward the waste generation, recycling and recovery targets considering population growth and urbanization and industrial growth.
- Conduct Policy Impact Evaluation in 2024 to assess environmental, social and economic benefits from waste management programs.
- Regular inspection of the implemented project to ensure effectiveness in reducing adverse environmental impacts.

64 European Commission (2015), Better Regulation "Toolbox", available here http://ec.europa.eu/smartregulation/index_en.htm

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 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.

FIGURE 24

Relevant SDG 11: Sustainable cities/Relevant SDG 15: Life on land

SDG indictors in Kuwait		
Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated 11.6.1	Grand generation of solid waste in Kuwait (million ton/year)	Per capita generation of solid waste (Kg/capita/day)
100	2.25	16,341
Annual mean of measured Ozone by fixed stations in 2017 (ppm)	Annual mean of measured NO2 concentration by fixed stations in 2017 (ppm)	Annual mean of measured CO concentration by fixed stations in 2017 (ppm)
0.02	401.6	1.1
Annual mean of measured PM2.5 concentration by fixed stations in 2017 (ug/m3)	Annual mean of measured PM10 concentration by fixed stations in 2017 (ug/m3)	Annual mean of measured SO2 concentration by fixed stations in 2017 (ppm)
93.4	165.7	0.007

SDG indictors in Kuwait		
Total construction waste received by recycling factory in 2017 (ton)	**Total paved roads in Kuwait (Km)**	**11.1.1 Proportion of urban population living in slums or informal settlements**
1,341,854	**7197,27**	**0**
Total construction solid waste collected in 2017 (ton)	**Total agricultural solid waste collected in 2017 (ton)**	**Total residential solid waste collected in 2017 (ton)**
13,054,731	**437,832**	**1,696,920**
		Total commercial solid waste collected in 2017 (ton)
		411,896
	Total area of protected area (km2)	**Number of protected areas**
	1,547	**1 0**
Number of documented illegal entries of wild animals into Kuwait in 2017	**Number of documented legal entries of wild animals into Kuwait in 2017**	**% of terrestrial protected areas of total area of the state**
6	**214**	**8.68**

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[65]. 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[66]. 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.

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 as a reduction in the need for health treatment

65 Alghais and Pullar, 2016.

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

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[67]. Green infrastructure is most often used as a way of integrating urban ecology into the built environment.

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 greener streets and green buildings and roofs.

Landscape connectivity is essential to connect people with their environment, including connectivity among green spaces, good street connectivity and connections with surrounding neighborhoods. Contact with nature promotes human health and well-being. Hence, providing 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)[68]. 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).[69]

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.

67 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

68 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

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

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.

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% -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 urban areas currently have few 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.

Suggested policy framework

Policy objectives

The purpose of this policy is to enhance the environmental sustainability of urban development, and to maintain large, high-quality remnant biodiversity habitats by broadly integrating eco-cities concepts into city planning platforms.

Specifically, the policy aims to:

- Incorporate principles for improving the suitability of the urban matrix into multiple types of green spaces, residential gardens, informal green spaces, green corridors and vegetative aspects of the built environment.
- Integrate eco-cities considerations into the broadest planning platforms in Kuwait, such as 4KMP.

- Promote environmental sustainability in new urban cities in Kuwait, such as the Silk City and Five Islands developments.
- Increase the density of native trees and retain large, mature trees throughout landscapes.
- Enhance the status of urban ecology in key cities in Kuwait.

Policy theory of change

Applying an eco-friendly approach to urban development will **enhance the quantity and quality of habitats** and thus the ecology of cities. Green infrastructure can provide valuable services and increase resilience to extreme weather events and climate change.

Empirical evidence of the health benefits of green space is growing. The idea that humans possess an inherent affinity for natural systems and processes[70] – links green spaces and human health. Green spaces contribute to **physical health and well-being** by encouraging physical activity. Research has also demonstrated an association between parks and open spaces and the propensity to engage in physical activity, although this finding is not consistent across all studies[71]. Kuwait urban areas have limited open green spaces that currently restrict opportunities for physical activities.

Climate change will continue to affect Kuwaiti cities, resulting in increased temperatures and extreme weather events. As temperatures increase, cooling demands also will increase, resulting in additional energy use by cooling devices such as air conditioning units and fans. Urban greening can **reduce the urban heat impacts** (UHI) effect and the energy requirements of buildings in urban environments[72]. Elements such as green roofs, green walls, open green spaces, wetlands and street trees can contribute significantly to such reductions by regulating the internal temperatures of buildings and reducing ambient temperatures in urban areas.

Urban trees and green walls **decrease the cooling demands** of buildings through shading and evapotranspiration. Green roofs are another passive cooling technique. They reduce the amount of solar radiation reaching building structures below and increase the insulation properties of buildings[73].

BEST PRACTICE BOX

In Seoul, South Korea, a park in the central business district (the Seolleung Royal Tomb Park) generated a cooling effect of 2 °C per 100m between it and the Seolleung subway station, over a distance of 370m[74].

70 Hélène, L. (2016). Becoming biophilic: challenges and opportunities for biophilic urbanism in urban planning policy. Smart and Sustainable Built Environment, 5(1), 15-24. doi:10.1108/SASBE-10-2015-0036

71 Wolf, K. L., & Robbins, A. S. (2015). Metro nature, environmental health, and economic value. Environmental Health Perspectives, 123(5), 390-398.

72 Castleton, et al. (2010). Green roofs; building energy savings and the potential for retrofit. Energy and Buildings.

73 Wong, et al. (2010). Thermal evaluation of vertical greenery systems for building walls. Building and Environment.

74 Lee, et al (2009). Effect of an urban park on air temperature differences in a central business district area. Landscape and Ecological Engineering.

Urban vegetation can **improve air quality**. Trees intercept atmospheric particles and absorb various gaseous pollutants, including sulfur dioxide, ozone, carbon monoxide and nitrogen dioxide[75]. Plant species used for green walls and green roofs have the potential to remove air pollutants; a variety of species have been shown to have this ability[76].

Urban development significantly modifies hydrological systems in urban areas. Changes to the natural environment, such as creek channelization, an increase in the area of impervious surfaces, and topographic modifications affect the quantity, **speed and direction of floodwater**[77]. Vegetation can be used in managing urban water flows, especially by adopting new ways of thinking about storm water in the urban context.

Construction, traffic and human activities create noise pollution in urban areas, with impacts on psychological and physiological health. **Green infrastructure can mediate noise pollution** through the absorption, deviation, reflection and refraction of sound waves[78]. Green roofs and walls can reduce noise pollution inside the buildings on which they are located. Green roofs reduce sound pollution by absorbing sound waves originating outside buildings and preventing their inward transmission.

75 Gómez et al. (2013). Classifying and valuing ecosystem services for urban planning. Ecological Economics.
76 Pérez et al. (2015). Vertical greening systems and sustainable cities. Journal of Urban Technology.
77 Barbosa, et al. (2012). Key issues for sustainable urban stormwater management.
78 Gómez et al. (2013). Classifying and valuing ecosystem services for urban planning. Ecological Economics.

Policy directions

1. Integrate eco-cities concepts into master planning processes

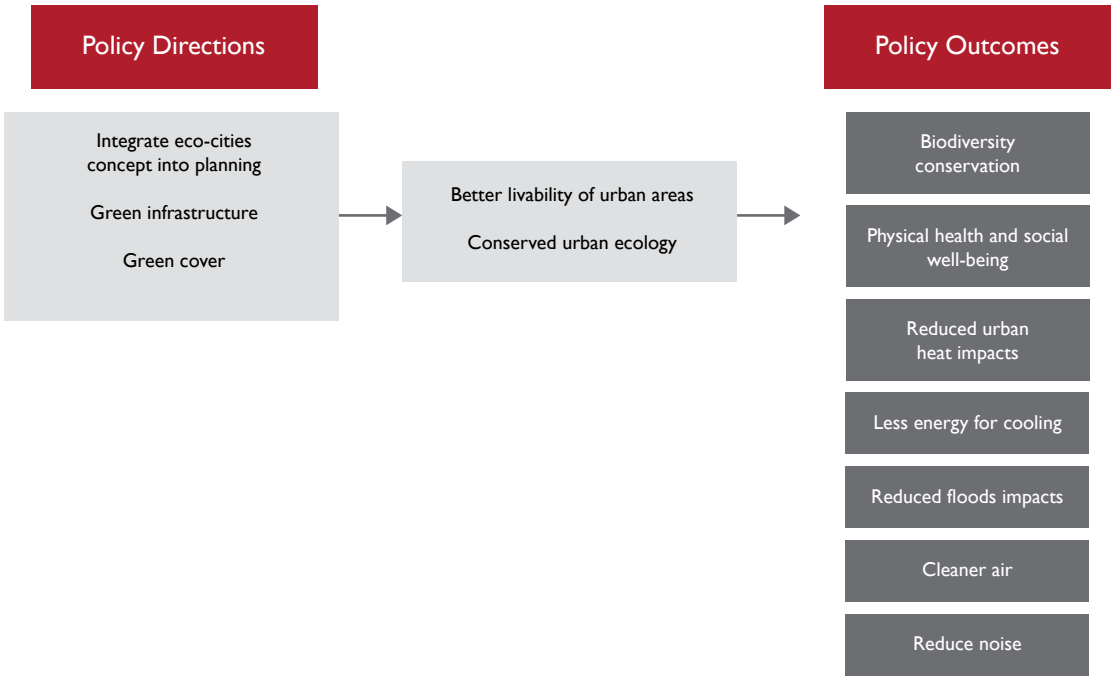
Professionals involved in preparing master plans for Kuwait have key roles to play in facilitating urban ecological outcomes in urban renewal and redevelopment projects. Urban planning should consider the complex ecological and social processes operating at different times and scales in a region. The integration of green infrastructure into the urban context will support ecosystems services. This will also improve the resilience of Kuwait in the face of climate change and extreme weather events.

The integration of the eco-cities concept into 4KMP could be achieved by:

- Planning for landscapes that could be a series of habitat patches and corridors. Planning for such integration should extend from large-scale city plans through to small-scale local plans, enabling an integrated, holistic approach to achieving urban ecological outcomes.

FIGURE 25

Policy directions and outcomes IV



- Developing a framework for building codes, standards and ratings that enables provision of the minimum necessary requirements for: safety and health; amenity and accessibility; energy savings; water savings; waste reduction; and sustainability of the biodiversity in the design, construction, performance and livability of new buildings throughout Kuwait.
- Establishing a framework for green infrastructure in the new areas to be urbanized such as the Silk City and Five Islands developments.
- Planning for adequate open spaces in Kuwaiti urban areas to create a livable environment for the community and increased habitat for biodiversity.

BEST PRACTICE BOX

Green Star is a voluntary sustainability rating system for buildings in Australia. It was launched in 2003 by the Green Building Council of Australia.

The Green Star rating system assesses the sustainability of projects at all stages of the built environment life cycle. Ratings can be achieved at the planning phase for communities, during the design, construction or fit-out phase of buildings, or during the ongoing operational phase.

The system considers, assesses and rates buildings, fit-outs and communities against a range of environmental impact categories and aims to encourage leadership in environmentally sustainable design and construction, showcase innovation in sustainable building practices, and consider occupant health, productivity and operational cost savings.

Green Star certification is a formal process in which an independent assessment panel reviews documentary evidence that a project meets Green Star benchmarks within each credit. The assessment panel awards points, with a Green Star rating determined by comparing the overall score with the rating scale:

FIGURE 26

Green Star rating

2. Piloting green infrastructure

Green infrastructure provides a design framework for implementing urban ecological renewal. Interest in, and the application of, green rather than grey infrastructure continues to increase. As new projects are commissioned, the potential exists to extend design briefs for green infrastructure elements to specify that they deliver biodiversity outcomes. Urban ecosystems are enhanced by green infrastructure, which includes products, technologies and design approaches that mimic natural processes and extend green cover in otherwise built-up urban environments. Green infrastructure has the potential to significantly enhance urban ecology through a hierarchy of interventions.

There are opportunities to integrate urban ecology in the built environment in Kuwait at all scales. The use of green infrastructure can support urban ecosystem renewal at a range of scales. Indeed, it is necessary to integrate urban ecology in the built environment at all scales to achieve comprehensive urban ecological outcomes.

As a relatively new concept to Kuwait, green infrastructure may go through a proof-of-concept approach to validate the best technology and tools that fit a Kuwaiti context and can be replicated and scaled up in the new cities. This involves piloting the following:

Green wall

Green wall is the general term for a variety of vertical greening systems, of which there are two main categories: "green facades" and "living walls." Green facades use climbers to spread over wall surfaces. Living walls use felt layers or modular hydroponic systems to form a living cover over wall structures.

Green wall technologies continue to evolve. The provision of adequate watering is essential for maintaining green walls, and automatic irrigation controls are helping to ensure this. Temperature and moisture sensors, as well as flow meters, can be embedded in green walls to measure water and temperature conditions and provide water to plants as needed.

Green roofs

Green roofs reduce the cost of heating and cooling, increase the longevity of the roof membrane, reduce the urban heat effect, improve air quality, increase sound insulation and fire resistance, improve stormwater management, increase human health and well-being and provide habitat for flora and fauna.

Green walls and roofs can potentially be piloted in Kuwait's urban areas prior to being replicated and scaled up across existing and new cities.

3. Improve and expand the network of open green spaces and greenbelts

A plan for growing Kuwait should aim to balance growth with support for a network of open spaces and green spaces and the protection of the natural environment and biodiversity. Managing the impacts of development on the environment at the city and site scales will require integrated planning approaches.

Green open spaces such as parks and bushland reserves are patches within the urban matrix that provide habitat for a diverse array of species. Greenways, green streets (street-tree plantings) and backyards can act as corridors or "stepping stones" among patches, facilitating the movement and dispersal of species through the landscape. The size and edge conditions of these corridors are very important in determining biodiversity outcomes.

BEST PRACTICE BOX

At the scale of master plans, the Rouse House Town Centre project (in Australia) is a good example of urban planning: it has facilitated the provision of 40% open space and 20% restored native vegetation, allowing development to occur around these features. This is not considered compact development, however; rather, it demonstrates the tendency to prioritize sprawling developments, especially on the outskirts of many Australian cities.

In order to achieve this objective in Kuwait, the new master plan of Kuwait needs to integrate the open space concept of open green spaces from the outset before being implemented.

This also requires mapping existing open spaces, selecting proper sites that are of ecological significance to be allocated as an open space, and rehabilitating existing spaces to be more biodiversity-friendly.

Tree planting programs in Kuwait also need to be expanded to include streets and open spaces using native species, including planting green belts around key urban areas. Silk City will be surrounded by a green belt of gardens and vast green spaces to guarantee the visitor a clean atmosphere for his visit.

4. Adopt Singapore Index on Cities' Biodiversity

KEPA has initiated a partnership with the National Parks Board of Singapore toward adoption of the Singapore Index on Cities' Biodiversity. The Singapore Index (SI) is a self-assessment tool for cities to evaluate and monitor the progress of their biodiversity conservation efforts against their own individual baselines. It comprises: a) the "Profile of the City," which provides background information on the city; and b) the 23 indicators that measure native biodiversity, ecosystem services provided by biodiversity, and governance and management of biodiversity.

The KEPA-Singapore partnership involves exchange of experiences, capacity building and technical support from Singapore. The index has been acknowledged by the Convention on Biodiversity (CBD) secretariat as a dynamic tool, relevant, credible and flexible enough to be adapted into broader frameworks.

5. Establish an ecological village

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 will be surrounded by a green belt of gardens and vast green spaces to guarantee the visitor a clean atmosphere.

The village will be a leading example, showing how to implement green standards at a city scale and showcase benefits for further replications.

Policy delivery principles

The key principles underpinning the delivery of eco-cities policy are:

- The government of Kuwait is committed to the sustainable cities agenda and to making cities more livable places for community and natural assets.
- The government of Kuwait is accountable for incentivizing the green infrastructure investments.
- The policy design, delivery and evaluation will be evidence-based.
- Stakeholder coordination is necessary to achieve the policy targets.
- The government of Kuwait will follow best practices to achieve policy targets.

Policy targets

TABLE 10

Eco-cities quantitative and qualitative targets

Policy area	2025 targets	2030/35 aspirations
Integrate eco-cities concepts into master planning	• Series of habitat patches and corridors are covered under the 4KMP • Development of building codes, standards and a ratings framework • Green infrastructure support scheme is established • Adequate open spaces in Kuwait urban areas are planned under 4KMP	• Updated building codes, standards and ratings applied to 100% of new buildings • Ongoing planning of open green spaces
Piloting green infrastructure	• At least four buildings in the urban area piloted green walls and roofs • Lessons from pilot projects are documented and demonstrated	• Green infrastructure solutions are integrated to city-wide planning
Improve and expand the network of open green spaces and green belts	• Double the percentage of open green areas available from the total urban land • One million native trees planted across key urban areas • Green belts around the key urban areas	• Five million native trees planted • Green belts around new cities
Adopt Singapore Index on Cities' Biodiversity	• MoU signed with Singaporean side • Exchange of experiences activities • Kuwait City reports on the Singapore index	• All Kuwait cities report on the Singapore index
Establish an ecological village	• Ecological village is established under the new Silk City	• Ecological village success is demonstrated

Monitoring and evaluation

Policy monitoring and evaluation will be used to assess the degree of effectiveness and efficiency of a policy throughout its implementation in order to determine whether its objectives have been met[79]. A sound monitoring and evaluation process must assess policies that are still relevant but that are not reaching their full potential, and thus need to undergo moderate to substantial revisions. As well, the assessments will determine which policies are no longer relevant or too far out of scope to revise, and thus should be retired.

IMPORTANCE OF POLICY M&E

- Challenges assumptions and strategy
- Provides information and new insights
- Increases likelihood that policy will make a positive difference
- Helps identify problems and causes
- Encourages acting on information/insight
- Measures policy effectiveness and feeds into new policy design
- Accounts for resources used

The following are key monitoring and evaluation activities suggested for this framework:

- Kuwait eco-cities policy framework will be reviewed every four years to ensure validity and applicability.
- Regular monitoring to check progress to date in achieving aforementioned targets.
- Assess the residual barriers toward conserving the urban ecology post piloting.
- Conduct Policy Impact Evaluation in 2024 to assess environmental, social and economic benefits from eco-cities initiatives.
- Regular inspection of implemented projects to ensure their effectiveness.

79 European Commission (2015), Better Regulation "Toolbox", available here http://ec.europa.eu/smartregulation/index_en.htm

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[80]. The country is highly water-stressed with internal renewable less than 70 mm/y, and high dependency on trans-boundary aquifers[81]. 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,

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

groundwater 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.

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[82].

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 percent 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 MIG
PD; 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.

82 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 percent.

FIGURE 27

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

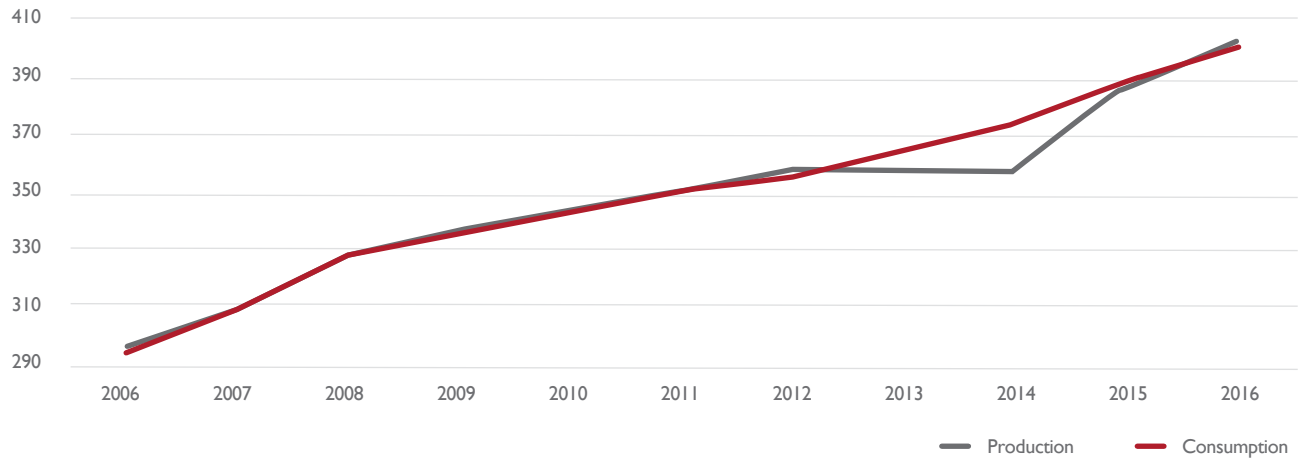


FIGURE 28

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

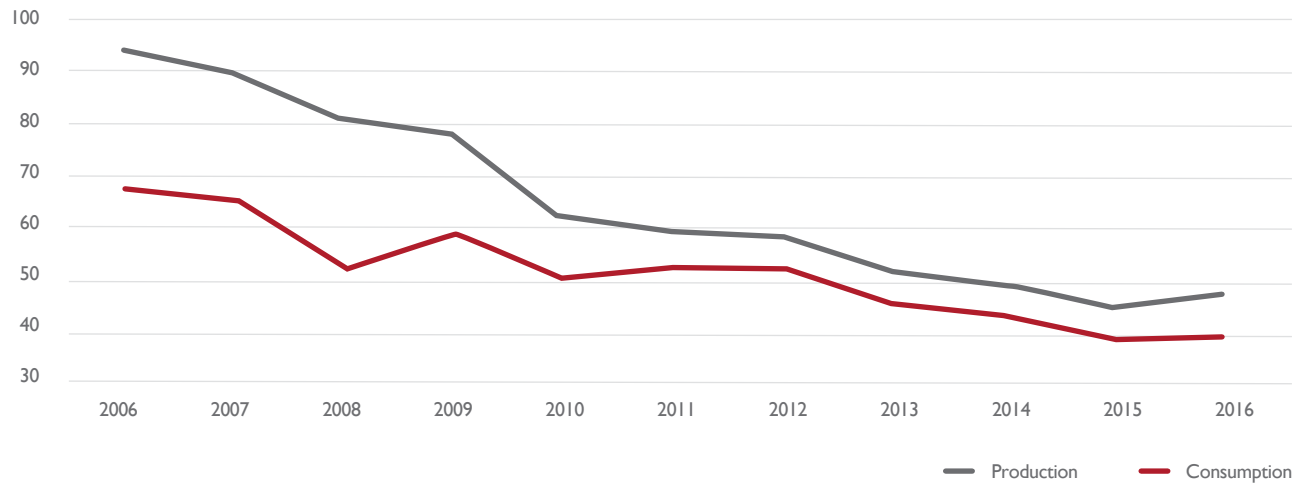


FIGURE 29

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.

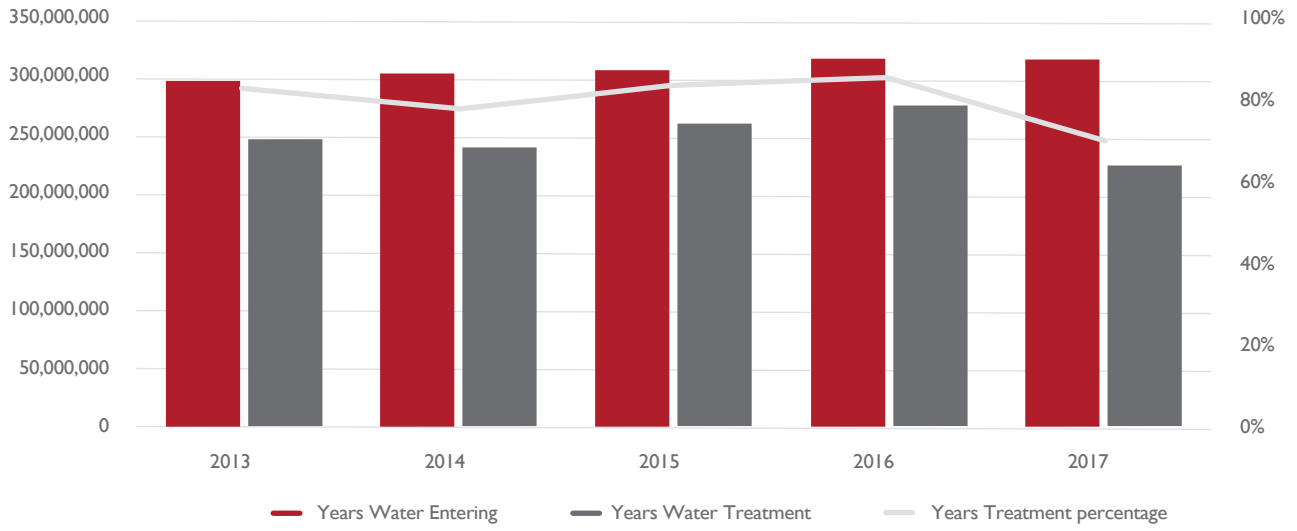
The quality of the treated municipal wastewater in Kuwait is very good[83], and is thus suitable for many reuse applications in addition to agricultural irrigation. To maximize the benefits of wastewater reuse, the country needs to diversify the applications for which such water is used. Other applications 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.

In fact, several technical, socio-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

FIGURE 30

otal quantities of raw and treated sewage water in treatment plants 2013-2017[84]



83 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.

84 Source of data is Central Statistical Bureau (CSB)

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 between 2000 and 2010[85].

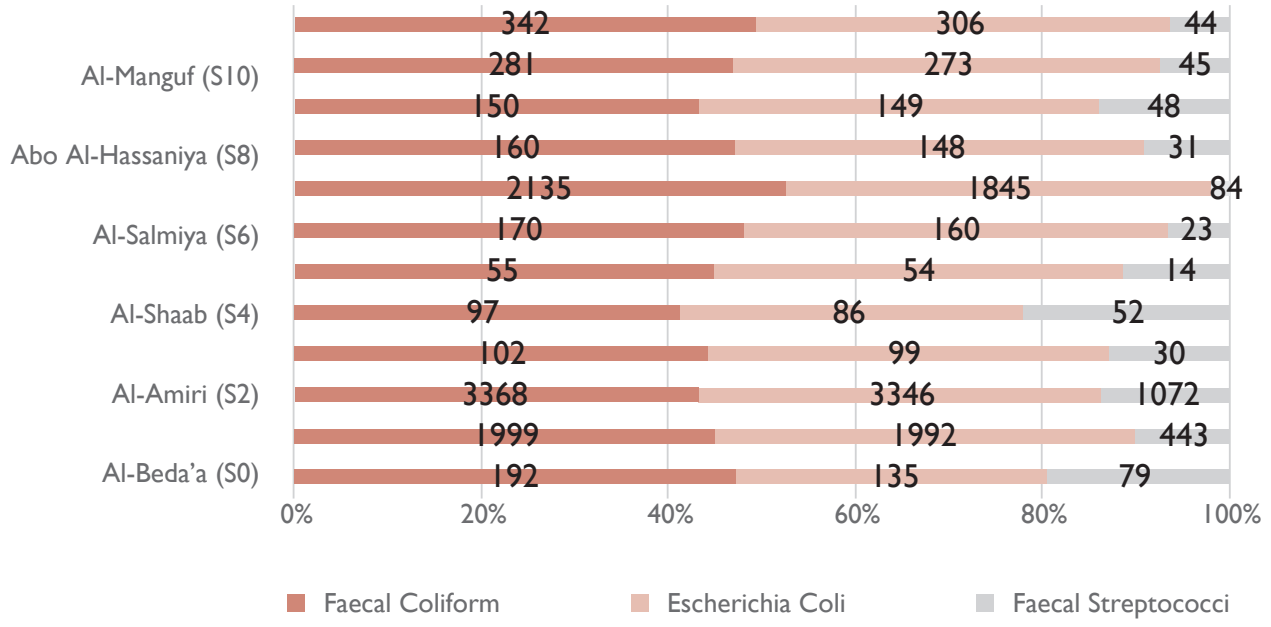
E. coli and enterococci levels are used as indicators of the presence of fecal material in drinking and recreational waters. Both indicate the possible presence of disease-causing bacteria, viruses and protozoans. Such pathogens may pose health risks to people fishing and swimming in a water body. Sources of bacteria include improperly functioning waste-water 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 31, 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.

FIGURE 31

Average results of testing coastal water pollutants in 2017 cfu/100ml[86]



85 Al-Anzi et al. Assessment of Waste Water Reuse in Kuwait and Its Impact on Amounts of Pollutants Discharged into the Sea. (2012).
86 Source : Environment Public Authority (EPA).

FIGURE 32

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.

Suggested Policy framework

Policy Objectives

The water policy aims at **ensuring sustainable management of water resources and improving water security in the state of Kuwait**.
The specific objectives of this policy are:

- Encouraging water efficiency and achieving water savings in Kuwait
- Encouraging wastewater treatment and reuse
- Moving toward environmentally sound management methods and technologies to mitigate negative effects of desalination plants on the marine environment

Policy Directions

1. Improve water use efficiency

The next phase of water sector management in Kuwait should focus on water demand management through pricing signals and efficiency improvement measures. International and regional experiences have demonstrated significant reductions in per capita water consumption after major demand control measures from pricing, incentives, and other regulatory programs were introduced.

There is no single answer to solving the problem of competing demands for water in Kuwait; therefore, improving water use efficiency requires multiple and diverse solutions. In order to meet the rapidly increasing demands for water and improve operational efficiency, Kuwait must undertake fundamental changes in the performance, incentive structure, and service orientation of urban water and sanitation utilities.

Water use efficiency planning should be integrated into residential, commercial and industrial development. This could be achieved through developing and enforcing water conservation standards for residential and commercial developments.

Water remains highly subsidized in Kuwait, and **removal of these subsidies** could ease the economic transition that accompanies water efficiency change. Subsidies are key drivers of the excessive consumption of resources.

A non-price policy, that has been given little attention by economists (mainly because of lack of appropriate data), is to promote the installation of **water-efficient devices in residential housing**.

Several countries or regions have promoted rebate programs for the installation of water-efficient technologies, among them California and Australia. Severe droughts between 1985 and 1992 in California required mandatory conservation and various measures were undertaken by local water agencies, including low-flow toilet rebate programs and the distribution of free plumbing retrofit kits.

In Kuwait, installation of water-efficient devices is seen as an effective means of bringing about water conservation for several reasons: first, water consumed through both indoor and outdoor appliances (e.g., showers, toilets, washing machines, sprinklers) represents a significant share of households' daily water use in Kuwait.

Second, the reduction potential of water-saving fixtures is now well acknowledged; among other examples, a water-efficient washing machine may use only one-third the water of an inefficient model.

Third, policies to promote installation of water-efficient devices are likely to be **more politically acceptable** than price increases or policies imposing water restrictions in Kuwait. Finally, another reason why adoption of water-efficient equipment is a potentially interesting policy tool is the pervasive role of **habits of human behavior**.

The adoption of water-saving devices may be incentivized through developing the market for these devices and raising public awareness.

Another concern expressed by various sectors is an overall lack of public knowledge regarding good water management in Kuwait. Instituting a public awareness campaign about water use is a cheap and easy way for the government to reduce demand. In the urban areas where use is especially high, it can be beneficial for individuals to understand where the water comes from and learn different conservation strategies. Reducing demand in the cities will mean that more water is available during the times of greatest need, such as during the dry, summer months.

WATER SAVINGS FORECAST

According to the Second National Communication on Climate Change, the following are key projections in relation to water savings in Kuwait (using Regional Climate Project (RCP) model 4.5:

- Employing new water tariffs would lead to a reduction in water consumption of about 435 Mm3 in 2035 in the municipal sector compared to the level in 2006. The reduction is about 7% and would bring water consumption to just below levels without climate change.
- Water Conservation: Utilizing water conservation technologies would result in a water savings of about 1,244 Mm3 in 2035. This appreciable water savings can be obtained if a lower tariff band of 20% is used; however, using state-of-the-art water-saving technologies will increase the savings even further.
- Reducing physical leakages: Adaptation in the form of minimizing water leaks from network systems would result in reducing water consumption by 622 Mm3 (10%) in 2035 related to BAU without adaptation measures.

2. Maximize wastewater reuse

Wastewater reuse has proven to be economically feasible and environmentally acceptable. Recycling treated wastewater is now a common practice, especially in arid and semiarid regions where water resources are very limited. For water-scarce areas, wastewater reuse

represents a reliable and steady supply of water throughout the year. In addition, wastewater reuse brings numerous economical and environmental benefits that include reduction of freshwater extraction from the environment, enhancement of crop productivity and reduction of environmental degradation.

In Kuwait, the primary use of treated wastewater is for municipal landscaping while a significant volume is lost to the sea or adjoining wadis, even after it is treated to the secondary level. The reuse of treated wastewater could be expanded for irrigating tree and fodder crops.

The treated municipal wastewater is of a good quality and could be utilized beneficially in many applications other than agricultural irrigation. The country needs to diversify its wastewater reuse applications, and the technical and socioeconomic constraints, particularly for urban reuse, need to be eliminated.

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 feedwater); environmental supply (e.g., irrigation of golf courses, hunting and equestrian clubs); and artificial recharge of groundwater, should be encouraged**. In fact, artificial recharge is still at the experimental stage, and also there are very few environmental reuse applications of treated wastewater in Kuwait.

3. Mitigate negative effects of desalination plants

As noted above, the environmental impact of brine discharge in the open sea poses a significant concern. The constant discharge of reject streams with high salinity and temperature levels can thus be fatal to marine life.

To provide a sustainable use of desalination technology, the impacts of desalination plants should be investigated and mitigated by means of environmental impact assessment studies.

It is also important to look into the efficiency and type of desalination used in Kuwait, and the way in which the treatment occurs.

Currently, the increasing rate at which desalination plants are being established has led to the development of many new methods and options to minimize the impact of brine disposal. Although many minimization options exist, a strategy must be matched to the needs of each specific location. Before deploying a strategy, it needs to **be evaluated both environmentally and economically**.

The range of alternative options of brine disposal can be divided into three different categories. 1. **Changing the location of brine disposal/ Treatment before discharge 2. Redesigning the desalination plant 3. Coupling the desalination plant with some existing treatment plant**.

Some of the best practices in this space offer range of options that can potentially be investigated on a case-by-case basis, such as:

- Brine can be discharged in the surface water and diluted by outfall diffusion devices like diffusion nozzles, or it can be mixed with less saline waste streams before ultimate discharge.
- Brine can be directed to the existing sewer treatment plant to dilute with municipal wastewater prior to discharge. However, volume and composition of the brine, the conveying process and the reaction of the brine with the wastewater needs to be considered.
- Injecting brine via wells into confined and non-potable aquifer systems is an option for disposing of brine.
- Spread brine in shallow ponds where it gradually evaporates, and put the residues in landfills.
- Beach wells or infiltration galleries can be installed that drag in seawater through the overlying substrate.
- Desalination plants can be coupled with some existing treatment plants, such as power plants and salt works, which can also be very useful in mitigating the impact of brine. Desalination plants can be co-located with older thermocouple plants to dilute the brine with power-plant cooling water.

The key principles underpinning the delivery of an eco-cities policy are:

- The government of Kuwait is committed to the sustainable water agenda.
- The government of Kuwait is accountable for achieving sustainable sources of water for community and industry needs.
- The policy design, delivery and evaluation will be evidence-based.
- Stakeholder coordination is intrinsic to achieve the policy targets.
- The government of Kuwait will follow best practices to achieve policy targets.

Policy delivery principles

TABLE 11

Water quantitative and qualitative targets

Policy area	2025 targets	2030/35 aspirations
Improve water use efficiency	• 10% reduction in water consumption rate per capita • Boost the use of water saving devices	• 25% reduction in water consumption rate per capita • Water saving devices are mandatory as per building codes
Maximize wastewater reuse	• 30% increase of the proportion of treated wastewater being reused	• Double up the proportion of treated wastewater being reused
Mitigate negative effects of desalination plants	• Mitigation options investigated and implemented • Impacts on marine environment are reduced (healthier ecosystem)	• Impacts on marine environment are reduced (healthier ecosystem)

Monitoring and evaluation

Policy monitoring and evaluation assesses the degree of effectiveness and efficiency of a policy throughout its implementation in order to determine whether its anticipated objectives have been met[87]. A sound monitoring and evaluation process must do two things: assess policies that are still relevant but that are not reaching their full potential so that they may undergo moderate to substantial revisions; and determine which policies are no longer relevant and too far out of scope to revise, and thus must be retired.

IMPORTANCE OF POLICY M&E

- Challenges assumptions and strategy
- Provides information and new insights
- Increases likelihood that policy will make a positive difference
- Helps identify problems and causes
- Encourages acting on information/insight
- Measures policy effectiveness and feeds into new policy design
- Accounts for resources used

87 European Commission (2015), Better Regulation "Toolbox", available here http://ec.europa.eu/smartregulation/index_en.htm

The following are key monitoring and evaluation activities suggested for this framework:

- Kuwait water policy framework will be reviewed every four years to ensure validity and applicability.
- Regular monitoring to check progress to date in achieving aforementioned targets.
- Assess the barriers to water demand management.
- Conduct Policy Impact Evaluation in 2024 to assess environmental, social and economic benefits of water policies in Kuwait.
- Regular inspection of the implemented project to ensure effectiveness.

مركز الكويت للسياسات العامة
Kuwait Public Policy Center