KINGDOM OF BAHRAIN
Supreme Council
for Environment

مملكة البحرين
المجلس الأعلى للبيئة

The First Biennial Transparency Report (BTR) of the

Kingdom of Bahrain

Submitted to the United Nations Framework Convention on Climate Change (UNFCCC)

2024

ACKNOWLEDGMENTS

The Supreme Council for Environment (SCE) extends its deepest appreciation to the various public and private sector entities whose support and cooperation were essential to the preparation of Bahrain's Greenhouse Gas (GHG) Inventory Report and First Biennial Transparency Report (BTR). The successful compilation of this work has been made possible through the diligent efforts and timely contributions of data and the expertise of all involved stakeholders.

In particular, the Supreme Council for Environment thanks the Ministry of Municipalities Affairs and Agriculture; the Electricity and Water Authority (EWA); the Ministry of Electricity and Water Affairs; the Ministry of Works; the Information & eGovernment Authority (iGA); the Ministry of Oil; the Waste Management Section and the National Ozone Unit within the Supreme Council for Environment; the National Initiative for Agricultural Development; and all the private sector entities across various industries in Bahrain. These public and private sector entities provided invaluable data, and support throughout the preparation process, underscoring a shared commitment to strengthening Bahrain's reporting capabilities and to communicating the Kingdom's climate efforts.

This cooperation not only advances the quality and reliability of Bahrain's national GHG inventory but also imparts the Kingdom's alignment to the transparency arrangements established by the United Nations Framework Convention on Climate Change (UNFCCC) and its Paris Agreement.

#فريق_البحرين

#TeamBahrain

CONTENTS

EXECUTIVE SUMMARY

This document compromises the Kingdom of Bahrain's first Biennial Transparency Report to the United Nations Framework Convention on Climate Change. It provides an overview of the Kingdom's national circumstances, presents a detailed inventory of national greenhouse gas emissions, assesses progress made towards Bahrain's Nationally Determined Contribution, and spotlights key actions taken to enhance Bahrain's resilience to climate change impacts. Through this submission, Bahrain demonstrates its commitment towards the transparency arrangements under the Convention and its Paris Agreement.

National Circumstances

The Kingdom of Bahrain is a small low-lying island state in the Arabian Gulf, characterized by an arid climate. With a total land area of approximately 780 km^2, and a population of about 1.5 million in 2022, Bahrain is one of the most densely populated countries in the world. Most of the population live in urban areas centered around the Capital Governorate.

The oil and gas sector has played a central role in Bahrain's economic and social development. Since the 1970s, Bahrain has diversified into other sectors, however, the oil and gas sector remains pivotal to Bahrain's economy, contributing significantly to public revenue. To this end, Bahrain faces unique national circumstances as it is susceptible not only to the adverse impacts of climate change but also to the potential impacts of response measures.

Greenhouse Gas (GHG) Inventory

The time-series in this submitted GHG inventory encompasses the years 2017 to 2022. As illustrated in Figure 1, Bahrain's national GHG emissions have increased by about 15% during this period, primarily due to industrial and economic growth, as well as population increase.

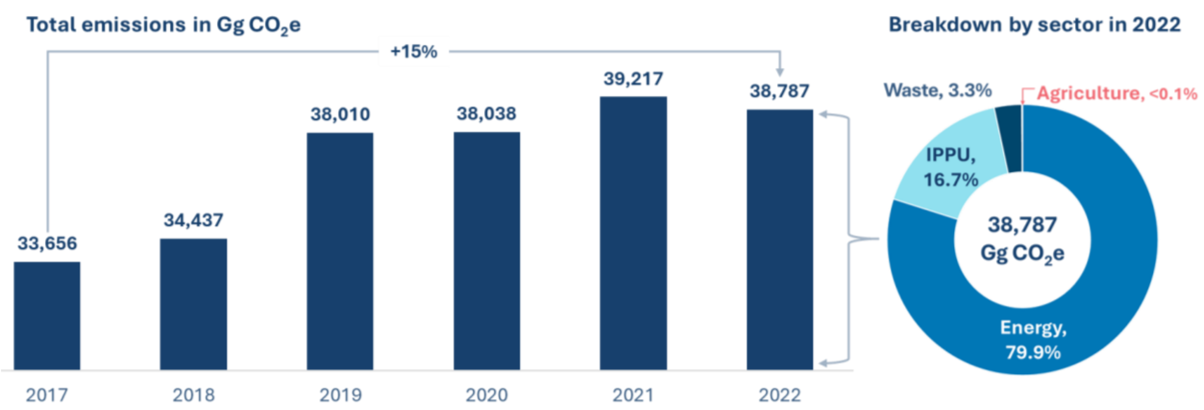

Figure 1: Bahrain's total annual GHG emissions (2017-2022) and breakdown by sector in 2022

Furthermore, Bahrain's GHG emissions totaled 38,787 Gigagram CO_2 equivalent (Gg CO_2e) in 2022, of which about 80% is attributable to the Energy Sector. Other key contributing sectors include Industrial Processes and Product Use (IPPU) and Waste, which account for about 16.7% and 3.3% of national GHG emissions, respectively. The Agriculture, Forestry, and Other Land Use (AFOLU) sector remains insignificant with minimal contribution to national emissions. Overall, Bahrain contributes less than 0.07% to the global GHG emissions, which were estimated at 57.4 million Gg CO_2e in 2022, according to the UNEP Emissions Gap Report 2023.

Progress Made in Implementing the NDC

Bahrain submitted an updated Nationally Determined Contribution (NDC) in 2021. Bahrain's NDC centers on adaptation actions and economic diversification with mitigation co-benefits. These actions have included plans and actions to expand renewable energy installations, improve energy efficiency, and increase mangrove and afforestation coverage. Specific indicators have been selected to track progress on each of these activities.

Information Related to Adaptation

As a small low-lying island, Bahrain is vulnerable to climate change impacts. Such impacts include rising temperatures, sea-level rise, and water scarcity. Bahrain has taken a proactive approach to adaptation. Key actions include the formulation of a National Adaptation Investment Plan that details a series of resilience projects and their potential funding avenues; a comprehensive model and action plan that ensures the Kingdom's long-term coastal resilience; and targeted actions to improve water resources management in the face of future uncertainties.

Concluding Remarks

Bahrain remains committed to climate action at the local and international levels, noting the importance of working towards achieving the goals of the Paris Agreement, in the context of sustainable development and wider efforts to eradicate poverty. Bahrain underscores the critical role of multilateralism in climate mitigation and adaptation, and emphasize the role of equity, and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances, as a cornerstone to the global climate regime. Bahrain will continue to play its part in addressing this critical global challenge.

Manama, the capital of the Kingdom of Bahrain
Photo by BE

Chapter 1

National Circumstances and Institutional Arrangements

1. CHAPTER 1: National Circumstances and Institutional Arrangements

1.1 Government Structure

The Kingdom of Bahrain is a hereditary constitutional monarchy with a democratic system of government, which rests on a separation of legislative, executive and judicial powers. The Constitution is the highest form of law and outlines the separation and cooperation between these independent powers.

Executive authority is vested in the King as well as the Cabinet, which is composed of the Prime Minister and several ministers. His Majesty the King is the Head of State, the supreme representative of the Kingdom, and the Supreme Commander of the Defense Forces. Moreover, the King appoints the Prime Minister and Cabinet.

Legislative authority is vested in the King, and the National Assembly. The National Assembly comprises two chambers: the Shura Council and the Council of the Representatives, each of which consists of 40 members. Members of the Shura Council are appointed by the King, whereas the Council of Representatives are elected. The first elections were held in 2002.

Judicial rulings are issued in the King's name. Judges are appointed by the King through Royal Orders, as proposed by the Higher Judicial Council and courts operate under a civil law system comprising several types of courts: Civil Courts, which adjudicate all commercial and civil cases; Sharia Courts, which adjudicate all issues related to the personal status of Muslims; and Criminal Courts, which adjudicate all criminal cases. Moreover, there are courts that exist outside of this standard structure. The Constitutional Court, for example, ensures that no enacted laws contradict the Constitution.

Established in 1996 by the then-Decree-Law 21 on the Environment, the Supreme Council for Environment (SCE) serves as the government entity responsible for protecting the environment, maintaining natural resources, and developing Bahrain's environmental strategies and sustainable development. The SCE is also responsible for coordinating and following up on the implementation of such strategies with relevant ministries, agencies, and institutions. The Climate Change and Sustainable Development Directorate (CCSD) is the technical body responsible for climate change-related matters within the SCE.

In 2020, His Majesty the King issued a Decree appointing a Special Envoy for Climate Affairs with ministerial rank, signaling Bahrain's dedication to this domain. This role is now embedded in the SCE's organizational structure.

1.2 Legal Framework

The Committee for Environmental Protection was the Kingdom of Bahrain's first official committee dedicated to environmental affairs. Established by Decree No. 7 in 1980, the Committee reflects the early interest of political leadership in environmental protection and environmental affairs. The Kingdom's rapid economic growth concurrently highlighted the importance of robust environmental management, and the sustainable use of natural resources as guarantees of sustainable economic development, elevated standards of living and enhanced quality of life.

The highest form of law in the Kingdom, the Constitution, encompasses provisions that safeguard the environment, while simultaneously balancing the need for sustainable development and the protection of the environment's natural resources. This commitment is articulated in several articles and is most prominently captured by Article 9(h) and Article 11. Article 9(h) specifically stipulates that "the State shall take the necessary measures for the protection of the environment and the conservation of wildlife", and Article 11 appropriates all natural resources to the government and commits, again, to their proper use and conversation, while also ensuring alignment with national security and economic development. This national commitment towards environmental protection and the responsible use of natural resources is reaffirmed in the National Action Charter, a national document put forth by His Majesty King Hamad bin Isa Al Khalifa in 2000 and approved by 98% of Bahrainis.

More recently, Law No. 7 of 2022 on the Environment, which repeals Decree-Law No. 21 of 1996, has been enacted to strengthen environmental protection efforts. This Law aims to safeguard the environment and its resources from a broad range of activities that contribute to pollution and degradation. Specifically, it addresses issues including (but not limited to) the marine and terrestrial environment, biodiversity, air quality, environmental disasters, waste management, pollution and radiation.

Notably, Law No. 7 designates the Supreme Council for Environment (SCE) as the national authority responsible for protecting the environment and pursuing sustainable development in the Kingdom. In this role, the SCE is authorized to request data or information from any entity engaged in activities that may lead to environmental pollution or degradation, as stipulated in Article 4(5). Furthermore, Article 34 specifically provides the SCE with the mandate of overseeing emissions released into the air and the right to monitor such emissions and make any requisite information requests. Correspondingly, undertakings are obligated to comply with SCE's requests. This ultimately provides the SCE with a legal basis for the data collection necessary for compiling the national greenhouse gas inventory.

At the international level, Bahrain is party to several international conventions and agreements, including the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol and Paris Agreement.

1.3 Institutional Arrangements

1.3.1 Institutional Arrangements for the Preparation of the BTR

At the national level, the SCE is the designated national entity responsible for coordinating the Kingdom's reporting requirements to the UNFCCC, including GHG emissions measurement, reporting and verification, and tracking progress in implementing and achieving the Nationally Determined Contributions (NDCs).

Within the SCE, the Climate Change and Sustainable Development Directorate (CCSD) is the technical body responsible for climate change-related matters. The CCSD works on both climate mitigation and adaptation and is Bahrain's focal point for the UNFCCC. In this role, the CCSD has collected GHG data and progress updates relevant to its NDC tracking directly from data providers. To track NDC progress, CCSD requested this information directly from implementing entities and relevant partners. Other information was obtained internally, as it falls within the SCE's implementation mandate. Data providers for the national inventory are further elaborated in Section 1.3.2. The information collected from data providers was then used to draft Bahrain's First Biennial Transparency Report (BTR).

The Biennial Transparency Report was then presented to His Excellency the Special Envoy for Climate Affairs for his review and feedback.

Following its final consolidation, Bahrain's First Biennial Transparency Report was presented to the National Taskforce for Information and Population for review. The Task Force is chaired by His Excellency the Minister of Cabinet of Affairs and includes representatives from 25 national entities, including the Prime Minister's Office. The Task Force's main objective is to monitor national indicators and information that reflect the Kingdom's status and performance in global reports and ensure the accuracy of the reported information. The diverse membership of the Task Force ensures a comprehensive review.

Subsequent to this process, the report was presented to the Cabinet for final approval. The Cabinet is a key executive authority in Bahrain and comprises His Royal Highness the Crown Prince and Minister, His Excellency the Deputy Prime Minister, and the Kingdom's 23 ministers.

These institutional arrangements are summarized in Figure 2.

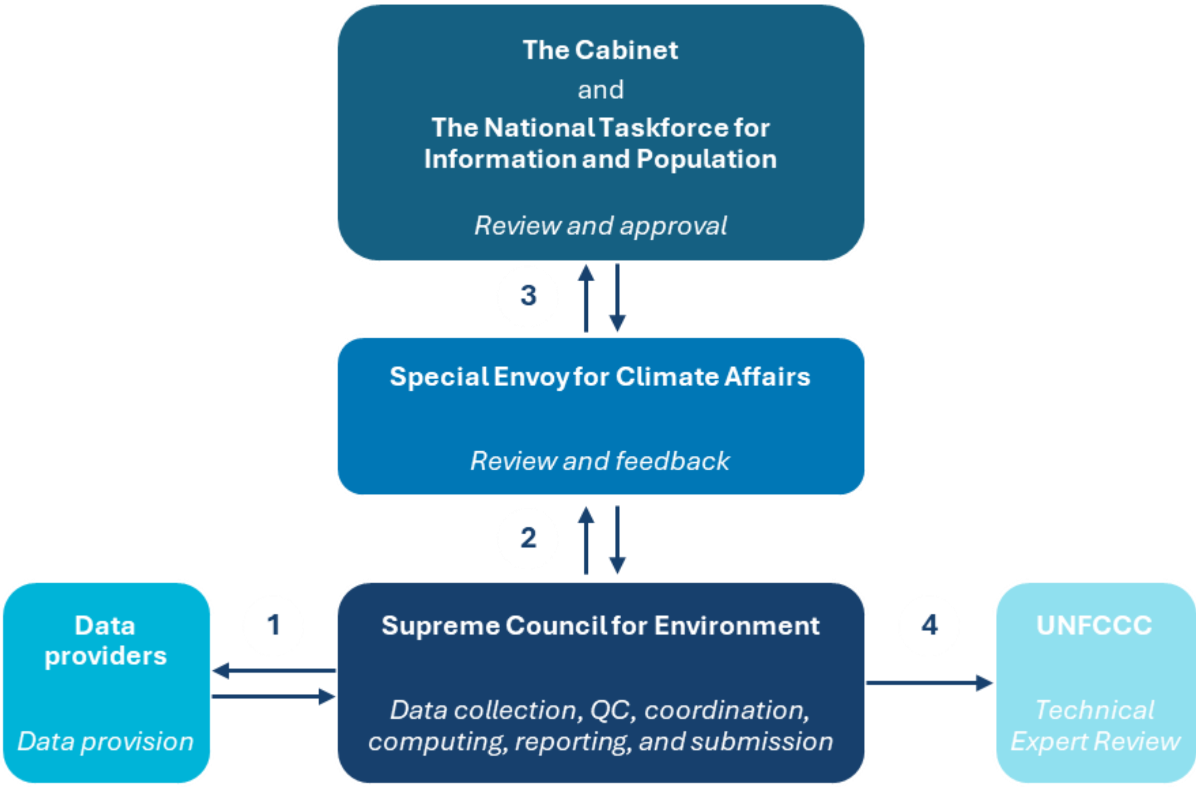

Figure 2: Overview of Bahrain's Institutional Arrangements for its first BTR

1.3.2 National Inventory Arrangements

The CCSD within the SCE is the national focal point with overall responsibility for the national greenhouse gas inventory. In this role, the CCSD collects, reviews, compiles, and coordinates with various public and private data providers for all sectors. Upon receiving the requested information, the CCSD then conducted follow-ups conducted to ensure completeness of submissions and to resolve any inconsistencies.

To ensure alignment with IPCC principles of transparency, accuracy, consistency, comparability, and completeness (TACCC), the CCSD performed various Quality Control (QC) procedures to ensure data accuracy and reliability during the compilation of the inventory.

These QC procedures included technical reviews of categories, activity data, emission factors, and estimation parameters, as well as identifying and addressing reporting errors and deficiencies, cross-checking data sources, comparing supply and demand balances, and analyzing time series. Other accuracy checks consisted of systematic assessments of the calculation spreadsheets, and the calculated emissions data and its pre-processing. Where emissions calculations have been performed using the IPCC software, the input data (activity data and emissions factors) were compared with the output data (emissions) to observe their alignment with the national context. Data was further verified by comparing internal calculations to those conducted by data providers throughout the inventory compilation process and following the completion of the inventory.

These processes aimed to ensure that the inventory represents the best possible estimates of emissions and removals given Bahrain's current data availability.

Furthermore, the roles and responsibilities of various entities involved in Bahrain's national inventory submitted as part of the BTR are summarized in Table 1. The entities include public and private sector actors responsible for collecting data relevant to the national GHG inventory and providing this data to the CCSD.

Table 1: Overview of roles and responsibilities related to the national inventory

Role	Description	Organization
National inventory coordinator	Leading on overall management and coordination, compilation, etc.	• SCE
QC leads	Conducting quality control checks at all stages of the process	• SCE
Energy sector data providers	Institutions providing data – installations, ministries, agencies, private sector, etc.	• Private sector entities • Electricity & Water Authority • Ministry of Oil • Information & eGovernment Authority
IPPU sector data providers		• Private sector entities • Information & eGovernment Authority • SCE
Waste sector data providers		• Municipalities • Ministry of Municipalities Affairs and Agriculture • Ministry of Works • SCE • Information & eGovernment Authority
AFOLU sector data providers		• Information & eGovernment Authority • Ministry of Municipalities Affairs and Agriculture

Moreover, the Kingdom of Bahrain is actively engaged in enhancing its Monitoring, Reporting, and Verification (MRV) processes, in line with the new biennial reporting requirements under the Enhanced Transparency Framework (ETF). As an initial step towards this process, the SCE commissioned international consultants to conduct a comprehensive Gaps and Needs Analysis of existing MRV processes. This analysis was completed in 2023, and the SCE is now working towards fulfilling these recommendations, which include:

- **Developing standard data collection templates** that define what is needed and when by key data providers.
- **Establishing a formal and defined National Inventory System (NIS)** with guidelines that describe the process of preparing the GHG inventory and a manual describing the procedural issues in preparing the GHG inventory (including the data needs, methods to be used, rules of procedures, confidentiality, etc….).
- **Developing quality assurance and quality control handbooks**

In January 2024, the SCE completed its review of its compilation processes and formulated standard data collection templates for all sectors covered by the current BTR. These templates were used to collect the required activity data and emission factors (when available) from the relevant data providers. The development of quality assurance and quality control handbooks, as well as a comprehensive manual that describes the process of compiling Bahrain’s GHG inventory, is also underway. These processes aim to replace and overcome the challenges posed by the previous ad-hoc project-based system of work.

1.4 Geography and Demographics

The Kingdom of Bahrain is located in the Arabian Gulf, between latitudes 25°32'N and 26°20'N and longitudes 50°20'E and 50°50'E, near the east coast of the Kingdom of Saudi Arabia. It is an archipelago of approximately 33 natural and 51 artificial islands, shoals, and small islets that vary considerably in size and structure. Bahrain Island constitutes the largest land mass, with the Kingdom’s capital, Manama, located on the island’s northeastern tip. With a total land area of approximately 780 km^2, Bahrain is among the smallest countries in the world.

The topography of Bahrain consists primarily of flat, gently rolling land with low relief, and the highest point is Jabal Al Dukhan, which rises to 135 meters above sea level. Bahrain has a total coastline of approximately 946 km. Both its coastline and land area have changed significantly over the last 35 years as a result of land reclamation projects. These land reclamation projects continue to the present day.

Bahrain's terrestrial landscape is primarily dominated by a desert environment, with a narrow fertile strip that is found along the northern and northwestern coastlines. This desert supports a diverse range of insects, reptiles, birds and wild mammals. The marine environment features various habitats including mangrove swamps, mudflats, coral reefs, sea grass beds, freshwater springs, lagoons and offshore islands. It is characterized by high rates of evaporation during most of the year and a shortage of freshwater input.

Bahrain has a total of eight protected areas. This includes two terrestrial protected areas – Wadi Al Buhair and Al Areen Wildlife Park and Reserve – and six marine protected areas: Arad Bay, Hawar Islands, Mashtan Island, Northern Hayrat, Najwat Bulthamah and Tubli Bay. Notably, marine protected areas cover 22.12% of Bahrain's maritime territory.

A map of Bahrain is presented in Figure 3.

Figure 3: Map of Bahrain (Nations Online, 2024)

Over the past decade, Bahrain's total population increased by about 26%, from approximately 1.2 million in 2012 to 1.5 million in 2022, as illustrated in Figure 4. In 2022, around 54% of the population consisted of expatriates who came to the country to pursue employment opportunities. This is reflected in the labor force, where around 70% are non-citizens, with about 72% of this group being male. Women account for approximately 38% of the total population, a low figure mainly due to the high number of male migrants.

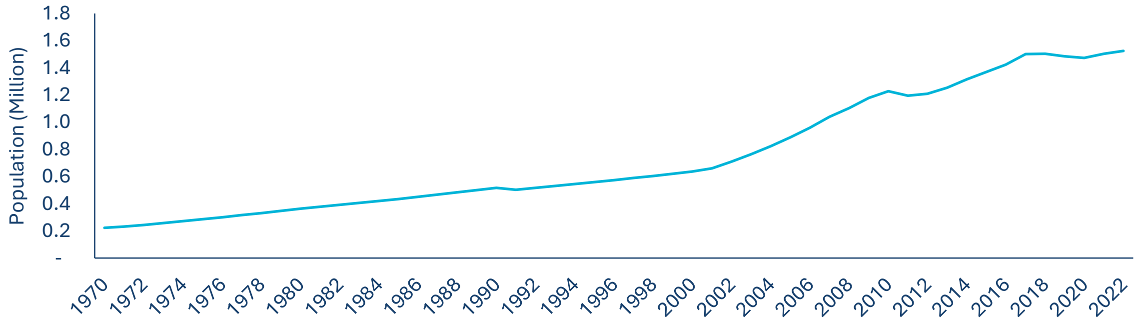

Figure 4: Population growth in Bahrain 1970-2022

The majority of the population is centered in the capital, Manama, and other major urban centers, such as Muharraq, Riffa and Hamad Town. This urbanization is reflected in a population density of about 1,979 people per km^2, positioning Bahrain as one of the most densely populated countries in the world.

1.5 Climate

Bahrain is an arid country with mild, pleasant winters, and hot, humid summers. Rainfall is negligible from April through the end of October, coinciding with high temperatures. Relative humidity is highest during the winter months of December through February. As illustrated in Figure 5, rainfall in Bahrain is limited, erratic, and occurs in brief, concentrated periods, with an average annual total of approximately 64 millimeters over the past decade, distributed across an average of merely ten days per year.

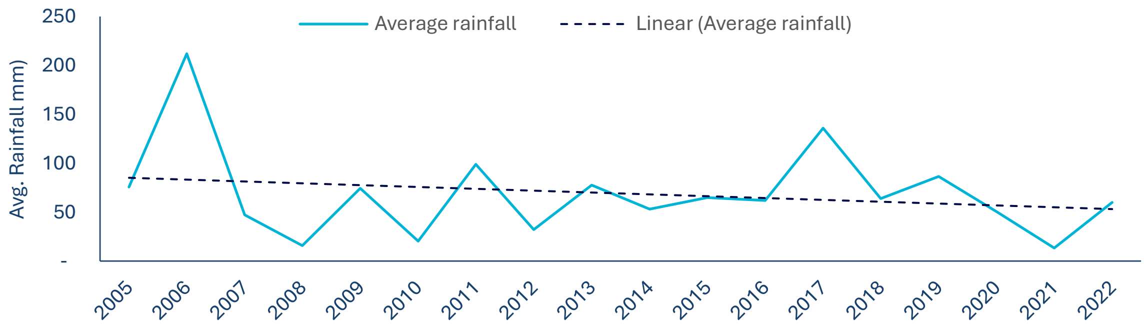

Figure 5: Average annual rainfall in Bahrain (2005-2022)

From 1940 to 2021, the mean annual temperature in Bahrain has shown a notable increase, as illustrated in Figure 6. Concerningly, this trend indicates that the mean annual temperature in Bahrain has increased by around 2 °C over the past 80 years, underscoring the rapid warming experienced in the country and in the region.

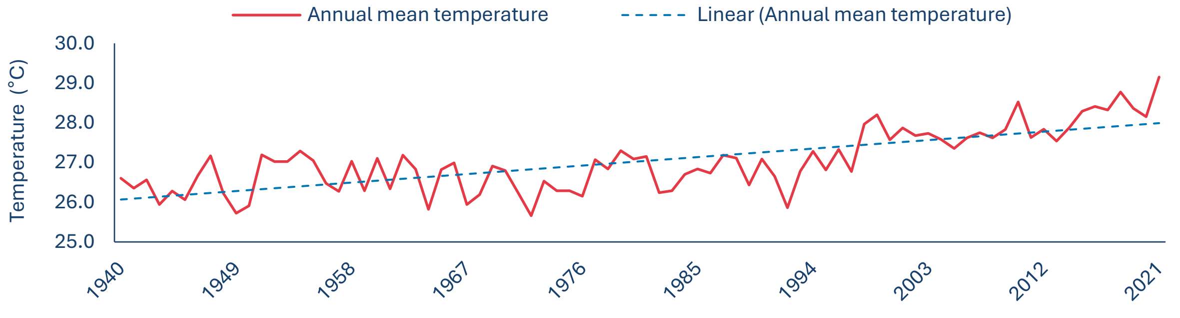

Figure 6: Mean annual temperature in Bahrain (1940-2021)

In 2022, Bahrain experienced an annual average temperature of 28.2°C and an average annual relative humidity of about 56%. Total annual precipitation was measured at 59.8 millimeters. Notably, December 2022 is ranked as the third warmest December ever experienced in Bahrain since the start of record (i.e. in 1902). Similarly, July 2022 was the second hottest July ever recorded in the country.

1.6 Economy

Bahrain boasts a relatively open economy and has ranked first in MENA for financial freedom, investment freedom, and trade freedom, as well as economic freedom in the Heritage Foundation's Index of Economic Freedom for 2022. Historically, Bahrain's economy predominantly relied on pearl-diving. However, beginning in the 1930s, the Kingdom transitioned into an oil-dependent economy. Since the 1970's, Bahrain has further diversified into other sectors, including petroleum processing and refining, finance, and manufacturing – particularly aluminum and iron and steel. Notably, in 2001, the Bahraini currency was officially pegged to the US dollar.

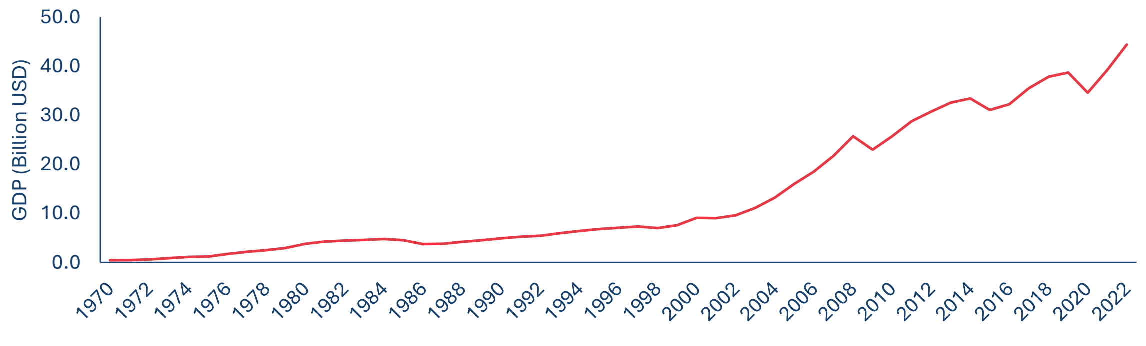

Figure 7: GDP growth in Bahrain 1970-2022

In 2022, Bahrain's GDP, in current prices, was approximately BHD 17.5 billion (equivalent to USD 46.5 billion[(1)]) as illustrated in Figure 7. Moreover, Figure 8 shows the breakdown of Bahrain's GDP for the years 2012 and 2022 by the type of economic activity.

The largest share of GDP, about 21%, comes from the manufacturing sector, which primarily reflects the production and export of aluminum and downstream products, such as metal cables. This is followed by the mining and quarrying sector, at 18%, of which oil and gas operations account for most of the contribution, about 94%. In contrast to the mining and quarrying sector which has experienced declining shares 6% of GDP, the manufacturing sector has been expanding, surpassing mining and quarrying to become the largest contributor to GDP since 2015. Nonetheless, the oil and gas subsector remains pivotal to Bahrain's economy, accounting for almost 70% of public revenue.

At about 15%, financial services account for the third largest sector, reflecting the significant contribution that Islamic finance makes to Bahrain's economy. Bahrain emerged as a new financial services hub in the 1990s and has maintained a strong presence in Islamic finance ever since.

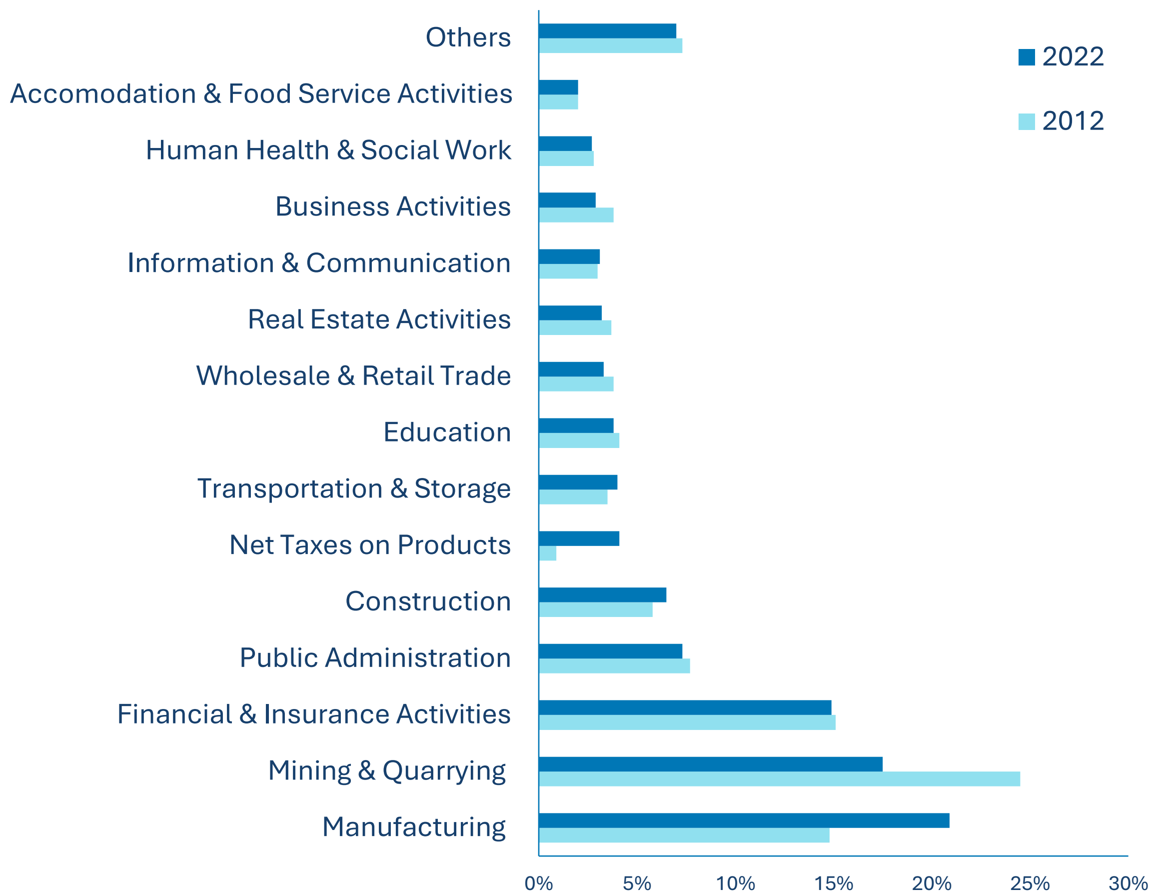

Figure 8: Bahrain GDP by type of economic activity

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(1) The exchange rate used in this report is 1 Bahraini Dinar (BHD) = 2.659 US Dollars (USD), as per the Central Bank of Bahrain (October 2024).

1.7 Key Sectors Contributing to National GHG Emissions

This section provides a brief overview of the key sectors contributing to national GHG emissions. More detailed information on each sector is provided in Section 2.2 of the National Inventory Document.

- **Energy:** Bahrain's energy sector, driven primarily by oil and gas production, is crucial to its economy. Key oil sources include the Bahrain Field and a 50% share in the offshore Abu Safah field shared with Saudi Arabia. Natural gas that is essential for electricity generation and industrial use is produced from Bahrain field. Bahrain aims to diversify its energy mix, with a particular focus on solar energy. Efforts also include enhancing energy efficiency and exploring technologies like carbon capture, hydrogen energy, and electric vehicles.
- **Industry:** Bahrain's Industrial Processes and Product Use (IPPU) sector includes emissions from cement, glass, ammonia, methanol, iron & steel, and aluminum production, as well as refrigeration and air conditioning. Other minor industrial sectors also produce trace amounts of GHG emission.
- **Waste:** Waste management in Bahrain historically relied on landfilling, a major source of methane emissions. In recent years, the country has implemented strategies to improve waste management through recycling, composting, and waste incineration. These efforts aim to enhance sustainability and manage limited landfill capacity. Most wastewater is treated and discharged to the sea, with a small portion being reused.
- **Agriculture:** Agricultural activities are very limited in Bahrain with around 3% of the total land classified as agricultural. The contribution of the sector to GHG emissions remains at very low levels.

1.8 Impacts of the Implementation of Response Measures

Climate response measures, whether implemented unilaterally, bilaterally, or multilaterally, can have unintended consequences that extend beyond national borders. As with climate change impacts, the impacts of climate response measures vary in their nature and their distribution and may pose obstacles to developing countries' progress towards achieving various Sustainable Development Goals (SDGs).

The UNFCCC acknowledges this dual challenge: Parties have recognized the need to reduce anthropogenic greenhouse gas emissions and the importance of ensuring that response measures do not exacerbate challenges faced by developing countries. Such considerations are embedded throughout the UNFCCC and its legal instruments. Articles 4(8) and 4(10) of the Convention specifically recognize the circumstances of developing countries with economies that are vulnerable to the adverse effects of the implementation of response measures. This includes the needs and concerns of developing countries whose “economies are highly dependent on income generated from the production, processing and export, and/or consumption of fossil fuels and associated energy-intensive products”. Article 4(10) additionally acknowledges the circumstances of Parties facing “serious difficulties in switching to alternatives [to fossil fuels]”. The Paris Agreement itself, under Article 4(15), requires Parties to take into consideration the concerns of Parties with economies most affected by the impact of response measures. This focus on national circumstances is further reinforced through the Agreement’s its differentiated approach to obligations and its emphasis on equity, sustainable development, and poverty eradication.

This approach of proactively assessing and addressing the potential impact of response measures avoids risking progress toward other SDGs. In this context, the objectives of the Paris Agreement and the SDGs are inextricably linked. A just and orderly transition to a low-carbon future depends on a strong foundation of robust sustainable development that addresses all aspects of society, the economy, and the environment. In many instances, it is progress towards this foundation that allows developing countries to accelerate climate action.

As detailed in Section 1.6, Bahrain’s reliance on oil and gas revenues and limited alternative energy capacity are key characteristics of its national circumstances. These resource dependence and energy transition challenges cause the Kingdom to be vulnerable to impacts of global climate change response measures. The impact of global climate change response measures may also result in socioeconomic losses, which could constrain Bahrain’s ability to implement effective climate action.

Bahrain views economic diversification as a key means to limiting the adverse impact of response measures. Economic diversification also contributes to the wider objective of sustainable development and spurs a shift away from resource dependence.

While national efforts to reduce dependence on the oil and gas subsector date as early as the 1970s, the following section summarizes on key policies, actions, and initiatives relating to Bahrain’s more recent economic diversification efforts.

Economic Vision 2030

In concert with other Gulf Cooperation Council (GCC) countries, Bahrain has been active in exploring economic diversification strategies to wean the economy away from oil dependency. In recognition of the need for economic reform, the government launched the Economic Vision 2030 in 2008, with a goal of a diversified and dynamic economy, including diversified energy sources.

The vision is shaped by three guiding principles: sustainability, competitiveness, and fairness. These principles were then translated into three sets of aspirations, encompassing Bahrain's economy, government and society:

- **Economy:** Diversifying the economy by focusing on existing high-potential sectors and stimulating growth by enhancing skills and productivity (rather than rising oil production and oil prices);
- **Government:** Improving accountability and transparency, and the quality of government services, policies, and infrastructure as well as reducing dependence on oil revenues; and
- **Society:** Providing Bahrainis with high quality education and healthcare, ensuring a secure and safe environment, and providing a high standard of social assistance.

The vision views the establishment of a dynamic and thriving private sector as a key enabler of economic transformation. Notably, it is also distinct from previous diversification efforts across the GCC due to its comprehensive and strategic nature, as it was conceived based on the assumption that its implementation would require high levels of coordination between relevant governmental organizations.

As a result of Vision 2030, Bahrain's economy today differs significantly from the turn of the millennium. Foreign Direct Investment (FDI) has now become an important source of jobs and growth; private enterprises receive targeted support, as do citizens seeking to gain professional qualifications that contribute to modern human capital. The TRA has effectively liberalized the telecommunications sector, leading to Information and Communication Technologies (ICT) infrastructure that is comparable to that found in Organization for Economic Co-operation and Development (OECD) economies. Moreover, the number of Bahrainis working in the private sector has risen considerably while many government services have become electronic, leading to vast improvements in quality and delivery time.

The Fiscal Balance Program

Recognizing fiscal sustainability is fundamental to attracting local and inward foreign investment, the Kingdom of Bahrain launched a fiscal balancing program in 2018. The Fiscal Balance Program aims to achieve fiscal balance by strategically restructuring the government budget to capitalize on economic growth and support sustainable development.

The initiatives of the program encompass numerous expenditure realization and revenue enhancement measures, including:

- **Introducing a voluntary retirement scheme for government employees:** A voluntary retirement scheme was offered to civil servants, providing them with the opportunity to contribute to the Kingdom's economic growth through entrepreneurship or participation in the private sector;

- **Balancing the Electricity and Water Authority's expenditures and revenues:** Gradual adjustments to electricity and water tariffs while preserving benefits for Bahrainis in their primary households, with the aim of enhancing efficiency and reducing spending to balance the Authority's expenditures and revenues;
- **Reducing recurrent non-manpower expenditure:** Furthering spending cuts of government recurrent expenditure to maximize spending efficiency;
- **Reducing project spend:** Reviewing and prioritizing project spending, while avoiding impact on major projects;
- **Reducing manpower expenditure:** Restructuring government entities to streamline resources and increase manpower efficiency;
- **Streamlining the distribution of cash subsidies to citizens:** Consolidating cash subsidies through one central government financial subsidies system for eligible citizens;
- **Increasing government-owned entities' annual contributions:** Increasing the annual contributions paid by government-owned entities and introducing contributions from other entities;
- **Adjusting commodities prices and prices of services provided to companies:** Establishing a mechanism to review and adjust commodity prices and the prices of services on a periodic basis to ensure alignment with market prices;
- **Introducing new government services revenue initiatives:** Establishing a new Revenue Development Taskforce to introduce new fees of services currently provided and to introduce new services; and
- **Introducing and increasing Value Added Tax:** Applying VAT to non-essential goods and services.

To support the implementation of these initiatives, the government established a governance framework to ensure that the Fiscal Balance Program is response to local and global economic developments. This has allowed the Fiscal Balance Program to succeed despite delays brought about by interruptions caused by global external shocks, including lower oil prices and the COVID-19 pandemic.

Private Sector Growth

The Kingdom of Bahrain has been working to spur private sector growth, enhance competitiveness, and diversify income sources in line with sustainable development.

Between 2001 and 2007, several new governmental organizations were founded in line with these goals, including the following key units:

- *The Economic Development Board (EDB)*: an investment promotion agency tasked with attracting foreign direct investment (FDI) and consolidating the process of investing in Bahrain;
- *Tamkeen:* national labor fund tasked with transforming the private sector into the main source of economic growth;
- *Telecommunications Regulatory Authority (TRA):* an independent body tasked with ensuring a high quality of information and communications infrastructure;
- *Labor Market Regulatory Authority (LMRA):* a government body tasked with managing the large pool of migrant workers in a manner that ensures the growth of job opportunities for Bahraini citizens; and
- *Information and eGovernment Authority (iGA):* a government body tasked with digitizing government services.

As affirmed in Economic Vision 2030, Bahrain recognizes the pivotal role of SMEs in a diverse and flourishing economy. Accordingly, the government has also adopted a suite of policies and initiatives that foster the growth of start-ups and SMEs and maximize their contributions to the economy.

A key development in recent years has been the establishment of the SMEs Development Board (SDB) in 2017. The SDB is tasked with coordinating efforts to strengthen the capacity of startups and SMEs across the Kingdom. This has spurred a variety of initiatives by government and semi-government actors that aim to enhance the competitiveness of start-ups and SMEs on a domestic, regional, and global level. This support ranges from funding, expert advice, administrative streamlining, and training opportunities.

For example, Bahrain Development Bank, established as a specialized bank, provides efficient and accessible lending products, funding, and advisory services for start-ups and SMEs; Tamkeen, the national labor fund, provides various enterprise support programs, vocational upskilling, and pre-seed funding; and Hope Fund invests specifically in youth talent, projects, and initiatives. To enhance the export of Bahraini products and services specifically, Export Bahrain was established in 2018 as the first national entity specialized in supporting and developing exports, enabling Bahraini businesses to expand into international markets.

Moreover, the Ministry of Industry and Commerce (MoIC) has consistently demonstrated strong support for SMEs, offering a digital registration system that enables SMEs to apply for a classification certificate that allows them to benefit from a range of development programs. These benefits include a 10% preference in the biddings for government tenders and for auctions of public utilities that are held within the establishments of government departments; qualifications to participate in SME-specific tenders; advisory and administrative support; and discount rates.

A key enabler of the MoIC's success has been its proactive approach in responding to market trends and fostering greater economic inclusion. A prime example is the launch of Sijili, in 2017, an online platform that allows citizens to legally operate a business within 39 designated commercial activities without the need to register a physical office address. This initiative responded to the rise of home-based and one-person based businesses run through social media platforms, such as Instagram. By simplifying business registration, Sijili empowers aspiring Bahraini entrepreneurs and small, individual projects to enter market.

In addition to these efforts, regulators have also established innovative and accessible avenues for SMEs to raise capital. In 2016, the Central Bank of Bahrain authorized the creation of a new equity market that allows privately held SMEs to issue shares under a more flexible regulatory framework, independent from the traditional stock exchange. In 2017, the Bahrain Investment Market (BIM) was launched as a market operated by Bahrain Bourse. This new market offers a less stringent regulatory environment, with more lenient disclosure and admission requirements. By facilitating easier access to capital, BIM aims to enhance SME contributions to Bahrain's economy and attract high-growth companies from across the region.

Today, Bahrain boasts a thriving entrepreneurial environment. More than 25 start-up incubators and accelerators operate in the country, providing comprehensive support services such as access to joint workspaces, mentorship, marketing support, business planning assistance, financial, and public relations resources for an incubation period.

To further nurture diverse entrepreneurial talent, some incubators specialize in specific sectors such as finance, medicine, and technology. Others responded to the unique entrepreneurial needs of different social segments. For example, recognizing women's challenges to accessing finance, the Supreme Council for Women helped establish Riyadat in 2013, a business incubator for Bahraini female entrepreneurs. In addition to these incubators, Start-Up Bahrain serves as a valuable platform that unites local start-ups, providing networking opportunities, mentorship and access to investment.

Collectively, these initiatives have created a robust ecosystem for start-ups and SMEs. In 2022, micro, small and medium enterprises made up 93.3% of all commercial registrations, with 81% of those owned by Bahrainis.

The National Energy Strategy (NES)

In 2022, the government began developing a strategy that outlines a clear path for the Kingdom's energy future. The developed strategy, now known as the National Energy Strategy (NES), serves as a cornerstone for economic resilience and prosperity, aiming to optimize energy demand and supply and provide a diversified, affordable, and low-carbon energy future. To achieve this goal, the NES outlines a series of energy efficiency measures across its supply chain and strives to diversify the Kingdom's energy mix by investing in renewable energy sources across different sectors. Decarbonization efforts, including operational improvements, fuel switching, circularity, and carbon capture and storage, will also contribute to the Kingdom's environmental aspirations.

As part of a cabinet reshuffle, a unified Minister of Oil and Environment portfolio was established in 2022, to further facilitation of the energy transition and ensure a coordinated approach.

The NES was endorsed by the Higher Committee of Energy and Natural Resources in 2023. Chaired by His Royal Highness the Crown Prince and Prime Minister, this Higher Committee now supervises the NES and receives reports from the Minister of Oil and Environment.

1.9 Impact of National Circumstances on GHG Emissions Over Time

Bahrain's unique national circumstances play a significant role in shaping the trajectory of its greenhouse gas (GHG) emissions and removals. Factors such as the country's climate, industrial expansion, population growth, and economic development have direct implications on its GHG inventory over time.

High Ambient Temperature

One of the key national circumstances influencing GHG emissions in Bahrain is the country's high ambient temperature. Bahrain experiences long, hot summers with temperatures frequently exceeding 40°C, which significantly affects energy consumption, especially in sectors such as electricity generation and air conditioning. The high demand for cooling drives increases in electricity consumption during peak summer months, which, in turn, results in increased GHG emissions. Cooling needs for residential, commercial, and industrial facilities also lead to greater use of energy-intensive technologies as well as high amounts of HFCs refrigerants.

Economic and Industrial Expansion

Bahrain's robust economic growth and industrial expansion are also key drivers of GHG emissions. As detailed in the upcoming chapter, the country's total GHG emissions grew from approximately 34,145 Gg CO_2e in 2017 to around 38,128 Gg CO_2e by 2022. This increase is closely linked to the expansion of Bahrain's industrial sector, particularly the metal industry. The country's growing industrial base, especially in aluminum and steel production, has significantly driven emissions in the Industrial Processes and Product Use (IPPU) sector. This growth aligns with Bahrain's efforts to diversify its economy, increase industrial output, and reduce reliance on the hydrocarbon sector. Furthermore, it also illustrates the challenge of balancing economic growth with efforts to reduce GHG emissions.

Energy Sector Dominance

Bahrain's energy sector remains the predominant source of GHG emissions, accounting for an average of 82.7% of total emissions between 2017 and 2022. The high reliance on fossil fuels for electricity generation and industrial processes is a central feature of Bahrain's emission profile. While there have been efficiency improvements in electricity production, as reflected by the 6.2% reduction in emissions from energy industries between 2017 and 2022, overall energy consumption continues to rise due to population and economic growth.

Bahrain recognizes Carbon Capture, Utilization and Storage (CCUS) and Carbon Capture and Storage (CCS) as proven technologies that support economic diversification and enhance energy security. These technologies also have the benefit of preserving existing infrastructure investments and facilitating the decarbonization of hard-to-abate sectors, as well as contributing to environmental efforts.

Energy Transition Challenges

Parallel to its reliance on fossil fuels, Bahrain also faces challenges in transitioning to alternative forms of energy. Limited land area, high urban density, low wind speeds and an absence of geothermal and hydropower sources pose considerable obstacles to an energy transition. Although solar energy represents Bahrain's most viable domestic renewable energy option, limited land availability and competing land-use demands constrain large-scale deployment. Despite these challenges, Bahrain remains committed to exploring and pursuing viable opportunities for developing alternative energy sources.

Water Scarcity and High Dependence on Seawater Desalination

Bahrain is a highly water-stressed country from a freshwater resource availability perspective. Water scarcity in Bahrain plays a key role in increasing GHG emissions due to the country's reliance on energy-intensive seawater desalination. With limited freshwater resources, desalination is vital but contributes to higher energy consumption, particularly during peak summer months when water demand surges. As electricity generation in Bahrain is predominantly fossil fuel-based, the growing need for desalination has led to increased emissions from the energy sector. Enhancing the efficiency of desalination processes and incorporating renewable energy sources like solar can help reduce the environmental impact while addressing the country's water security needs.

Population Growth and Urbanization

Bahrain's population grew by approximately 26% over the past decade, driving increased demand for energy, transportation, and waste management services. Urbanization and population growth have direct implications on GHG emissions, particularly in sectors such as transport and waste management. Road transportation remains the dominant source of emissions within the transport sector, which grew by 6.2% over the period. However, the growth in emissions was slower than the growth in population and gross domestic product (GDP), indicating some progress in managing transportation emissions.

Similarly, waste sector emissions, driven by population growth, have also increased, although efforts to enhance waste management practices, such as promoting higher recycling rates and landfill diversion, have been instrumental in containing emissions growth in this sector to single-digit growth.

Limited Agricultural Activity

Agriculture in Bahrain is a minor sector, contributing less than 0.1% to total GHG emissions. Limited agricultural activity in the country is primarily due to the Kingdom's arid climate and lack of arable land. This situation has resulted in the Agriculture, Forestry, and Other Land Use (AFOLU) sector being an insignificant contributor to emissions.

Aerial view of the Tree of Life Visitor's center in Sakhir. Photo by WorldWalkerz

Chapter 2

National Greenhouse Gases Inventory Report

2. CHAPTER 2: National Greenhouse Gases Inventory Report

2.1 National Circumstances and Institutional Arrangements

The National Greenhouse Gas (GHG) Inventory of Bahrain has been meticulously compiled by the Climate Change and Sustainable Development Directorate (CCSD) team, which operates under the Supreme Council for Environment (SCE). The preparation of this inventory follows a structured, sector-based approach to collect data on GHG emissions, while taking into account the interplay between various sectors to prevent double counting or omissions. This careful coordination ensures the inventory's accuracy and completeness.

To facilitate data collection, customized data collection templates were designed in strict accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and the 2019 Refinement. These templates were then distributed to designated data providers across each sector, ensuring consistency in the information gathered. Following data collection, the CCSD team conducted data analysis for verification and QC of collected data. Verified data was fed into the IPCC Inventory Software to compute GHG emissions.

In its ongoing efforts to strengthen the GHG inventory system, Bahrain is committed to institutionalizing and streamlining the procedures, roles, and responsibilities related to the preparation of future national inventories. This will support the continuous improvement of the system, and ensure the timely submission of transparent, accurate, consistent, complete, and coherent data for both domestic use and international reporting requirements.

Further details on national circumstances and institutional arrangements are discussed in Section 1.3.

2.2 Overview of the National Inventory Document 2017-2022

The national GHG inventory of Bahrain has been prepared to cover the entire area that makes up the Kingdom's national territory and all the sectors within it for the period of 2017-2022 (i.e. the current reporting period). Table 2 provides an overview of the GHGs and sectors covered by the National Inventory Document (NID) of Bahrain.

Table 2: GHGs and sectors covered by the NID of Bahrain

Covered	✓
Not Covered	
Not Applicable	

Sector	**CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**	**NF_3**	**NO_x**	**CO**	**NMVOC**	**SO_x**
1. Energy	✓	✓	✓								
2. IPPU	✓	✓	✓	✓	✓						
3. Waste	✓	✓	✓								
4. Agriculture	✓	✓									
5. LULUCF											

The national GHG inventory of Bahrain has been prepared as per the recommended methods (tier level) for individual sources outlined in the 2006 IPCC Guidelines and the 2019 Refinement. The national GHG inventory of Bahrain is generally estimated using a mix of Tier 1 and Tier 2 methods. All Activity Data are either country-specific or facility-specific with a large degree of confidence. Whereas Emission Factors used are primarily the IPCC default EFs, and sometimes, depending on data availability, EFs are facility-specific calculated from natural gas consumption. Table 3 provides a summary report for methods and emission factors used across the reporting period.

Furthermore, the national GHG inventory of Bahrain has been prepared using the 100-year time-horizon Global Warming Potential (GWP) values from the IPCC Fifth Assessment Report (AR5) as per para. 37 in decision 18/CMA.1 annex.

Table 3: Summary report for methods and emission factors used

GHG Source and Sink Categories	CO_2		CH_4		N_2O		HFCs		PFCs	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
1. Energy	T1,NA	D,NA	T1,NA	D,NA	T1,NA	D,NA				
1.A. Fuel combustion	T1,NA	D,NA	T1,NA	D,NA	T1,NA	D,NA				
1.A.1. Energy industries	T1,NA	D,NA	T1,NA	D,NA	T1,NA	D,NA				
1.A.2. Manufacturing industries and construction	T1,NA	D,NA	T1,NA	D,NA	T1,NA	D,NA				
1.A.3. Transport	T1,NA	D,NA	T1,NA	D,NA	T1,NA	D,NA				
1.A.4. Other sectors	T1,NA	D,NA	T1,NA	D,NA	T1,NA	D,NA				
1.A.5. Other	T1,NA	D,NA	T1,NA	D,NA	T1,NA	D,NA				
1.B. Fugitive emissions from fuels	T1,NA	D,NA	T1,NA	D,NA	NA	NA				
1.B.1. Solid fuels	NA	NA	NA	NA	NA	NA				
1.B.2. Oil and natural gas and other emissions from energy production	T1,NA	D,NA	T1,NA	D,NA	NA	NA				
1.C. CO_2 transport and storage	NA	NA								
2. Industrial processes	T1,T2,NA	D,PS,NA	T1,NA	D,NA	NA	NA	T1,NA	D,NA	T1,NA	D,NA
2.A. Mineral industry	T2,NA	PS,NA	NA	NA	NA	NA				
2.B. Chemical industry	T2,NA	PS,NA	T1,NA	D,NA	NA	NA	NA	NA	NA	NA
2.C. Metal industry	T1,NA	D,PS,NA	T1,NA	D,NA	NA	NA	NA	NA	T1,NA	D,NA
2.D. Non-energy products from fuels and solvent use	NA	NA	NA	NA	NA	NA				
2.E. Electronic Industry					NA	NA	NA	NA	NA	NA
2.F. Product uses as ODS substitutes							T1,NA	D,NA	NA	NA
2.G. Other product manufacture and use	NA	NA	NA	NA	NA	NA			NA	NA
2.H. Other	NA	NA	NA	NA	NA	NA				
3. Agriculture	T1,NA	D,NA	T1,NA	D,NA	NA	NA				
3.A. Enteric fermentation			T1,NA	D,NA						
3.B. Manure management			T1,NA	D,NA	NA	NA				
3.C. Rice cultivation			NA	NA						

Table 3: Summary report for methods and emission factors used

GHG Source and Sink Categories	CO_2		CH_4		N_2O		HFCs		PFCs	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
3.D. Agricultural soils			NA	NA	NA	NA				
3.E. Prescribed burning of savannahs			NA	NA	NA	NA				
3.F. Field burning of agricultural residues			NA	NA	NA	NA				
3.G. Liming	NA	NA								
3.H. Urea application	T1	D								
3.I. Other carbon-containing fertilizers	NA	NA								
3.J. Other	NA	NA	NA	NA	NA	NA				
4. Land use, land-use change and forestry	NA	NA	NA	NA	NA	NA				
4.A. Forest land	NA	NA	NA	NA	NA	NA				
4.B. Cropland	NA	NA	NA	NA	NA	NA				
4.C. Grassland	NA	NA	NA	NA	NA	NA				
4.D. Wetlands	NA	NA	NA	NA	NA	NA				
4.E. Settlements	NA	NA	NA	NA	NA	NA				
4.F. Other land	NA	NA	NA	NA	NA	NA				
4.G. Harvested wood products	NA	NA								
4.H. Other					NA	NA				
5. Waste	T1,T2,NA	D,NA	T1,T2,NA	D,NA	T1,T2,NA	D,NA				
5.A. Solid waste disposal			T1,T2,NA	D,NA						
5.B. Biological treatment of solid waste			T1,T2,NA	D,NA	T1,T2,NA	D,NA				
5.C. Incineration and open burning of waste	T1,T2,NA	D,NA	T1,T2,NA	D,NA	T1,T2,NA	D,NA				
5.D. Waste water treatment and discharge			T1,T2,NA	D,NA	T1,T2,NA	D,NA				
5.E. Other	NA	NA	NA	NA	NA	NA				
6. Other *(as specified in summary 1)*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

2.2.1 Trends and Breakdowns of GHG Emissions

As shown in Figure 9, total greenhouse gas (GHG) emissions in Bahrain were estimated at approximately 33,656 Gg CO_2e in 2017, increasing to around 38,787 Gg CO_2e by 2022. Overall, Bahrain contributes less than 0.07% to the global GHG emissions, which were estimated at 57.4 million Gg CO_2e in 2022, according to the UNEP Emissions Gap Report 2023.

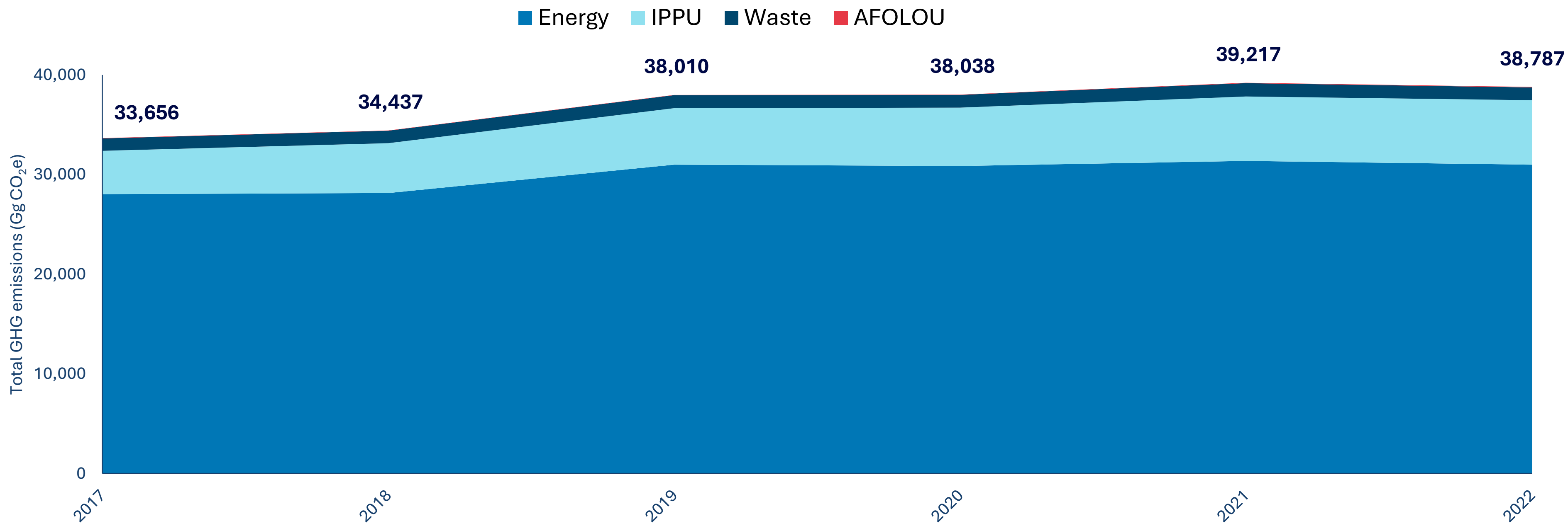

Figure 9: GHG emission trends by sector 2017-2022

The increase in Bahrain's total emissions between 2017 and 2022 is largely attributed to the industrial sector, which experienced a ~49% growth in emissions due to industrial sector expansion, highlighting the country's advancing industrial expansion. Other sectors, such as energy, waste and agriculture, saw more moderate, single-digit growth, suggesting that while economic development accelerates, there are still opportunities to optimize emissions management in these areas.

Furthermore, as is the case globally, the energy sector remains the primary contributor to GHG emissions, responsible for an average of about 81.3% of total emissions between 2017 and 2022. The IPPU and waste sectors follow with an average contribution of about 15.2% and 3.5% respectively. AFOLU remains an insignificant contributor with less than 0.09% of the national inventory resulting from the limited agricultural activities.

Key trends in the main sectors over the reporting period (2017-2022):

Figure 10 provides a further breakdown of the trends in the main sectors over the reporting period.

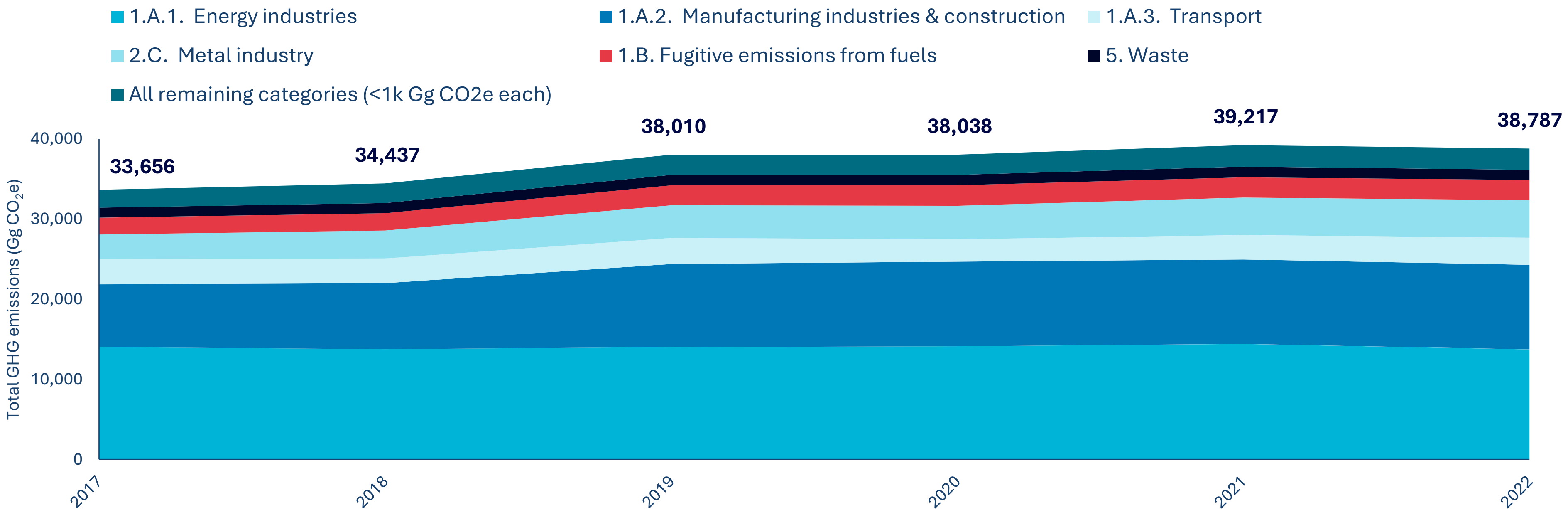

Figure 10: GHG emission trends by category 2017-2022

- **Energy – Energy Industries:** Despite the continuous increase in energy consumption over time, energy industries experienced a 2.1% drop over the reporting period. This drop was mainly driven by the enhancement of efficiency of electricity production as well as the decommissioning of old less efficient power stations.

- **Energy – Manufacturing industries and construction:** This section corresponds to the energy produced for manufacturing industries. Aligned with the major expansions of industries, especially the metal industry, during the reporting period, energy production for those industries has also grown. This resulted in an overall ~35.1% increase in emissions from this sub-category.

- **Energy – Transport**: Emissions from the transport sector are dominated by road transportation. The entire sector underwent an overall 5.8% increase in emissions as a result of economic growth. Yet, the growth rate of emissions was less than the growth rate of GDP, which grew by 25%, over the same period.

- **Energy – Fugitive emissions:** Fugitive emissions resulting from the oil and gas industry showed an increase of around 18.8% over the reporting period corresponding to the expansions in oil and gas operations from both upstream and downstream.

- **IPPU - Metal Industry**: Aluminum IPPU emissions contributed an average of approximately 57% of the metal industry's emissions over the reporting period, while Iron and Steel Production accounted for the remaining 43%. During this period, IPPU emissions from Aluminum Production grew by 63.1%, driven mainly by capacity expansion. Likewise, emissions from Iron and Steel Production increased by 44.2%, primarily due to a rise in production volumes, especially in pellet production.

- **Waste**: Emissions from the waste sector saw a modest growth of approximately 2.9% over the reporting period, driven mainly by population growth. Promoting higher recycling rates and landfill diversion have been instrumental in containing emissions growth in this sector to single-digit growth.

- **All remaining categories:** smaller sectors, emitting less than 1,000 Gg CO_2e each, including smaller industries, refrigeration sector and minor activities. These sectors combined experienced a 17.7% increase in emissions over the reporting period.

GHG emission by Gas and Source in 2022

As illustrated in Figure 11, about 87% of the GHG emissions in 2022 were CO_2, primarily released from fuel combustion in the Energy sector, which accounted for approximately 74% of total emissions, followed by the IPPU sector at roughly 13%. CH_4 contributed about 8.8% of emissions, mainly from the Energy (~5.4%) and Waste (~3.1%) sectors. HFCs and PFCs, and N_2O emissions made up a small fraction adding up to about 4% from the overall emissions, mainly from the IPPU (~3.6%), Energy (~0.2%), and Waste (~0.1%) sectors.

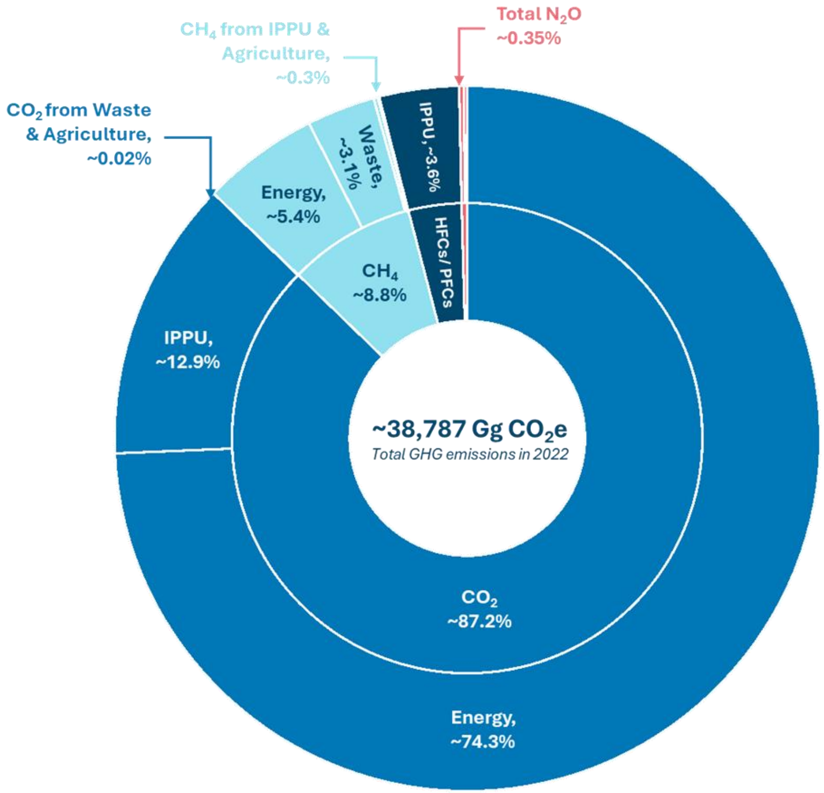

Figure 11: Breakdown of GHG emission by gas and source in 2022

Table 4 and Table 5, extracted from the CRTs, detail GHG source and sink categories per the 2006 IPCC guidelines.

Table 4: GHG emissions by year and category for 2017-2022

GHG Source and Sink Categories	GHG emissions per year in Gg CO_2e						Change from 2017 to 2022 (%)
	2017	2018	2019	2020	2021	2022	
TOTAL Net Emissions (1+2+3+4+5+6)	**33,655.69**	**34,436.45**	**38,010.05**	**38,037.52**	**39,216.75**	**38,786.52**	**15.25**
1. Energy	**28,039.44**	**28,138.42**	**30,998.03**	**30,847.60**	**31,368.88**	**30,987.08**	**10.49**
1.A. Fuel combustion	25,933.58	25,983.25	28,495.97	28,313.24	28,839.71	28,484.81	9.81
1.A.1. Energy industries	14,016.95	13,737.30	14,010.09	14,130.25	14,401.46	13,729.50	-2.05
1.A.2. Manufacturing industries and construction	7,821.41	8,261.07	10,365.63	10,534.64	10,547.23	10,564.75	34.96
1.A.3. Transport	3,184.94	3,076.78	3,252.58	2,810.67	3,038.12	3,368.56	5.77
1.A.4. Other sectors	215.58	224.17	225.25	215.04	212.11	227.13	5.36
1.A.5. Other	694.70	683.94	642.42	622.64	640.79	594.87	-14.37
1.B. Fugitive emissions from fuels	2,105.86	2,155.17	2,502.06	2,534.37	2,529.17	2,502.27	18.82
1.B.1. Solid fuels	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	–
1.B.2. Oil and natural gas and other emissions from energy production	2,105.86	2,155.17	2,502.06	2,534.37	2,529.17	2,502.27	18.82
1.C. CO_2 Transport and storage	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	–
2. Industrial processes and product use	**4,343.76**	**5,012.85**	**5,677.13**	**5,864.59**	**6,481.81**	**6,489.82**	**49.41**
2.A. Mineral industry	32.61	19.93	18.97	18.57	20.81	30.46	-6.61
2.B. Chemical industry	575.52	538.94	542.67	543.17	550.82	533.39	-7.32
2.C. Metal industry	3,037.11	3,487.42	4,085.61	4,186.05	4,682.28	4,697.94	54.68
2.D. Non-energy products from fuels and solvent use	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	–
2.E. Electronic industry	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	–
2.F. Product uses as substitutes for ODS	698.51	966.56	1,029.88	1,116.79	1,227.91	1,228.03	75.81
2.G. Other product manufacture and use	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	–
2.H. Other	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	–
3. Agriculture	**33.40**	**34.89**	**36.15**	**35.27**	**35.57**	**35.15**	**5.24**
3.A. Enteric fermentation	30.62	32.12	33.35	32.56	32.89	32.36	5.70
3.B. Manure management	2.08	2.18	2.22	2.09	2.17	2.15	3.34

Table 4: GHG emissions by year and category for 2017-2022

GHG Source and Sink Categories	GHG emissions per year in Gg CO_2e						Change from 2017 to 2022 (%)
	2017	2018	2019	2020	2021	2022	
3.C. Rice cultivation	NE	NE	NE	NE	NE	NE	–
3.D. Agricultural soils	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	–
3.E. Prescribed burning of savannahs	NO	NO	NO	NO	NO	NO	–
3.F. Field burning of agricultural residues	NE	NE	NE	NE	NE	NE	–
3.G. Liming	NE	NE	NE	NE	NE	NE	–
3.H. Urea application	0.70	0.59	0.58	0.61	0.51	0.64	-9.18
3.I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	–
3.J. Other	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	–
4. Land use, land-use change and forestry	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**–**
4.A. Forest land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	–
4.B. Cropland	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	–
4.C. Grassland	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	–
4.D. Wetlands	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	–
4.E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	–
4.F. Other land	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	–
4.G. Harvested wood products	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	–
4.H. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	–
5. Waste	**1,239.09**	**1,250.29**	**1,298.74**	**1,290.06**	**1,330.49**	**1,274.47**	**2.86**
5.A. Solid waste disposal	1,129.33	1,146.57	1,181.57	1,170.86	1,169.00	1,165.36	3.19
5.B. Biological treatment of solid waste	NE,NO	0.06	0.10	0.12	0.18	0.11	–
5.C. Incineration and open burning of waste	2.43	1.80	2.05	4.35	8.94	9.14	275.69
5.D. Wastewater treatment and discharge	107.33	101.86	115.03	114.73	152.37	99.86	-6.95
5.E. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	–
6. Other	**NA,NE**	**NA,NE**	**NA,NE**	**NA,NE**	**NA,NE**	**NA,NE**	**–**
Memo items:							
1.D.1. International bunkers	**1,359.30**	**1,470.52**	**1,544.54**	**873.70**	**979.82**	**1,579.39**	**16.19**

Table 4: GHG emissions by year and category for 2017-2022

GHG Source and Sink Categories	GHG emissions per year in Gg CO_2e						Change from 2017 to 2022 (%)
	2017	2018	2019	2020	2021	2022	
1.D.1.a. Aviation	1,359.30	1,470.52	1,544.54	873.70	979.82	1,579.39	16.19
1.D.1.b. Navigation	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	–
1.D.2. Multilateral operations	NO	NO	NO	NO	NO	NO	–
1.D.3. CO_2 emissions from biomass	NO	NO	NO	NO	NO	NO	–
1.D.4. CO_2 captured	NO	NO	NO	NO	NO	NO	–
5.F.1. Long-term storage of C in waste disposal sites	**6,610.51**	**6,955.85**	**7,155.89**	**7,395.27**	**7,616.66**	**7,843.34**	**18.65**
Indirect N_2O	NE	NE	NE	NE	NE	NE	–
Indirect CO_2	NE	NE	NE	NE	NE	NE	–
Total CO_2 equivalent emissions without LULUCF	33,655.69	34,436.45	38,010.05	38,037.52	39,216.75	38,786.52	15.25
Total CO_2 equivalent emissions with LULUCF	33,655.69	34,436.45	38,010.05	38,037.52	39,216.75	38,786.52	15.25
Total CO_2 equivalent emissions, including indirect CO_2, without LULUCF	33,655.69	34,436.45	38,010.05	38,037.52	39,216.75	38,786.52	15.25
Total CO_2 equivalent emissions, including indirect CO_2, with LULUCF	33,655.69	34,436.45	38,010.05	38,037.52	39,216.75	38,786.52	15.25

Table 5: GHG emissions by gas type for the year 2022

GHG Source and Sink Categories	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	HFCs (Gg CO_2e)	PFCs (Gg CO_2e)	Total for 2022 (Gg CO_2e)
TOTAL Net Emissions (1+2+3+4+5+6)	**33,834.01**	**121.37**	**0.52**	**1,228.03**	**187.50**	**38,786.52**
1. Energy	**28,818.32**	**74.46**	**0.32**	-	-	**30,987.08**
1.A. Fuel combustion	28,382.46	0.68	0.31			28,484.81
1.A.1. Energy industries	13,716.17	0.24	0.02			13,729.50
1.A.2. Manufacturing industries and construction	10,554.49	0.19	0.02			10,564.75
1.A.3. Transport	3,296.17	0.18	0.25			3,368.56
1.A.4. Other sectors	226.53	0.02	0.00			227.13
1.A.5. Other	589.10	0.06	0.02			594.87

Table 5: GHG emissions by gas type for the year 2022

GHG Source and Sink Categories	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	HFCs (Gg CO_2e)	PFCs (Gg CO_2e)	Total for 2022 (Gg CO_2e)
1.B. Fugitive emissions from fuels	435.85	73.78	0.00			2,502.27
1.B.1. Solid fuels	NE,NO	NE,NO	NE			NE,NO
1.B.2. Oil and natural gas and other emissions from energy production	435.85	73.78	0.00			2,502.27
1.C. CO_2 Transport and storage	NE,NO					NE,NO
2. Industrial processes and product use	**5,007.58**	**2.38**	**NA,NE,NO**	**1,228.03**	**187.50**	**6,489.82**
2.A. Mineral industry	30.46	NE	NE			30.46
2.B. Chemical industry	506.39	0.96	NE	NE	NE	533.39
2.C. Metal industry	4,470.73	1.42	NE	NE	187.50	4,697.94
2.D. Non-energy products from fuels and solvent use	NA,NE	NA,NE,NO	NA,NE,NO			NA,NE,NO
2.E. Electronic industry			NA,NE	NE	NE	NA,NE
2.F. Product uses as substitutes for ODS				1,228.03	NE,NO	1,228.03
2.G. Other product manufacture and use	NE	NE	NE		NE,NO	NE,NO
2.H. Other	NE	NE	NE			NE,NO
3. Agriculture	**0.64**	**1.23**	**NA,NE,NO**	**-**	**-**	**35.15**
3.A. Enteric fermentation		1.16				32.36
3.B. Manure management		0.08	NA,NE,NO			2.15
3.C. Rice cultivation		NE				NE
3.D. Agricultural soils		NA	NE,NO			NA,NE,NO
3.E. Prescribed burning of savannahs		NO	NO			NO
3.F. Field burning of agricultural residues		NE	NE			NE
3.G. Liming	NE					NE
3.H. Urea application	0.64					0.64
3.I. Other carbon-containing fertilizers	NE					NE
3.J. Other	NO	NE	NE			NE,NO
4. Land use, land-use change and forestry	**NA,NE,NO**	**NA,NE,NO**	**IE,NA,NE,NO**	**-**	**-**	**IE,NA,NE,NO**
4.A. Forest land	NE	NE	NA,NE			NA,NE
4.B. Cropland	NE	NE	IE,NA,NE			IE,NA,NE

Table 5: GHG emissions by gas type for the year 2022

GHG Source and Sink Categories	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	HFCs (Gg CO_2e)	PFCs (Gg CO_2e)	Total for 2022 (Gg CO_2e)
4.C. Grassland	NE	NE	IE,NA,NE			IE,NA,NE
4.D. Wetlands	NA,NE	NA,NE	NA,NE			NA,NE
4.E. Settlements	NE	NE	NA,NE			NA,NE
4.F. Other land	NA,NE,NO	NA,NE,NO	NA,NE,NO			NA,NE,NO
4.G. Harvested wood products	NE,NO					NE,NO
4.H. Other	NO	NO	NA,NO			NA,NO
5. Waste	**7.47**	**43.30**	**0.21**	**-**	**-**	**1,274.47**
5.A. Solid waste disposal		41.62				1,165.36
5.B. Biological treatment of solid waste		0.00	0.00			0.11
5.C. Incineration and open burning of waste	7.47	0.00	0.01			9.14
5.D. Wastewater treatment and discharge		1.67	0.20			99.86
5.E. Other	NA,NO	NO	NO			NA,NO
6. Other *(please specify)*	**NE**	**NE**	**NE**	**NE**	**NE**	**NA,NE**
Other sources of emissions/removals [IPCC Software 5.C]	NE	NE	NE	NE	NE	NA,NE
Memo items:						
1.D.1. International bunkers	1,567.21	0.01	0.04			1,579.39
1.D.1.a. Aviation	1,567.21	0.01	0.04			1,579.39
1.D.1.b. Navigation	NE,NO	NE,NO	NE,NO			NE,NO
1.D.2. Multilateral operations	NE	NE	NE			NE
1.D.3. CO_2 emissions from biomass	NE,NO					NE,NO
1.D.4. CO_2 captured	NE					NE
5.F.1. Long-term storage of C in waste disposal sites	7,843.34					7,843.34
Indirect N_2O			NE			NE
Indirect CO_2	NE					NE

2.2.2 Energy Sector

2.2.2.1 Overview

The Energy Sector in the Kingdom of Bahrain is a crucial component of its economy, primarily driven by Oil and Gas (O&G) production, which has historically served as the backbone of the country's economic development. As the Kingdom seeks to diversify its economy and adapt to global energy transitions, the sector is evolving towards greater sustainability, while continuing to rely on its established energy resources. In general, Bahrain mainly relies on gaseous and liquid fuels for its energy sector, whereas the use of solid fuels is limited to leisure activities, such as charcoal for grilling.

1. **Oil and Gas**

Bahrain is the first of the Gulf states to discover oil, with its first oil well dating back to 1932. Bapco Energies, a state-owned holding company, manages all oil and gas infrastructure in Bahrain including O&G production, refining, processing and upgrading. The primary oil-producing field within Bahrain is the Bahrain Field, which produces approximately 40,000 barrels of oil per day.

Additionally, Bahrain benefits from a 50% share in the offshore Abu Safah oil field, located in the Arabian Gulf. The field is jointly operated by Saudi Arabia and Bahrain, with Bahrain’s share contributing significantly to its total oil revenues. The Abu Safah field produces about 300,000 barrels of oil per day, and Bahrain's 50% share provides a substantial boost to its crude oil supply, supplementing its domestic production. Further, Bahrain imports additional crude oil from Saudi Arabia via a 55-kilometer pipeline for refining.

Bahrain also possesses natural gas that is a key fuel for Bahrain's domestic energy consumption, particularly for power generation, water desalination, and industrial use.

2. **Electricity Generation and Distribution**

Bahrain's electricity generation is primarily based on natural gas. The Electricity and Water Authority (EWA) manages the distribution network, ensuring reliable electricity to households, industries, and businesses. The total installed capacity connected to the national grid stands at around 5,000 megawatts (MW). The increasing demand for electricity due to urbanization, industrial expansion, and population growth as well as the Kingdom’s dedication towards preserving the environment has led Bahrain to modernize its infrastructure and explore alternative energy sources to diversify its electricity generation mix.

Furthermore, several large industries in Bahrain operate their own captive power plants to meet their substantial energy requirements. These industrial power plants contribute significantly to the country's overall energy production, supplementing the national grid while enhancing energy security and operational efficiency within the industrial sector.

Bahrain is also a member of the Gulf Cooperation Council (GCC) Interconnection Authority, which links the electricity grids of GCC countries, allowing for electricity trade and greater grid stability in the region.

3. Renewable Energy Initiatives

While Bahrain's energy sector remains dominated by fossil fuels, the government is committed to diversifying its energy mix by incorporating renewable energy sources. In alignment with Bahrain's Economic Vision 2030 and its pledge under the Paris Agreement, the National Renewable Energy Action Plan (NREAP) aims to generate 5% of its electricity from renewable sources by 2025 and 10% by 2035.

Solar energy is at the forefront of renewable energy efforts, with numerous projects initiated to install solar panels around the country.

4. Energy Efficiency and Sustainability

Bahrain is focusing on improving energy efficiency across various sectors, ranging from industrial applications to residential energy use. Efforts include the promotion of energy-efficient buildings, appliances, and vehicles, with regulations in place to drive these initiatives.

To further enhance the sustainability of its energy sector, Bahrain is also exploring advanced technologies like carbon capture, utilization and storage (CCUS) and hydrogen energy, alongside efforts to promote electric vehicles (EVs) and invest in green energy solutions. These initiatives align with the government's broader strategy to reduce the carbon intensity of its economy while ensuring energy security.

2.2.2.2 Source Category Description

1. Main Electricity Production

Bahrain is a small island where 100% of the population is connected to the grid with four main power plants currently supplying the grid. As of 2022, following the decommission of two older facilities, all power plants use combined-cycle gas turbine technology. The natural gas is directly supplied from Bahrain Field to the power stations through a distribution network managed by Bapco Energies. Table 6 shows the capacity of all power plants connected to the grid for this reporting period.

Table 6: Installed capacity of grid-connected power production facilities (2017-2022)

Facility	2017	2018	2019	2020	2021	2022
	Installed Capacity (MW)					
Sitra Power Station	125	125	125	125	125	0
Riffa Power Station(2)	700	700	700	700	700	450
Hidd Power Station	929	929	929	929	929	929
AlEzzel Power Station	941	941	941	941	941	941
Al-Dur 1	1,224	1,224	1,224	1,224	1,224	1,224
Al-Dur 2	0	0	0	0	1,500	1,500

As shown in Figure 12, the consumption of electricity from the national grid has been gradually increasing between 2017 and 2022. A major decline is noticeable in the commercial and industrial sectors in 2020 due to COVID-19, when the activities of both sectors were limited. Figure 12 is not representative of the national sectoral breakdown of electricity consumption, as it only reflects the consumption from the national grid, whereas a few industries have their own captive power generation which will be discussed in subsequent sections.

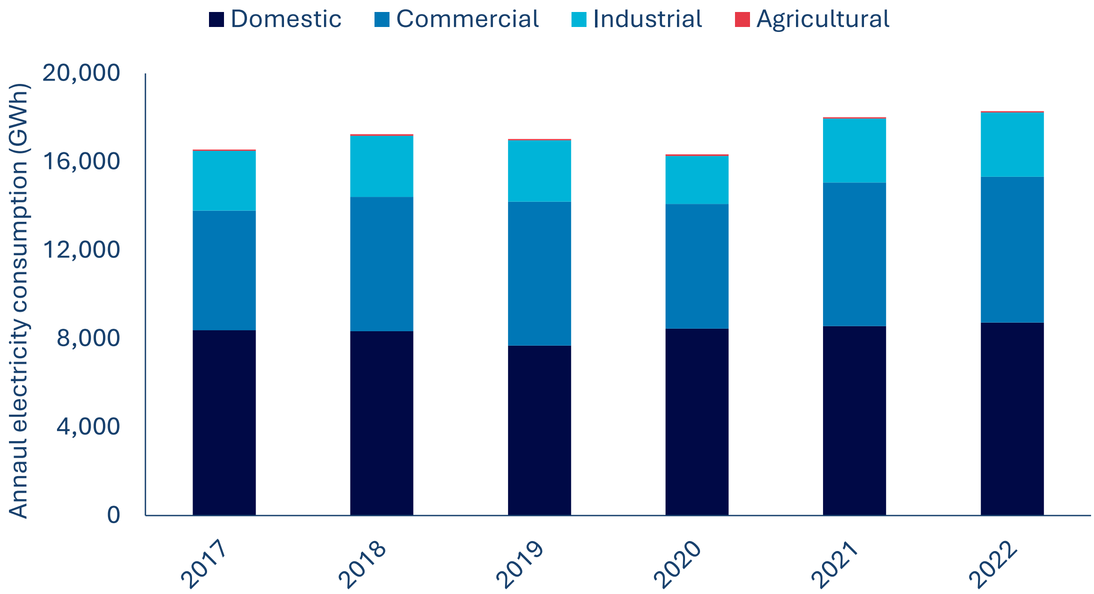

Figure 12: Electricity consumption from the national grid per sector

2. Manufacturing Industries, Construction and Other Energy Industries

The energy sector process starts at Bahrain Field, where the production of oil and gas takes place. In 2022, crude and condensate production averaged at 39.5 thousand barrels per day, while natural gas production averaged at 1,647 million standard cubic feet per day. Further, an additional amount of crude oil is imported from Saudi Arabia through pipelines, amounting to a total of 77,743 thousand barrels in 2022. The upstream petroleum industry meets part of its energy needs on-site using a mixture of natural gas,

(2) Riffa Power Station is no longer operational as of 2022, but it is kept as a stand-by facility.

diesel and solar power, and relies on the national electricity grid for the remainder. Following upstream sector processes, products are then transferred for export, processing, or direct use by industries.

Natural gas is distributed through a network to all power plants (that are either owned by the industries or connected to the grid), industries, as well as a gas processing facility under Bapco Energies. The gas processing facility processes the natural gas, along with the associated gas and condensate produced from Bahrain Field, to produce more valuable products. The processing facility also produces its own electricity on-site. The direct emissions of power generation from both the upstream production and the gas processing are reported under "1.A.1.c.ii – Other Energy Industries".

Crude oil is sent to a refining plant where a variety of products – ranging from light refinery gas to heavy bitumen asphalt – are produced. These products are then partly sold locally and partly exported. In addition to the refined products, Bahrain also exports a proportion of the produced crude oil and condensate. The refining plant also produces electricity on-site and is reported under "1.A.1.b Petroleum Refining".

Furthermore, several major industries including Iron and Steel, Aluminum, and Petrochemical industries produce their own electricity. Each of these industries are reported on under their respective subsections under "1.A.2 Manufacturing Industries, Construction". Small industries and SMEs (e.g., metal recycling) that use small amounts of natural gas for energy generation are grouped and their emissions are reported under "1.A.2.m Non-specified Industry".

Figure 13 provides an illustration of energy flows in Bahrain.

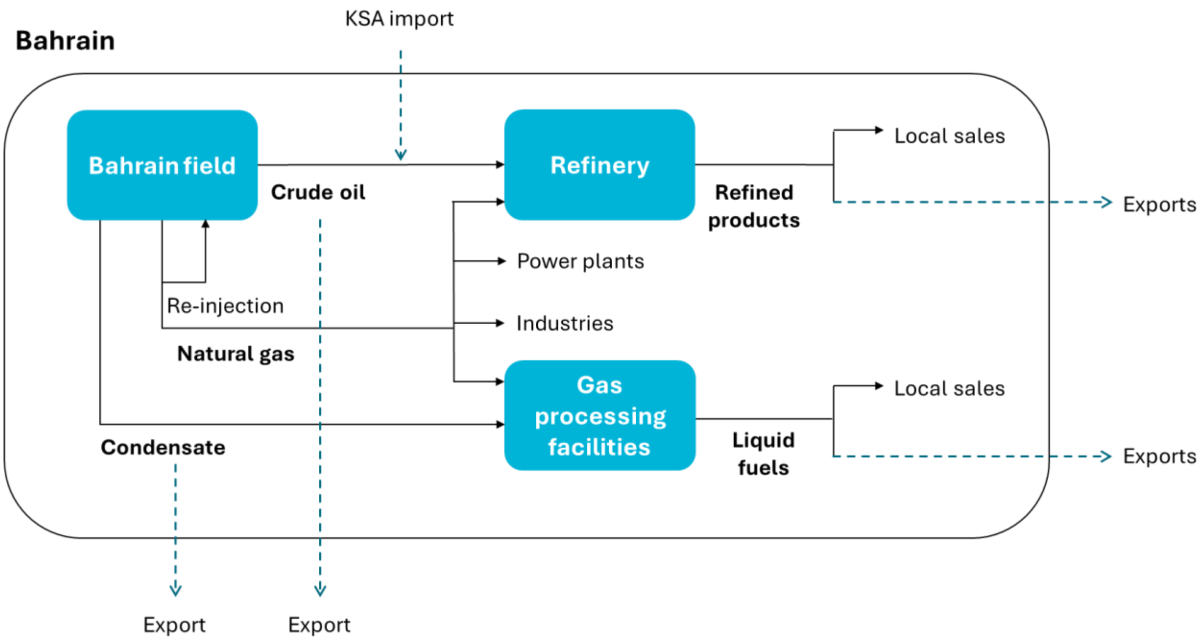

Figure 13: Energy flows in Bahrain

3. Transport

Bahrain's transportation sector plays a key role in the Bahrain's economy and is an important focus in the national GHG inventory. Road transport, including private vehicles and freight, forms a significant part of this sector, and primarily relies on fossil fuels. Figure 14 depicts the evolution of the total number of vehicles in use, and encompasses all types of vehicles (i.e. cars, motorcycles, heavy vehicles, etc…). This gradual increase is reflective of the Kingdom's population and economic growth.

Public transportation, mainly provided through the Bahrain Public Transport Company's bus network, supports the sector, and efforts are ongoing to expand its use. Bahrain's position as a regional trade hub is bolstered by the Bahrain International Airport and Khalifa Bin Salman Port, both of which are central to the country's aviation and maritime sectors. Additionally, pipeline transport plays a key role in the movement of oil and natural gas, further contributing to the sector's emissions profile. In line with Bahrain's climate goals, initiatives such as promoting electric vehicles and enhancing public transport systems are being pursued to further optimize the sector's environmental impact.

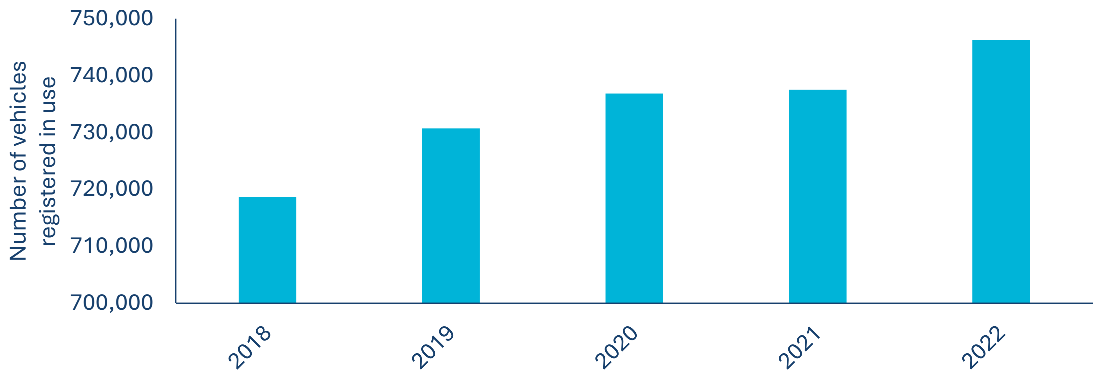

Figure 14: Total number of vehicles registered in use in Bahrain.

4. Other Sectors

The residential and commercial sectors in Bahrain relies entirely on the national grid for electricity. However, these sectors do emit direct GHG emission from the use of cooking fuel in the form of Liquified Petroleum Gas (LPG). The total emissions resulting from LPG consumption nationally are grouped and reported under "1.A.4.b Residential".

5. Fugitive Emissions

Fugitive emissions resulting from oil operations have been mostly consistent throughout the reporting period of this BTR (2017-2022) due to the stability of the production and refining rates. However, there was a significant jump in natural gas fugitive emissions from 2019 onwards, coinciding with the commissioning of an expansion to a gas processing plant that increased its processing capacity from around 300 to 650 MMSCF per day.

2.2.2.3 Methodology

2.2.2.3.1 Sectoral Approach

Tier 1 approach has been used across the Energy Category using IPCC default emission factors following IPCC 2006 Guidelines. The activity data, depending on the volume of operation, is either supplied by the operators for large emitters or by central governmental entities (i.e. iGA) for small sources.

1. **Energy Industries**

Being one of the largest contributors to the national GHG inventory, the activity data for this subcategory is obtained from the operators of the different facilities. The datasets provided by the operators (i.e., the consumers) are compared with datasets provided by Bapco Energies (i.e., the supplier) which manages the natural gas distribution network. This exercise helps reduce uncertainties and ensures the consistency of the time-series. Grid-connected power plants that use single cycle technology are reported under *“1.A.1.a.i Electricity Generation”*, while those using combined cycle technology are reported under *"1.A.1.a.ii Combined Heat and Power Generation”*. Furthermore, the emissions resulting from power generation in refineries are reported under *“1.A.1.b Petroleum Refining”*. Some of these facilities use trace amounts of diesel for start-ups and other activities. The emissions from liquid fuel are not reported here but are included elsewhere (under *“1.A.4 - Other Sectors”)* grouped with other sources.

2. **Manufacturing Industries and Construction**

Energy production from major industries is reported under this subcategory, specifically under *“1.A.2.a Iron and steel”, “1.A.2.b Non-ferrous Metals”,* and *“1.A.2.c Chemicals”*. The activity data of these sub-categories are provided by the relevant industries. In a similar manner to the previous section, data sets provided by operators are compared against the supplier’s datasets to minimize uncertainties. Other sectors, such as construction and food processing, might use trace amounts of liquid and gaseous fuels. However, the breakdown from these sectors is not available and therefore they are grouped with other sectors and reported under “1.A.2.m – Non-specified Industry”.

3. **Transport**

The transport sector in Bahrain relies mainly on liquid fuels. More specifically, civil aviation utilizes aviation gasoline and jet kerosene, and both road transportation and water-borne navigation use motor gasoline and diesel. Additionally, “Pipeline Transport” is an activity occurring in Bahrain, but no emissions are reported under this sub-category due to the lack of segregated data. The emissions of pipeline transport are, however, impeded within the other sub-categories (included elsewhere). The activity data used for this category is the local sales of these fuels provided by the Ministry of Oil (MOO). The local sales of liquid fuels are classified based on “Service Station”, “Government”, “Industrial”, and “Marine Stations”. The emissions of these fuels are reported as follows:

- Motor gasoline sales classified under “Service Stations”, “Government”, and “Industrial” are reported under “1.A.3.b.i – Cars”.
- Motor gasoline sales classified under “Marine Stations” are reported under *"1.A.3.d.ii – Domestic Water-borne Navigation”*.
- All local sales of Kerosene and Jet fuel are reported under *“1.A.3.a.ii – Domestic Aviation”*.
- Local sales of diesel classified under “Service Stations” and “Government” are reported under *“1.A.3.b.iii – Heavy-duty trucks and buses”*.
- Local sales of diesel classified under “Marine Stations” are reported under *"1.A.3.d.ii – Domestic Water-borne Navigation”*.
- Local sales of diesel classified under “industrial” are reported under *“1.A.5 Non-specified”*.

All assumptions and other activities that might be reported under other sub-categories are summarized in Table 7.

4. Other Sectors

LPG is the main cooking fuel in Bahrain and is reported under *“1.A.4.b – residential”*. Although it is also used by other sectors (i.e., commercial), it is all reported under residential due to the lack of segregated data. The activity data used is the local sales of LPG provided by MOO. Moreover, other activities under *“1.A.5 – Non-specified”* such as fishing and off-road machinery are occurring in Bahrain but are included elsewhere due to the lack of data breakdowns.

5. Non-Specified

Local sales of diesel classified as “Industrial” provided by MOO is reported under *“1.A.5 – Non-specified”* as the exact fate of diesel depends on the end-user which may vary from off-grid generators for construction and other activities, start-up fuel for gas-fired power plants, fuel for heavy vehicles, or other applications. Therefore, those amounts were grouped and reported under “non-specified” sub-category.

6. Fugitive Emissions

The activity data used to calculate fugitive emissions are obtained from Bapco Energies, which oversees all oil and gas operations in Bahrain. The activity data used to compute the emissions from this sector are as follows:

- **Oil Production:** annual amount of crude oil produced from Bahrain field.

- **Gas Production:** annual amount of gas produced from Bahrain field including associated gas.
- **Oil Transported by Pipeline:** total amount of oil including imported oil from Saudi Arabia by pipelines.
- **Oil Refined:** Amount of oil supplied to the refining facilities.
- **Gas Processing (raw gas feed):** total feed gas to the gas processing and gas-to-liquid facilities.
- **Marketable Gas and Utility Sales:** total natural gas distributed through the gas distribution network.

7. Summary of Cross-Sectoral Energy Activities

Due to the lack of an extensive breakdown of data, few activities are grouped and reported under one sub-category. Table 7 provides a summary of these activities as well as the sources of data and main assumptions used.

Table 7: Summary of cross-sectoral emissions under energy category

Data	Data Source	Reported in:	Assumptions	Other sources that might be included under this sub-category
Natural Gas supplied to small industries	Bapco Energies	*1.A.2.m – Non-specified Industry*	100% of the gas supplied to small industries is combusted	IPPU emissions of some amount of gas that is used for non-energy
Local sales of Motor Gasoline (Service Stations + Government + Industrial)	MOO	*1.A.3.b.i – Cars*	100% of gasoline sales (excluding those sold in marine stations) are used for cars	Other vehicles that use gasoline (i.e. motorcycle) and other industrial uses of gasoline
Local sales of Motor Gasoline (Marine Stations)	MOO	*1.A.3.d.ii – Domestic Water-borne Navigation*	100% of gasoline sales in marine stations are used for water-borne navigation	Other sea activities (i.e. fishing)
Local sales of Kerosene and Jet Fuel	MOO	*1.A.3.a.ii – Domestic Aviation*	100% of local sales of these two fuels are used for civil aviation	Industrial uses of kerosene and other aviation purposes (i.e. multilateral operations)

Table 7: Summary of cross-sectoral emissions under energy category

Data	Data Source	Reported in:	Assumptions	Other sources that might be included under this sub-category
Local sales of Diesel (Service Stations + Government)	MOO	*1.A.3.b.iii – Heavy-duty trucks and buses*	100% of diesel local sales classified under Government and Service Stations is used by heavy trucks and buses	Other types of vehicles using diesel (i.e. light-duty trucks) and other activities that use diesel (i.e. off-grid diesel generators)
Local sales of Diesel (Marine Stations)	MOO	*1.A.3.d.ii – Domestic Water-borne Navigation*	100% of diesel sales in marine stations are used for water-borne navigation	Other sea activities (i.e. fishing)
Local sales of Diesel (Industrial)	MOO	*1.A.5 – Non-specified*	Diesel used by industries with unknown application	All industrial uses of diesel (i.e. trucks, power plants)
Local Sales of LPG	MOO	*1.A.4.b – residential*	100% of LPG local sales are used as cooking fuel	Other non-residential LPG uses (i.e. commercial)

2.2.2.3.2 The Reference Approach

The Reference Approach was applied using national energy statistics provided by iGA as a QC measure to verify the outcomes of the sectoral approach. The apparent consumption was calculated using the national energy balance, which includes:

- **Production:** crude oil, condensate, natural gas and associated gas
- **Imports:** crude oil
- **Exports:** crude oil, condensate, and refined products
- **International Bunkers:** fuel sold for international aviation and water-borne navigation.
- **Stock Changes:** all fuels.

Afterwards, “Excluded Carbon” was estimated in accordance with IPCC guidelines to eliminate the energy of fuels that are used for non-energy purposes, which includes:

- **Natural Gas Re-injection:** the proportion of natural gas that is re-injected to oil wells in Bahrain field to maintain the pressure.

- **Natural gas feedstocks:** natural gas used as a feedstock by some industries (i.e. petrochemicals and iron & steel). These datasets are obtained from the relative industries to distinguish between the amounts used as feedstock and the amounts used for energy production.
- **Non-energy products:** Liquid fuels used for non-energy purposes (i.e. asphalt).

Overall, the difference in CO_2 emissions between the reference and sectoral approaches ranged from 3-9% during the reporting period (2017-2022). The differences are attributed mainly to fugitive emissions, and stock changes in consumers' level.

2.2.3 Industrial Processes and Product Use (IPPU) Sector

2.2.3.1 Overview

The IPPU Sector in Bahrain covers GHG emissions from the following sub-sectors, as per IPCC 2006 guidelines categories:

1. Mineral Industry, specifically: Cement Production and Glass Production
2. Chemical Industry, specifically: Ammonia Production and Methanol Production
3. Metal Industry, specifically: Iron and Steel Production and Aluminum Production
4. Product Uses as Substitutes for ODS, specifically: Refrigeration and Air Conditioning (RAC)

As illustrated in Table 4, the metal industry is the largest emission source within the IPPU sector followed by emissions from the chemical industry and RAC. Further details on those sub-sectors are discussed in the following section.

2.2.3.2 Source Category Description

1. Cement Production

Clinker production is the main source of CO_2 in the cement production process. Bahrain has only one clinker production facility with a capacity of 950 tonnes per day. Since Q1 2017, the facility has been no longer operational, and currently, all cement production facilities in Bahrain are importing clinker for their processes.

2. Glass Production

In Bahrain, fiberglass (E-glass) is the primary type of glass produced, using natural gas-fired furnaces. As shown in Figure 15, the production capacity of fiberglass in Bahrain has steadily risen, from 30,000 tons per year in 2017 to 120,000 tons per year by 2022, according to industry-reported data. This increase in production capacity has contributed to the rise in emissions from this sector. Additionally, industries reported a cutlet ratio ranging from approximately 1% to 6% during this period.

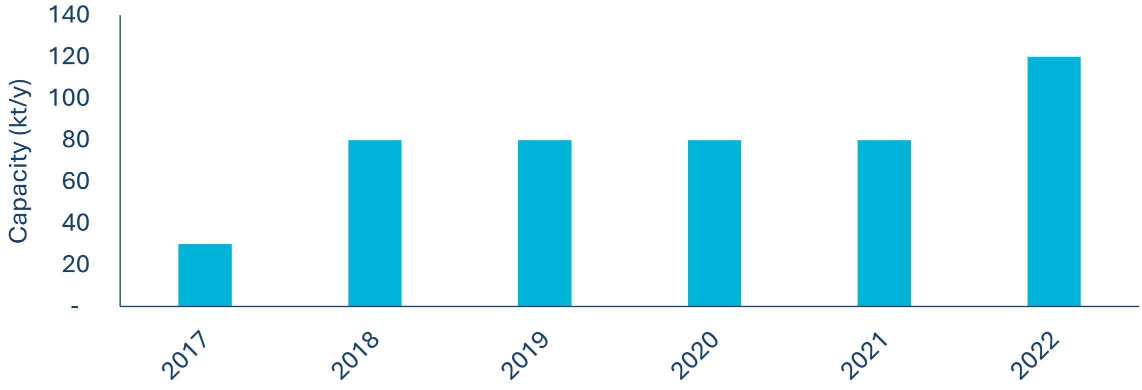

Figure 15: Fiberglass production capacity in Bahrain.

3. Ammonia Production and Methanol Production

In Bahrain, ammonia and methanol production occurs at a single facility powered by natural gas. This facility also includes a urea production unit and a Carbon Dioxide Recovery (CDR) unit, which captures up to 450 tonnes of CO_2 per day from methanol reformer stack emissions to produce additional methanol and urea. Figure 16 illustrates the annual production levels of ammonia, methanol, and urea in the Kingdom.

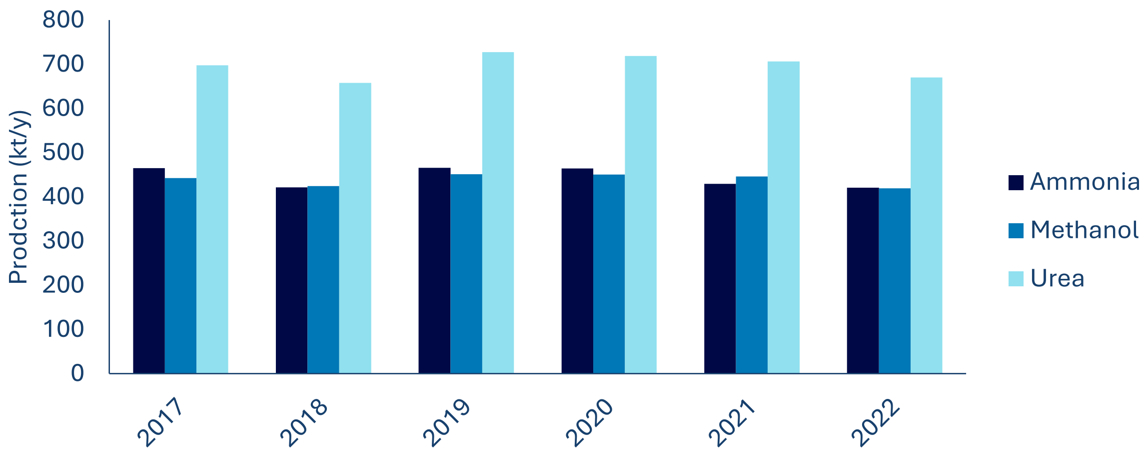

Figure 16: Annual production of Ammonia, Methanol, and Urea

4. Iron and Steel Production

The Iron and Steel production process in Bahrain is illustrated in Figure 17:

- **The pellet production plant** converts iron ore fines into agglomerated, indurated pellets "iron ore pellets".
- **The DRI plant** has a designed capacity of 1.5 million tonnes a year. The facility can produce hot DRI for in-house consumption, and cold DRI for the market.
- **The Melt Shop** has a design capacity of 0.97 million tonnes a year. It employs Electric Arc Furnace (EAF) technology.

- **The Heavy Section Mill** is a computer-controlled facility with a designed capacity output of 0.6 million tonnes a year.

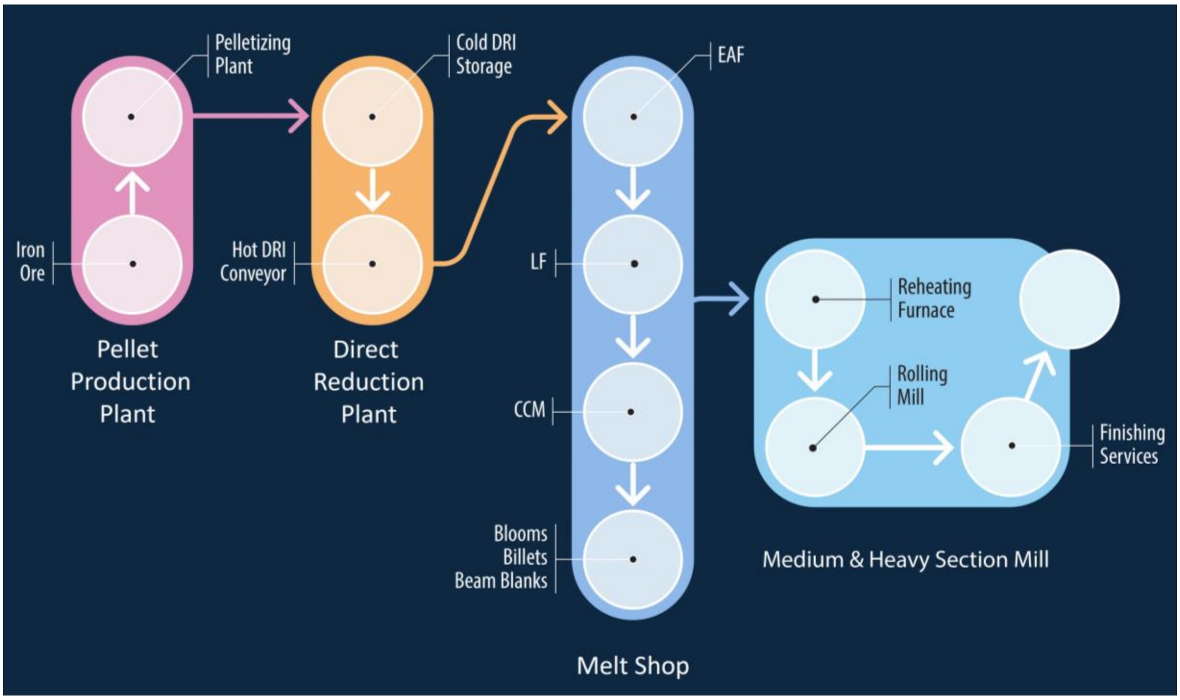

Figure 17: Illustration of the iron and steel production process.

Pellet production, DRP, and EAF are the main sources of IPPU-related GHG emissions in the iron and steel production sector. For example, Figure 18 shows the annual production of pellets.

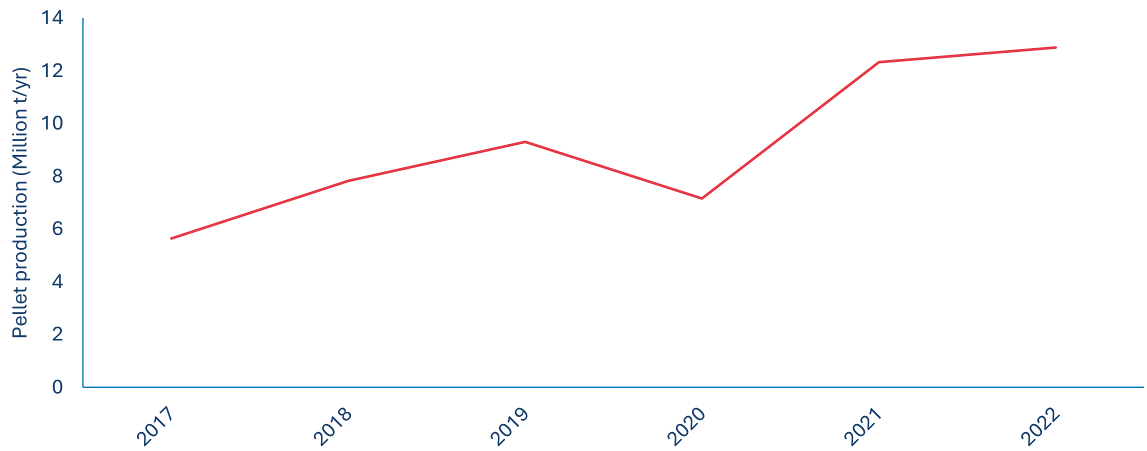

Figure 18: Annual production of pellets.

5. Aluminum Production

The aluminum industry is a cornerstone of Bahrain's economy, with Aluminum Bahrain B.S.C. (Alba) ranking among the largest aluminum smelters worldwide. The industry, which began in 1971 with the establishment of Alba, has since expanded significantly, contributing substantially to the country's GDP, exports, and employment. The latest expansion was commissioned in late 2018, when a new production train was introduced to the operation (Line 6) increasing the overall production capacity from 960,000 to 1,500,000 t/yr. Yet, the actual production exceeded 1,600,000 in the following years as shown in Figure 19.

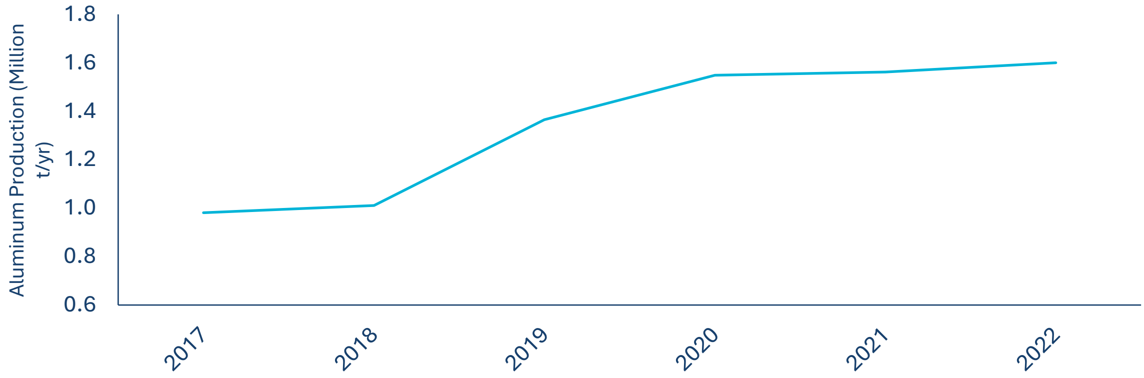

Figure 19: Annual primary aluminum production in Bahrain.

In the context of Bahrain's national GHG emissions, the aluminum industry is a significant contributor. The first part is in the form of CO_2, CH_4, and N_2O emissions from electricity generation, which was reported under *"1- Energy"*. The second part is reported under IPPU in the form of CO_2 and PFCs emitted from the redox reaction that reduces alumina to produce molten aluminum.

6. Refrigeration and Air Conditioning (RAC)

Refrigerants are chemical compounds used in air conditioning, refrigeration (RAC), heat pump and fire-fighting systems to absorb and release heat, enabling temperature regulation. Common RAC applications of refrigerants include residential and commercial air conditioning, industrial refrigeration systems, and automotive cooling systems like vehicles and refrigerated trucks. In the Kingdom of Bahrain, where the climate is predominantly hot and humid, the demand for efficient cooling systems is high, making refrigerants a necessity, rather than a luxury, for maintaining comfort and safety in homes, offices, and industries. Other applications also include foam manufacturing, where some refrigerants are used as a blowing agent in pre-blended polyols to manufacture insulation foams for refrigerators, freezer and cold rooms.

The National Ozone Unit (NOU) at the Supreme Council for Environment plays a critical role in ensuring the country's compliance with the Montreal Protocol. NOU enforces regulations, licensing, monitoring, and gradual phase-out of the controlled substances, promoting the adoption of eco-friendly alternatives with lower environmental impacts.

In 2024, Bahrain officially ratified the Kigali Amendment, whereby it is required to reduce 85% of HFCs consumption by the year 2047 and have an active HCFCs phase-out management plan (HPMP) in place until the year 2040. HCFCs in Bahrain are widely used in the air condition sector, which is easily targeted through national regulations. Such regulations include, for example, bans on the import of large AC systems, such as chillers that are heavily reliant on HCFCs. Other examples of regulation include the continuous update in Minimum Energy Performing Standards (MEPS), supporting a transition away from heavily HCFC-dependent units, fostering a market shift towards more sustainable alternatives.

HFCs also have a wide range of applications, including various types of air conditioning units – such as window, split, package and chiller systems and in-vehicle ACs. They also serve crucial commercial and industrial uses, in display cabinets, cold rooms and refrigerated trucks that transport perishable goods. Moreover, HFCs have also replaced halons in fire-fighting applications, where they are used in fire suppression systems, particularly in data centers, telecommunications facilities, museums, and other sensitive environments where asset protection is crucial. Similarly to other sectors, the RAC sector has expanded over the past few years due to increased demand corresponding to population growth and industrial development.

2.2.3.3 Methodology

1. Cement Production

Activity data including annual clinker and cement production data, as well as the average fraction of Calcium Oxide (CaO) from carbonate, were collected from the industries for 2017-2022. The emission factor for clinker production was calculated using IPCC equation 2.4 (Tier 1), while the emissions were calculated using IPCC equation 2.2 (Tier 2) and IPCC default emissions correction factor for Cement Kiln Dust (CKD). As discussed in the previous section, no clinker production has taken place since Q1 2017, therefore there are no process-related emissions from cement production after 2017.

2. Glass Production

Activity data including annual glass production data, cullet ratio, and natural gas consumption were collected from the industries for 2017-2022. Using natural gas consumption data and IPCC default emission factors for CO_2 content (i.e., 56,100 Kg CO_2/TJ), an industry-specific emission factor was estimated (i.e., Kg CO_2/Kg glass produced). IPCC equations 2.10 and 2.11 were used to estimate GHG emissions from glass production (Tier 2).

3. Ammonia Production and Methanol Production

Activity data, including annual production data for ammonia, methanol, and urea, annual natural gas consumption by product (including LHV and carbon content data), CDR unit production data, CO_2 consumed in Urea production, and CO_2 consumed in Methanol Production were collected from the industries for the 2017-2022 period.

- **For CO_2 emissions from ammonia production,** activity data were used to calculate industry-specific parameters and emission factor (Tier 2) for IPCC equations 3.1,3.2, 3.3, and 3.4 such as feedstock fuel for ammonia production (in GJ/tonne ammonia produced), carbon content of fuel (Kg C/GJ). IPCC default value for the Carbon oxidation factor was used.

- **For CO_2 emissions from methanol production,** a similar approach was implemented to calculate industry-specific emission factor (Tier 2) for IPCC equation 3.15 (i.e., tonne CO_2/tonne methanol produced).

- **For CH_4 emissions from methanol production,** an IPCC default emission factor of 2.3 kg CH_4/ tonne methanol produced was used (Tier 1).

4. Iron and Steel Production

Activity data including annual production data and natural gas consumption were collected from the industries for 2017-2022. Due to the complexity of higher-tier methods for this sector and the lack of the required activity data, IPCC default emission factors were used, except for pellet production, to estimate GHG emissions from the iron and steel industry using IPCC equations 4.12, 4.13, and 4.14.

5. Aluminum Production

Activity data, including production and type of technology, were obtained from industries for the reporting period (2017-2022). All production trains were operated under "CWPB - $PFPB_L$" technology for the entire reporting period. Tier 1 from IPCC methodology was applied to compute the emissions from this sector as follows:

- **CO_2:** Equation 4.20 and default emission factor from table 4.10 (1.6 tonnes CO_2 / tonne Al), from 2006 IPCC guidelines.

- **CF_4:** Equation 4.25-Updated and default emission factor from table 4.15-updated (0.016 kg CF_4/tonne Al), from 2019 IPCC refinement.

- **C_2F_6:** Equation 4.25-Updated and default emission factor from table 4.15-updated (0.001 kg C_2F_6/tonne Al), from 2019 IPCC refinement.

6. Refrigeration and Air Conditioning (RAC)

This section provides an estimate of GHG emissions resulting from the use of fluorinated substitutes for ozone-depleting substances (ODS) using the IPCC Tier 1 methodology. This approach relies on annual sales data at the national level, which ultimately reflects imports, as Bahrain does not manufacture or export these chemicals. The data on imports is provided by NOU.

Due to the lack of breakdown of these gases by application, emissions from this sector are grouped and reported under *"2.F.1 Refrigeration and Air Conditioning"*. Moreover, the same assumption was applied to the whole sector to compute the emissions as follows:

- **The assumed equipment lifetime is 15 years,** which is considered an average value as it can vary from less than 5 years to more than 30 years depending on the application and sector.
- **20% emission factor from installed base** which is relatively high, due to the high ambient temperature in the country.
- **0% of gas is destroyed at the end of life.**

2.2.4 Waste Sector

2.2.4.1 Overview

As per the IPCC, the Waste Sector in Bahrain encompasses the following sub-sectors:

1. Solid Waste Disposal (SWD)
2. Biological Treatment of Solid Waste (BToSW)
3. Waste Incineration (WI)
4. Wastewater Treatment and Discharge (WWT&D)

Historically, Municipal Solid Waste (MSW) landfilling was the dominant waste management practice in Bahrain, a major source of CH_4 emissions. However, as part of Bahrain's Waste Management Strategy developed between 2017 and 2019, other waste management practices are being implemented and gradually expanding such as recycling and composting. The strategy aims at improving waste management practices in Bahrain, especially MSW, due to limited landfill capacity, limited land availability, and to ensure sustainable waste management in Bahrain.

Other waste management practices, such as waste incineration, are applied primarily for clinical waste and some industrial hazardous waste and WWT sludge. Moreover, all the generated wastewater in Bahrain is collected and treated primarily in centralized Wastewater Treatment Plants (WWTPs) and mainly discharged to the sea (up to 85% discharge and ~15% reuse).

Further details on these sub-sectors are discussed in the following section.

2.2.4.2 Source Category Description

1. Solid Waste Disposal (SWD)

As shown in Table 4, SWD is the main source of GHGs in the waste sector due to the historical dominance of landfilling practice. There are two landfills in Bahrain:

- **Askar Landfill,** in which operations commenced in 1986. The landfill covers a significant footprint (estimated at 400 ha) and is relatively shallow, with depth estimates varying between 5 to 20 meters. The site is currently the primary disposal point for most wastes generated in Bahrain and is dedicated solely to MSW and Non-Hazardous Industrial Waste (NHIW), which is mainly Construction and Demolition Waste (C&D). Before Askar Landfill, Wadi Al-Buhair Site was the primary disposal point, which is assumed to be unmanaged shallow SWDS. This site has been closed and remediated to comply with environmental regulations and is now utilized for residential and commercial activities.

- **Hafira Hazardous Industrial Landfill,** in which operations commenced in 2001. The landfill is spread over a 150,000 m2 area and has an estimated volume of 746,000 m3. The site consists of three primary cells with associated leachate evaporation ponds, and is constructed of a basal geotextile underlay, 1.5mm liner and covering sand layer. It is dedicated only to Hazardous Industrial Waste (HIW) and Sludge.

All the MSW generated in Bahrain is collected and managed by the Ministry of Municipalities Affairs and Agriculture (MoMAA) in partnership with private service providers for the provision of waste collection services. Bahrain is making remarkable strides in improving its waste management system, with a strong emphasis on sustainability and reducing environmental impact. Bahrain's approach includes an integrated mix of landfilling, recycling, and composting, each designed to enhance resource efficiency and protect the environment:

- **Landfilling:** Landfilling remains the dominant waste management method in Bahrain to date. However, Bahrain is actively working on reducing its dependence on landfills through increased recycling and composting. Furthermore, Bahrain is exploring innovative waste-to-energy technologies, which will help transform waste into renewable energy, further reducing the environmental footprint of landfilling.

- **Recycling:** Bahrain has taken significant steps to boost recycling efforts across the nation. With an increasing awareness of environmental issues. Bahrain has rolled out several initiatives to encourage the separation of recyclable materials such as paper, plastic, and metal. The establishment of dedicated recycling centers and the expansion of curbside collection programs have made it easier for residents and businesses to participate. Through these efforts, Bahrain is steadily improving its recycling rates, with the aim of reducing the amount of waste sent to landfills.

- **Composting:** To increase landfill diversion, MUN commissioned a pilot unit in 2018 with a total capacity of 10 tonnes per day, using windrow composting to treat garden and park waste and produce fertilizer for agricultural use.

Furthermore, between 2017 and 2022, MoMAA conducted a comprehensive waste characterization survey(3) to analyze and audit the composition of municipal solid waste (MSW) in Bahrain in detail. A similar, though less detailed, survey had been conducted earlier in 2003. The results from both surveys were summarized and reclassified to align with the IPCC waste composition categories, as illustrated in Figure 20.

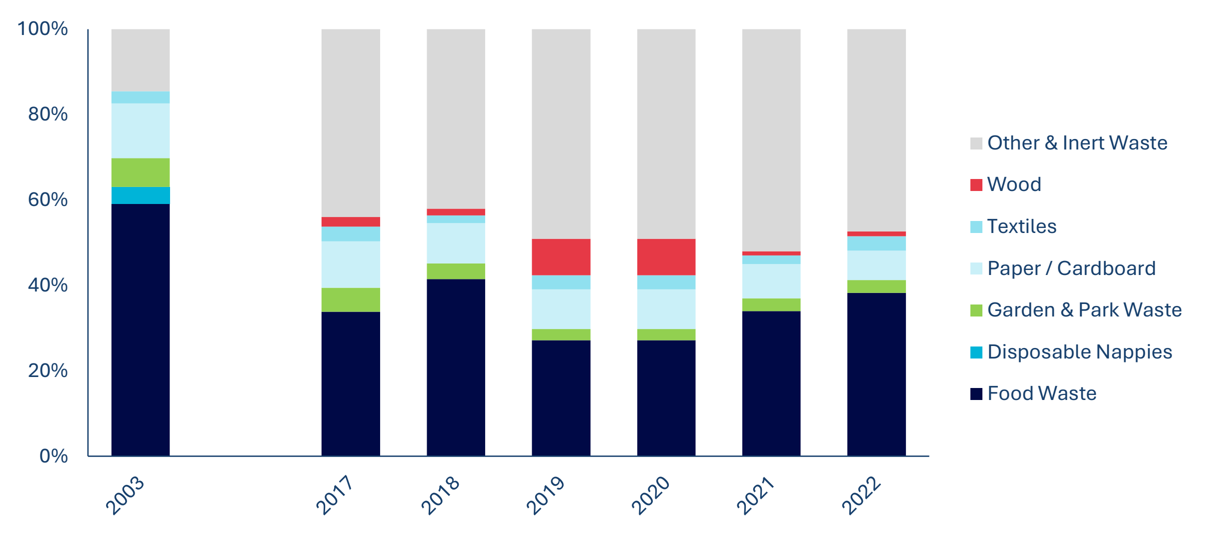

Figure 20: Composition of MSW in Bahrain.

The category “Other & Inert Waste” in the figure above includes plastics, glass, metals, electrical and electronic waste, and other miscellaneous/residual waste.

2. Biological Treatment of Solid Waste

Starting in 2018, MUN commissioned a pilot unit with a total capacity of 10 tonnes per day, using windrow composting to treat garden and park waste and produce fertilizer for agricultural use. Between 2018 and 2022, the unit was utilized at 9%- 28% of its capacity.

3. Waste Incineration

Waste Incineration is applied primarily for clinical waste and part of the industrial hazardous waste and WWT sludge. Industries generating hazardous waste are responsible for the management of their waste streams (e.g., collection and treatment) in cooperation with private service providers and under the supervision of the Waste Management Section at the SCE. Hazardous waste in Bahrain is typically treated by either: incineration (e.g., clinical waste and sludge), or Autoclave then landfilling (e.g., clinical waste and sludge).

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(3) Due to the COVID-19 pandemic, no waste characterization survey was conducted in 2020. Therefore, the municipal solid waste (MSW) composition for 2020 is assumed to be the same as that of 2019.

4. Wastewater Treatment and Discharge (WWT&D)

Domestic Wastewater Treatment Plants (WWTPs) are regulated and mainly operated by the Ministry of Works (MoW) in partnership with the private sector. There are 17 domestic WWTPs in Bahrain treating all the domestic wastewater, and wastewater from small-medium industries (approximately 96% of the inflow to WWTPs is domestic wastewater). The total design capacity of those plants is more than 370,000 m^3/d, of which three are large-centralized WWTPs accounting for ~91% of the total design capacity, namely: Tubli WWTP (~200k m^3/d, currently undergoing expansion to double its capacity); Muharraq WWTP (100k m^3/d); and Madinat Salman WWTP (40k m^3/d).

All the large-centralized WWTPs and the vast majority of decentralized WWTPs are treating wastewater to a tertiary level and producing water for reuse, mainly in irrigation and landscaping. Large industries such as O&G, petrochemicals, and aluminum have their industrial WWTPs to treat industrial effluents and discharge to the sea as per SCE's effluent discharge standards.

2.2.4.3 Methodology

1. SWD, BToSW, and WI

The First Order Decay (FOD) method is used to estimate emissions from SWD. To run the FOD model, a comprehensive waste model for Bahrain covering years between 1970 to 2022 was prepared by the CCSD using:

- Activity data collected from MoMAA, iGA, and SCE's waste management section, including statistics on:
    - Municipal waste collected from households (MSW) between 2000-2022
    - Municipal waste collected from other origins (commercial & NHIW) between 2000-2022
    - Waste management methods (recycling, composting, incineration, landfilling, other) between 2000-2022.
    - Composition of MSW sent to landfill between 2017-2022 and landfill type.
    - Sludge generated and management method between 2020-2022.
    - Hazardous industrial waste generated and management methods between 2017-2022 and landfill type.
    - Population (1991-2022) and GDP (2011-2022)
- Proxy data used to estimate activity data back to the year 1970 including:
    - Population 1970-1990 from the UN Stats website
    - GDP 1970-2010 from UN Stats website

- Estimated Generation rates per capita for MSW, sludge, and medical hazardous waste (based on collected activity data)
- Generation rates per GDP for non-hazardous and hazardous industrial waste (estimated based on collected activity data)

Historical data for population and GDP used in the model are shown in Figure 21.

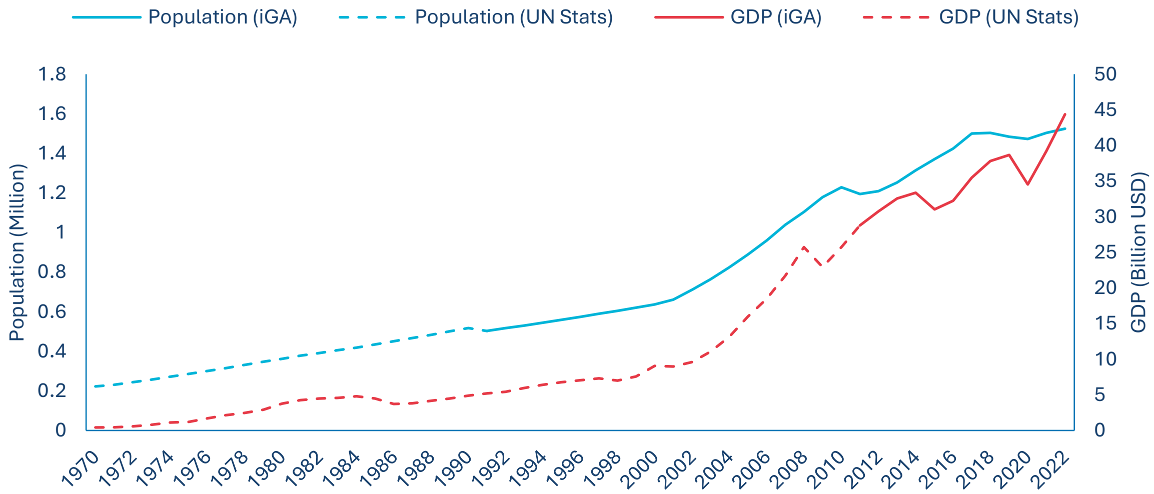

Figure 21: Historical data for population and GDP.

Using the activity and proxy data discussed above, waste quantities by type were estimated as illustrated in Figure 22.

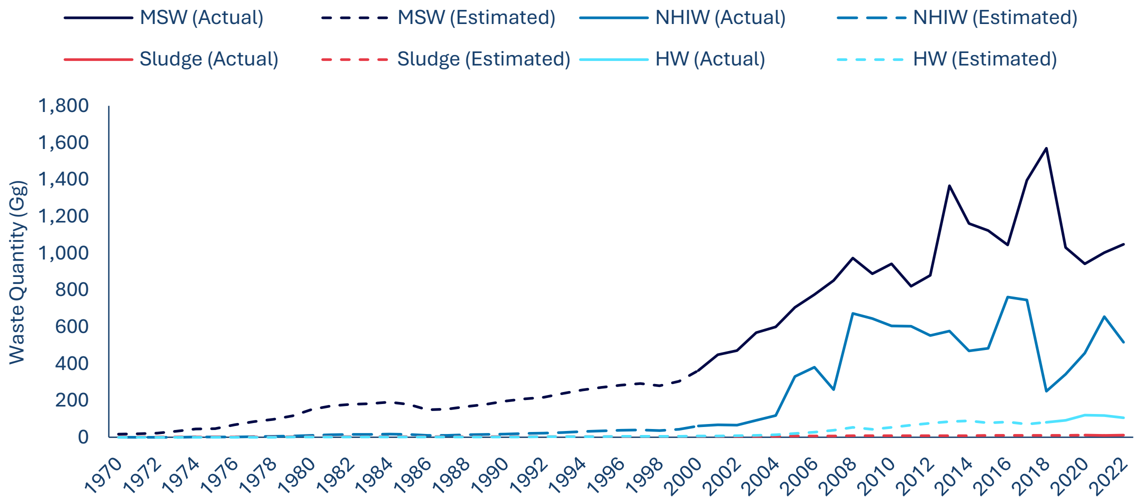

Figure 22: Historical data for waste generation by type.

The waste model's output (i.e., activity data) was fed into the IPCC software, and default Emission Factors (EFs) were used to estimate emissions from SWD, BToSW, and WI.

2. WWT&D

Activity data was collected from the iGA, large industries, and SCE's Environmental Inspection Section, including statistics on:

- Population (1991-2022) and percentage of the population connected to wastewater network (2000-2021) to determine the income group (Urban low vs. Urban high)
- List of WWTPs with their capacities, treatment technology, average discharge volumes, and effluent quality (e.g., BOD)
- List of industries and volume of their treated wastewater discharge into marine (as shown in Figure 23), treatment technology, sludge volume, and effluent quality (e.g., COD and N)

Proxy data used includes:

- Annual per capita protein consumption from FAOSTAT.com to estimate N2O emissions from domestic WWTPs.

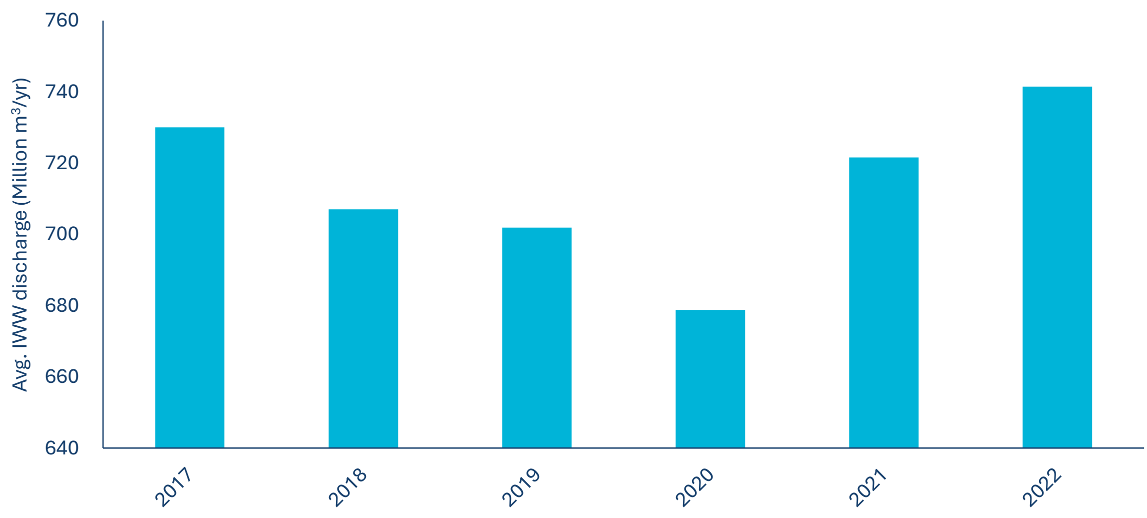

Figure 23: Average volume of treated industrial WW discharged in the sea.

The collected activity data was fed into the IPCC software, and default emission factors were used to estimate emissions from WWT&D.

2.2.5 Agriculture, Forestry and Other Land Use (AFOLU) Sector

The agriculture sector in Bahrain plays a relatively small role in the national economy, contributing primarily through crop production, livestock farming, and aquaculture. Due to its arid climate, Bahrain faces significant challenges such as water scarcity, salinization, and limited arable land, which constrain agricultural activities. According to the land use statistics by the Urban Planning and Development Authority (UPDA), around 3.17% of the total land area is classified as agriculture areas.

"*3.A – Livestock*" was estimated using the Tier 1 approach, using livestock statistics provided by iGA, including cattle, sheep, goats, camels, horses and poultry. *"3.C.3 – Urea application"* was estimated based on annual urea local sales provided by the petrochemical industries. Other AFOLU sub-categories, including the entire LULUCF sub-category, are considered insignificant, as their emissions are likely to be below 0.05% of the national total. Accordingly, these sub-categories are not estimated.

2.3 Key Category Analysis (KCA)

Key Category Analysis (KCA) was conducted following the 2006 IPCC Guidelines, employing both Level and Trend Assessment approaches for the initial and most recent reporting years of the inventory. Emissions from the LULUCF sector were not estimated due to their insignificance, as outlined in paragraph 32 of decision 18/CMA.1 annex. Consequently, the KCA results are identical with and without the inclusion of LULUCF. Table 8, Table 9, and Table 10 present the key categories identified in both level and trend assessments for the starting and latest inventory years.

Table 8: Key Category Analysis - Level Assessment for Year 2017

IPCC Category	GHG	| 2017 emissions | Gg CO_2e	% of total	Cumulative % of total
1.A.1 Energy Industries - Gaseous Fuels	CO2	14,003	41.6%	41.6%
1.A.2 Manufacturing Industries & Construction - Gaseous Fuels	CO2	7,814	23.2%	64.8%
1.A.3.b Road Transportation - Liquid Fuels	CO2	2,934	8.7%	73.5%
1.B.2.b Natural Gas	CH4	1,578	4.7%	78.2%
2.C.3 Aluminum production	CO2	1,570	4.7%	82.9%
2.C.1 Iron and Steel Production	CO2	1,317	3.9%	86.8%
4.A Solid Waste Disposal	CH4	1,129	3.4%	90.2%
2.F.1 Refrigeration and Air Conditioning	HFCs, PFCs	699	2.1%	92.2%
1.A.5 Non-Specified - Liquid Fuels	CO2	688	2.0%	94.3%
2.B.1 Ammonia Production	CO2	278	0.8%	95.1%
All remaining categories	Multiple	1,646	4.9%	100.0%
Total GHG emissions (Gg CO_2e)	**Multiple**	**33,656**	**100%**	**n/a**

Table 9: Key Category Analysis - Level Assessment for Year 2022

IPCC Category	GHG	| 2022 emissions | Gg CO_2e	% of total	Cumulative % of total
1.A.1 Energy Industries - Gaseous Fuels	CO2	13,716	35.4%	35.4%
1.A.2 Manufacturing Industries & Construction - Gaseous Fuels	CO2	10,554	27.2%	62.6%
1.A.3.b Road Transportation - Liquid Fuels	CO2	3,156	8.1%	70.7%
2.C.3 Aluminium production	CO2	2,560	6.6%	77.3%
2.C.1 Iron and Steel Production	CO2	1,911	4.9%	82.2%
1.B.2.b Natural Gas	CH4	1,852	4.8%	87.0%
2.F.1 Refrigeration and Air Conditioning	HFCs, PFCs	1,228	3.2%	90.2%
4.A Solid Waste Disposal	CH4	1,165	3.0%	93.2%
1.A.5 Non-Specified - Liquid Fuels	CO2	589	1.5%	94.7%
1.B.2.b Natural Gas	CO2	320	0.8%	95.5%
All remaining categories	Multiple	1,735	4.5%	100.0%
Total GHG emissions (Gg CO_2e)	**Multiple**	**38,787**	**100%**	**n/a**

Table 10: Key Category Analysis - Trend Assessment for Years 2017-2022

IPCC Category	GHG	2017 emissions Gg CO_2e	2022 emissions Gg CO_2e	Trend Assessment	Contribution to trend	Cumulative % of total
1.A.1 Energy Industries - Gaseous Fuels	CO2	14,003	13,716	7.2%	36.1%	36.1%
1.A.2 Manufacturing Industries & Construction - Gaseous Fuels	CO2	7,814	10,554	4.6%	23.1%	59.2%
2.C.3 Aluminum production	CO2	1,570	2,560	2.2%	11.2%	70.4%
2.F.1 Refrigeration and Air Conditioning	HFCs, PFCs	699	1,228	1.3%	6.3%	76.7%
2.C.1 Iron and Steel Production	CO2	1,317	1,911	1.2%	5.9%	82.6%
1.A.3.b Road Transportation - Liquid Fuels	CO2	2,934	3,156	0.7%	3.4%	85.9%
1.A.5 Non-Specified - Liquid Fuels	CO2	688	589	0.6%	3.0%	89.0%
1.B.2.b Natural Gas	CO2	159	320	0.4%	2.0%	91.0%
4.A Solid Waste Disposal	CH4	1,129	1,165	0.4%	2.0%	93.0%
2.B.8 Petrochemical and Carbon Black Production	CO2	269	243	0.2%	1.0%	94.0%
1.B.2.a Oil	CH4	239	214	0.2%	0.9%	95.0%
All remaining categories	Multiple	2,835	3,130	1.0%	5.1%	100.0%
Total GHG emissions (Gg CO_2e)	**Multiple**	**33,656**	**38,787**	**19.9%**	**100%**	**n/a**

2.4 Uncertainty Assessment, Time-series Consistency, QC and Verification

As the national actor with overall responsibility for compiling the national GHG inventory, the CCSD engaged in various Qualitative Control (QC) procedures throughout the compilation process to enhance data reliability. These procedures included technical reviews of categories, activity data, emission factors, and estimation parameters, as well as identifying reporting errors, cross-checking data sources, and analyzing supply and demand balances. Data verification involved comparing internal calculations with those from data providers. A more detailed discussion of QC and verification procedures can be found in Section 1.3.

Furthermore, the CCSD conducted a qualitative uncertainty assessment for each GHG category in the inventory. There is high confidence in the accuracy of the activity data. Comparisons were made between data sets obtained from data providers and the iGA. As the centralized national data collection agency, the iGA has well-established data collection procedures and networks. National statistics on consumption and production of different sectors were also compared with the sectoral aggregates obtained from individual data providers.

To ensure time-series consistency, the same methodology and data sources were used to calculate emissions and removals in all years across the reporting period (2017-2022). There is no use of surrogate data nor interpolation or extrapolation of activity data except for historical waste quantities, whereby data was extrapolated. To ensure the accuracy of this extrapolated data, splicing techniques were applied.

2.5 Common Reporting Tables (CRTs)

The Common Reporting Tables (CRTs) of the national inventory greenhouse gases report are included in "Annex 1: Common Reporting Tables (CRTs)" of this report.

Industrial facility in Bahrain
Photo by BE

Chapter 3

Information Necessary to Track Progress Made in Implementing and Achieving NDCs

3. CHAPTER 3: Information Necessary to Track Progress Made in Implementing and Achieving NDCs

3.1 Description of Bahrain's NDC

In 2021, Bahrain submitted an updated Nationally Determined Contribution (NDC) to the UNFCCC in demonstration of its dedication towards strengthening the collective global response to climate change and climate change impacts.

Bahrain focused its NDC on adaptation actions and economic diversification measures with mitigation co-benefits. This approach recognizes Bahrain's unique circumstances as a small, low-lying island developing state that is also reliant on the income generated from its energy sector. It also acknowledges that Bahrain is vulnerable not only to the adverse impacts of climate change but also to the potential impacts of response measures. By focusing on adaptation actions and economic diversification measures with mitigation co-benefits, Bahrain intricately balances achieving the objectives of the Paris Agreement as well as the broader goals of sustainable development.

The plans and activities set out in Bahrain's NDC relate to four key areas:

- The National Renewable Energy Action Plan (NREAP)
- The National Energy Efficiency Action Plan (NEEAP)
- The National Plan for Afforestation
- Mangroves Habitats

In its NDC, the Kingdom of Bahrain highlighted that the domestic actions it has communicated are voluntary in nature and are to be implemented in accordance with UNFCCC principles and provisions. It also highlighted that the extent to which it will be able to meet its obligations also highly depends on the level of international support in means of implementation, including finance, technology transfer, and capacity-building.

Moreover, Bahrain's NDC reserves the right to engage in voluntary cooperation and cooperative approaches that involve the use of internationally transferred mitigation outcomes (ITMOs) as per Article 6 of the Paris Agreement. For the Kingdom of Bahrain, such cooperation and cooperative approaches will be multi-metric in their nature and include not only GHG but also other related parameters such as renewable energy, energy efficiency etc. The Kingdom has not engaged in any such approaches in the reporting period covered by this Biennial Transparency Report.

A general description of Bahrain's NDC is provided in Table 11. Details on the progress made with respect to each NDC activity are provided in the sections that follow. This information should be read in conjunction with the corresponding Common Tabular Format (CTF) tables (See Annex 2).

Table 11: Description of Bahrain's NDC

Target(s) and description, including target type(s), as applicable	The economic diversification plans with mitigation co-benefits communicated in the NDC focus on the energy sector and include contributions relating to renewable energy and energy efficiency. These contributions are set out in the National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP), and include: **Contribution 1: National Energy Efficiency Plan** Reduction in energy consumption (i.e. electricity consumption) by 6% in 2025 **Contributions 2.1 and 2.2: National Renewable Energy Action Plan** • 2.1: Total installed renewable energy capacity equal to 5% by 2025 • 2.2: Total installed renewable energy capacity equal to 10% by 2035 The adaptation actions with mitigation co-benefits included in the NDC encompass contributions related to afforestation and mangroves. The contributions relating to this area are as follows: **Contribution 3: The National Plan for Afforestation** Increase the number of trees from 1.8 million to 3.6 million trees by 2035 **Contribution 4: Mangrove Habitats** Plant 1.6 million mangrove seedlings by 2035
Target year(s) or period(s), and whether they are single-year or multi-year target(s), as applicable	**Contribution 1: National Energy Efficiency Plan** Single year – 2025 **Contributions 2.1 and 2.2: National Renewable Energy Action Plan** Multi-year 2.1 = 2025, 2.2 = 2035 **Contribution 3: The National Plan for Afforestation** Single year – 2035 **Contribution 4: Mangrove Habitats** Single year – 2035

Table 11: Description of Bahrain's NDC

Reference point(s), level(s), baseline(s), base year(s) or starting point(s), and their respective value(s), as applicable	**Contribution 1: National Energy Efficiency Plan** Reference period = 2009-2013 Reference point = 0% Starting point = 2017 **Contributions 2.1 and 2.2: National Renewable Energy Action Plan** Reference year = 2010 Starting point = 2017 **Contribution 3: The National Plan for Afforestation** Reference year = 2021 Starting point = 2022 **Contribution 4: Mangrove Habitats** Reference year = 2021 Starting point = 2022
Time frame(s) and/or periods for implementation, as applicable	**National Energy Efficiency Plan and National Renewable Energy Action Plan** The NEEAP and NREAP were both launched in 2017. **The National Plan for Afforestation and Mangrove Habitats** Implementation towards doubling the number of trees and planting 1.6 million mangrove seedlings in Bahrain commenced in 2022. The timeframe for reporting and tracking these contributions is 2021-2035.
Scope and coverage, including, as relevant, sectors, categories, activities, sources and sinks, pools and gases, as applicable	**Scope:** National level **Sectors:** Energy Sector, Forestry Sector, Cross-cutting
Intention to use cooperative approaches that involve the use of ITMOs under Article 6 towards NDCs under Article 4 of the Paris Agreement, as applicable	The Kingdom of Bahrain will consider voluntary cooperation and cooperative approaches that involve the use of ITMOs as per Article 6 of the Paris Agreement. These will be multi-metric in their nature and include parameters such as renewable energy, energy efficiency and adaptation measures.

3.2 National Circumstances and Institutional Arrangements

The national circumstances, institutional arrangements and legal frameworks related to tracking progress in implementing and achieving NDCs are described under Chapter 1.

As detailed in Section 1.3, the Climate Change and Sustainable Development Directorate (CCSD) within the SCE is the technical body responsible for climate change-related matters, focusing on both climate mitigation and adaptation. In this role, the CCSD tracks progress on NDC-related activities by collecting data directly from the entities responsible for their implementation. Where such activities fall within the SCE's mandate, the information necessary to track progress is obtained internally. The data providers for this specific chapter include the Ministry of Municipalities Affairs and Agriculture and the Ministry of Electricity and Water Affairs.

Furthermore, it is important to note that each NDC activity has its own institutional arrangements and oversight processes. These arrangements are further elaborated on in the sections dedicated to each respective activity.

3.3 Information Necessary to Track Progress Made in Implementing and Achieving NDCs

3.3.1 Economic Diversification Plans with Mitigation Co-Benefits

Bahrain's NDC sets out the National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP) as economic diversification plans with mitigation co-benefits. Both plans were developed in 2017 by the Sustainable Energy Unit (SEU).

The SEU was initially established in November 2014 as a joint initiative between the Government of Bahrain, represented by the Ministry of Electricity and Water Affairs (MEWA), and the United Nations Development Program (UNDP). The key objectives of the SEU unit were to develop a cohesive and sustainable energy policy and to promote renewable energy and energy efficiency in the Kingdom of Bahrain. The Unit also worked towards bridging the legal, institutional, and capacity gaps to ensure the Bahrain energy sector is capable to meet future challenges.

In 2021, the SEU transitioned to become the Sustainable Energy Authority (SEA) as per Royal Decree No. 87 of 2019. Further to that, in January 2022, Royal Decree No. 3 of 2022 was issued, transferring the tasks and powers of the SEA to the Ministry of Electricity and Water Affairs (MEWA). The MEWA, through the General Directorate of Energy Efficiency (GDEE), has since become the entity mandated to lead and promote energy efficiency practices, transfer and diffuse renewable energy technologies, and draft related policies and regulatory frameworks in close coordination with stakeholders and partners in the Kingdom of Bahrain.

The GDEE works to provide technical support and coordination between governmental and non-governmental agencies for renewable energy and energy efficiency initiatives, and follows up on the implementation of the policies, projects, and initiatives under the National Renewable Energy Action Plan (NREAP) and National Energy Efficiency Action Plan (NEEAP).

The Implementation Follow-Up Committee (IFC), chaired by the Minister of Electricity and Water Affairs and composed of officials from various Ministries and government agencies, discusses the progress of implementing these action plans and initiatives. Committee members include representatives from the Ministry of Works, the Ministry of Industry and Commerce, the Ministry of Transportation and Telecommunications, the Ministry of Housing and Urban Planning, the Electricity and Water Authority, the Capital Municipality, the Ministry of Finance and National Economy, the Ministry of Oil, the Prime Minister's Office, and the Supreme Council for Environment.

3.3.1.1 National Energy Efficiency Action Plan (NEEAP)

Launched in 2017, the NEEAP sets a national target of reducing energy consumption (i.e., electricity consumption) by 6% in 2025 and identifies various initiatives to improve energy efficiency. In its pursuit of enhanced energy efficiency, the NEEAP offers a range of benefits, including promoting more efficient electricity use, optimizing the use of natural resources, reducing peak electricity demand, and improving energy security in the long-term. In this context, energy efficiency means using less energy for the same output or service, and in some cases, this can also improve the service itself. For example, replacing traditional incandescent lamps with energy-efficient LEDs lowers electricity consumption and thus lowers GHG emissions, while also providing higher quality lighting.

In setting the NEEAP target, the SEU based its analysis on EWA's projected electricity demand for the years 2020 and 2030, considering three growth scenarios (low, medium, and high), starting from 2013. The projected electricity demand took into consideration projections of population growth, economic development, and the expansion of industries connected to the national grid. The targeted 6% reduction of electricity consumption represents the savings achieved in comparison to the projected electricity demand in the medium scenario.

This target is based on Bahrain's energy balance statistics compiled by the International Energy Agency (IEA) on the cumulative amount of electricity consumed between 2009-2013 (i.e., five years), which is equivalent to 96,527 GWh.

The indicator selected to track progress in implementing and achieving the NEEAP under the BTR is the **percentage reduction in actual electricity consumption**. This indicator is relevant to the NDC contribution as it tracks progress towards achieving NEEAP's target and reflects improvements in energy efficiency, demonstrating the effectiveness of measures taken to reduce electricity consumption, without degrading the quality of the final service or product.

This indicator is calculated as follows:

$$\% \, \mathbf{REC}_{\mathbf{Year\,x}} = \frac{\left(\mathbf{EC}_{\mathbf{Projected,\;Year\,x}} - \mathbf{EC}_{\mathbf{Actual,\;Year\,x}}\right)}{\mathbf{96,527\;GWh}} \times \mathbf{100\%}$$

Where:

- *REC means Reduction in Electricity Consumption in %*
- $EC_{Projected,\;Year\,x}$ *means projected electricity consumption in year x under the NEEAP in GWh*
- $EC_{Actual,\;Year\,x}$ *means actual electricity consumption in year x in GWh*
- *96,527 GWh is the cumulative amount of EC between 2009-2013*

The target level for this indicator is set at 6% reduction, in line with the NEEAP target. The 6% reduction target is equivalent to 5,792 GWh saved in 2025.

Based on this indicator, electricity consumption was reduced by 2.41% in 2021. This number increased to 3.03% in 2022, equivalent to 2,922 GWh reaching approximately half of the target level of 6%.

Bahrain has made notable progress in enhancing energy efficiency, with key contributions resulting from major reforms in electricity production and upgrades in the industrial sector. A range of policies that enhance energy efficiency across various sectors have also been implemented over the years. These efforts primarily focus on the electricity sector, the building sector, and appliance regulation, each targeting specific areas for optimization. A summary of these reforms and policies are summarized below.

Electricity Production Reform

With regards to electricity production, reforms have involved retiring old facilities, upgrading existing technology and establishing new power stations. For example, Sitra power station, which commenced operations in 1975, was retired in 2021. In the same year, Riffa power station ceased operations and was transitioned to a stand-by facility, with a downscaled capacity of 450 MW from 700 MW. These are significant developments as the combined capacity of both facilities – totaling 850 MW – previously accounted for over 30% of installed capacity of electricity generation infrastructure, prior to the commissioning of new facilities in 2009.

Additionally, two new power stations have been gradually introduced to the electricity supply between 2010 and 2022 – namely Al-Dur 1 and Al-Dur 2 – in the south of the country. These two power stations have a total capacity of 2,724 MW and amount to more than 50% of the current installed capacity. These measures, along with the upgrades in the other existing facilities, have contributed to significantly enhancing the efficiency of electricity production in the Kingdom, as evidenced in Figure 24.

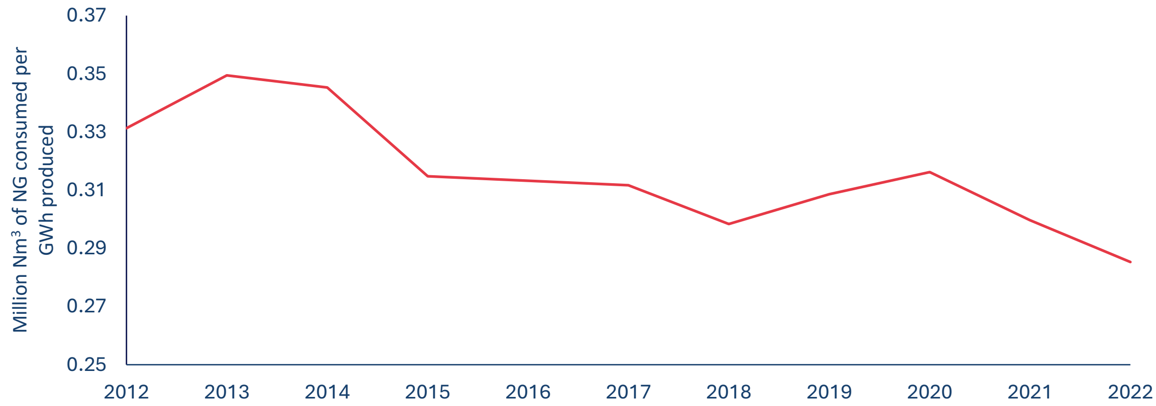

Figure 24: Energy intensity of main electricity production in Bahrain.

In the industrial sector, developments in energy production have contributed to energy efficiency efforts. A prime example is that of Alba (Aluminium Bahrain B.S.C.), a local aluminum smelter that currently contributes to approximately one third of national GHG emissions. In 2018, Alba expanded its operations by increasing its capacity by 50% after constructing a sixth potline in what is known as the 'Line 6 Expansion Project'. Parallel to this expansion, in 2018, Alba launched the operation of a new 1,792 MW power station that uses a highly efficient generator and shut down two older power stations in 2020. This resulted in a significant improvement in Alba's Natural Gas (NG) consumption intensity, which decreased from 8.85 to 7.25 MMBTU/MWh between 2016 and 2022.

Moreover, Bahrain has implemented a range of policies over the years to enhance energy efficiency across various sectors. These efforts primarily focus on the electricity sector, the building sector, and appliance regulation, each targeting specific areas for optimization. These policies are briefly summarized below.

Electricity Policies

Under the electricity sector, Bahrain's Power Factor Correction Program, Smart-Metering Program, and Electricity Transmission and Distribution (T&D) Efficiency Program are three key policies to enhancing energy efficiency.

The objective of the Power Factor Correction Program is to enhance the power factor of electrical installations to achieve a value of 0.9 or higher. The power factor is the ratio of working power to apparent power. A higher power factor leads to a more efficient use of electricity, low voltage drops, and reduced overheating of equipment. This program effectively puts Ministerial Order No. 4/2011 into practice, which mandates the overall power factor for customer electrical installations not fall below 0.9, otherwise the excess reactive power consumption will be calculated based on a power factor value of 0.9. This effectively leads to better utilization of power plants and transmission lines which, in turn, results in improved operational efficiency and energy savings. The program has been applied across industrial, commercial, and government sectors since February 2011. In cases where the power factor is less than 0.9, any excess reactive power used incurs a charge which is included within a monthly customer bill.

The Smart Metering Program deploys smart meters in consumer households, leading to several benefits including more accurate meter reading, more efficient billing, an enhanced ability to manage debtors and a better ability to manage daytime consumption peaks and electricity consumption through the use of real-time pricing. Consumer energy efficiency has undergone a digital transformation, with smart meters now covering approximately 97% of all meters.

Finally, the Electricity T&D Efficiency Program aims to enhance the efficiency of the transmission and distribution system and mitigate losses through network upgrades, capacitor banks, and efficient electricity transfer from generation to consumption. These improvements aim to keep pace with Bahrain’s ongoing economic growth and to establish and modernize infrastructure to ensure the efficiency, reliability, and quality of the country’s electrical system.

Building Sector Policies

A suite of policies targeting the electricity usage of buildings have been rolled out over the years. These policies target residential, commercial and public buildings and include thermal insulation regulations, green building initiatives, and appliance regulations, among others.

Thermal insulation regulations mandating the insulation of buildings above five stories and setting minimum efficiency requirements for residential and commercial building envelopes were introduced in 1999 and amended in 2012 and in 2018. The U-value of roofs and walls has decreased by 50% and 25%, respectively, since the launch of the regulations in 1999. As U-value decreases, the heat flow into the building decreases and insulation increases, thus improving insulation and reducing cooling load requirements. Since 2012, thermal regulations have applied to all air-conditioned building types, including those below five stories. Maximum U-values are specified for roofs, walls, and glass surfaces and all facades, surfaces, and balconies exposed to external weather must also be insulated. Moreover, building permits are not to be issued unless the building’s U-value is approved by EWA.

Moreover, the Green Building Code (GBC), issued in 2019, contributes to improving the performance of buildings by reducing energy and water consumption, in addition to reducing greenhouse gas emissions and improving public health, safety, and well-being in buildings. The GBC aims to set clear guidelines for the design and construction of new buildings in Bahrain to ensure achieving the minimum level of energy efficiency. It focuses on five categories: (1) Environment and Planning; (2) Building Vitality; (3) Energy Efficiency; (4) Water Conservation; and (5) Materials and Resources.

In addition to these efforts, Bahrain is also in the process of developing a Green Public Procurement Manual that requires all ministries and governmental authorities to prioritize sustainable and energy efficient products when purchasing equipment, services, and products.

Appliance Policies

Implementing energy performance standards for households and commercial appliances or equipment used in buildings prevents the needless waste of energy and contributes to reducing energy consumption and associated emissions.

Bahrain is characterized by high temperatures, especially during the summer, when temperatures frequently exceed 40°C. Consequently, a significant part of annual electricity use is attributed to air conditioning and tackling the energy efficiency of air conditioning is of particular importance.

In 2015, Bahrain launched a star labelling program and minimum energy performance standards (MEPS) for small capacity air conditioners. The MEPs set the minimum energy efficiency level that equipment must meet and the energy labelling program rates appliances from 1 to 6 based on their energy performance, with higher star rating indicating higher energy efficiency. The MEPS scheme for air conditioners became mandatory from 2016 and was updated in 2017, and again in 2023. The MEPS scheme and energy labelling program covers all air conditioning used in residential commercial and industrial sectors with nominal capacities less than or equal to 65,00 Btu/h.

In 2023, Bahrain launched MEPs for large capacity air conditioners with a cooling capacity greater than 65,000 Btu/h. The program covers all types of large capacity cooling devices including chillers, Variable Refrigerant Flow (VRFs) and condensing units.

Apart from air conditioners, Bahrain also introduced functional and efficiency requirements for lamps in 2015. The regulation covers various types of lamps, including LED, discharge and filament lamps. The lamp efficiency requirement in the regulation is based on the maximum rated power of the lamp for a given rated luminous flux. In simpler terms, if a lamp can provide higher luminous flux at a lower maximum rated power, it is considered more efficient, as it produces more visible light with less power consumption. Lamps that comply with the lamp efficiency requirement in the regulation can be marketed as energy-saving lamps.

Energy efficiency policies in lighting also include regulations that ban the use of incandescent lamps in Bahrain. Ministerial Order No. 6-14/2013 mandates the replacement of incandescent and halogen lamps in government buildings with energy-efficient alternatives in 2014, and Ministerial Order No. 3/2015 establishes market regulations that effectively phase out the use of incandescent lamps of non-directional household lamps, including when they are marketed for non-household use or when they are integrated into other products.

Transport Sector

Bahrain has strived to enhance energy use in the transport sector by investing in technology and influencing driver behavior and choices.

In 2015, Bahrain made significant investments to improve its public transport network. The country’s bus network was extended and upgraded, with the introduction of new, fuel-efficient, Wi-Fi-enabled buses, making public transportation more accessible, affordable, and convenient. These improvements have expanded coverage to service of a wider percentage of the population, with increased frequency. The number of buses was expanded from 25 to 140, connecting various areas across the Kingdom’s governates through more than 600 bus stops.

In the same year, the Ministry of Industry, Commerce and Tourism promulgated fuel consumption labels, enabling consumers to make more informed decisions and fostering demand for vehicles with better fuel efficiency. Light-duty vehicles weighing less than 2500 kg are required to have a fuel consumption label. The efficiency parameter for the label is kilometers per liter, and fuel consumption is measured according to the New European Driving Cycle (NEDC) or Corporate Average Fuel Economy (CAFE) norms.

In 2021, Bahrain launched electric vehicle regulations to specify the functional, safety, and electrical performance requirements for electric vehicles (EV) and associated charging stations. The regulation applies to all electric vehicles with a weight up to 3500 kg and requires all electrical cars to carry an electrical performance label. The energy efficiency parameter for the label is measured in Wh/km as per standardized test conditions and at a temperature of 45°C outdoor temperature.

To further encourage the uptake of electric vehicles, MEWA is working to issue an EV Strategy and plans to install five of the fastest EV charging station technologies available to date. These state-of-the-art charging stations will be strategically located across all governorates of Bahrain, ensuring that EV users have convenient access to rapid charging facilities.

3.3.1.2 National Renewable Energy Action Plan (NREAP)

Launched in 2017, the NREAP sets national renewable energy targets of 5% and 10% for 2025 and 2035, respectively. These targets were determined based on the projected peak load demand.

In setting the NREAP target, the SEU based its analysis on EWA's projected electricity demand for the years 2020 and 2030, considering three growth scenarios (low, medium, and high), starting from 2013. The projected electricity demand took into consideration projections of population growth, economic development, and the expansion of industries connected to the national grid.

The indicator selected to track progress in implementing and achieving the NREAP under the BTR is the **percentage of renewable energy installed capacity**. This indicator is relevant to the NDC contribution related to the NREAP as it tracks progress towards achieving the NREAP's target. The reference year for this indicator is 2010, whereby the total renewable energy installed capacity was equal to 0 MW. The reference point for this indicator is 0%.

This indicator is calculated as follows:

$$\% \, \boldsymbol{RE}_{\boldsymbol{Installed}, \ \boldsymbol{year\ x}} = \frac{\boldsymbol{RE}_{\boldsymbol{Installed}, \ \boldsymbol{year\ x}}}{\boldsymbol{Demand}_{\boldsymbol{PL}, \ \boldsymbol{year\ x}}} \times \mathbf{100\%}$$

Where:

- $\% \, RE_{Installed, \ year\ x}$ *means the % of renewable energy installed capacity in year x*
- $RE_{Installed\ , \ year\ x}$ *means total installed capacity of renewable energy systems in year x in MW*
- $Demand_{PL, \ year\ x}$ *means the peak load demand in year x in MW (i.e., Grid supplied electricity – does not incluide industry's own generation)*

The renewable energy options identified and prioritized by the NREAP primarily include solar, wind and waste-to-energy. Biomass and geothermal energy are also mentioned as other renewable sources, albeit with no or very limited resource supply potential.

The total percentage of renewable energy installed capacity reached 0.43% in 2021 and nearly tripled in 2022, to reach a total of 1.26%. This percentage encompasses several renewable energy installations across various sectors, including educational, agricultural, healthcare and retail.

Notable projects include the Bahrain International Circuit's solar carpark project, the Royal College for Surgeons of Ireland's solar PV rooftop and carpark installation and Peninsula Farms' ground-mounted solar PV plant. The government sector in Bahrain has also been pro-active, initiating the installation of solar systems on their premises to promote sustainability and reduce electricity costs. In this context, among the successful accomplishments to date has been the installation of solar PV systems on the roofs of numerous government schools.

Several government-led major renewable energy projects are currently under development. These projects include a 72-MW multi-site solar PV project located in Sakhir, which comprises rooftop, ground-mounted, car park solar power systems and EV charging stations at Bahrain International Circuit, the University of Bahrain, Exhibition World Bahrain and Al Dana Amphitheatre, as well as a 100-MW standalone solar power plant in Askar.

The NREAP is underpinned by three key policies that aim to drive progress towards the established renewable energy targets and attract private sector investment in renewable energy technologies. These three policies are: net metering, renewable energy mandates for new buildings and tender-based feed-in tariffs.

Net Metering

The net metering policy enables residential, commercial, and industrial customers to generate and consume electricity on-site by installing renewable energy systems on their premises and exporting the excess electricity to the national grid. Customers are billed for only the 'net' energy used, according to the latest electricity retail tariffs approved by the Government. The excess electricity produced is credited in the next billing period. The net metering policy was launched in 2017.

Since 2021, the net metering service has become available through Benayat, a digital platform which allows individuals and institutions to submit their requests to install solar energy systems online. By the end of 2023, approximately 59.3 MW of renewable energy projects were installed, the majority of which are connected to the national electricity grid through the net metering scheme.

Renewable Energy Mandate for New Buildings

Launched in 2019 under the Green Building Code, the renewable energy mandate for new buildings and real estate developers encourages the integration of renewable energy technologies in the building design, such as roof-top PV, building integrated PV, solar water heaters, and urban wind systems. The generated renewable energy is consumed on-site; and the excess electricity will be fed to the grid according to net metering regulations.

Tender-based Feed-in Tariff

The tender-based feed-in tariff allows private players and developers to develop renewable electricity generation projects and participate in a bidding process for feed-in tariffs. The participating bidders are assessed, and the awarded bidder is selected through a competitive procurement and evaluation process. This approach allows the government to promote renewable energy projects at the best price.

Public-Private Partnerships

In addition to these key policies, key efforts have centered on enhancing the involvement of the private sector in the renewable energy sector. This is exemplified in Bahrain’s use of the BOOM (Build, Own, Operate, Maintain) model for installing PV systems on government premises. This public-private partnership framework allows the private sector to install and operate PV systems, providing electricity at a fixed tariff for 20 years, which is expected to be lower than the existing electricity tariff. This model alleviates financial burdens on government while effectively utilizing government-owned land and rooftops, thus addressing the limited land challenges faced by small island states.

Tamkeen, Bahrain’s national labor fund, has also partnered with several leading banks to launch the Solar Financing Scheme. The Scheme empowers and enables enterprises to purchase PV systems to generate energy to help reduce their operating costs. The amount of funding ranges between 5,000 BHD and 500,000 BHD with a repayment period of up to 10 years, and a grace period that’s subject to the terms of the bank.

Moreover, the Ministry of Water and Electricity Affairs is also working to establishing a Renewable Energy Certificates Platform, which aims to develop an auditable renewable energy certification platform compatible with the International Renewable Energy Standard (I-REC). This platform will provide a mechanism for tracking and trading certificates of renewable energy certificates and serve as a significant incentive for investors by enhancing the value and feasibility of renewable energy projects in Bahrain, thus encouraging greater uptake and growth in this field.

3.3.2 Adaptation Actions with Mitigation Co-Benefits

As part of its NDC, the Kingdom of Bahrain communicated two adaptation actions with mitigation co-benefits: one focused on afforestation and the other on mangrove planting. The Ministry of Municipalities Affairs and Agriculture is leading the implementation of both these actions.

Moreover, Bahrain’s NDC had imparted that the extent to which it will meet its obligations under the UNFCCC, across mitigation and adaptation, is contingent on the availability of means of implementation. The implementation of tree and mangrove projects has commenced with the understanding that they may be financed through other sources than the public budget, for example, through carbon markets.

3.3.2.1 The National Plan for Afforestation

The National Plan for Afforestation aims to increase green areas in the Kingdom of Bahrain, by doubling the number of trees from 1.8 million to 3.6 million by 2035. The Plan was launched towards the end of 2021, with a starting year of 2022. The baseline for the

2035 contribution is 1.8 million trees, as this is the number of trees in 2021, which is the designated reference year.

The indicator selected to track progress of the National Plan for Afforestation under the BTR is **the number of trees planted**, which captures the total number of trees planted as a cumulative. This indicator relates to the NDC as it tracks progress of the tree-planting efforts of the National Plan for Afforestation, which is included as part of the NDC’s adaptation actions with mitigation co-benefits. The reference point for this indicator is zero trees.

To optimize afforestation efforts, the National Plan for Afforestation relies on thermal satellite imagery to identify heat hotspots in the Kingdom of Bahrain that would benefit from increased tree planting. In addition, it specifies a selection of tree species well-suited to Bahrain's specific environmental conditions and its arid climate, high-salinity soils, and limited water resources. Emphasis is also placed on trees varieties with large green canopies due to their ability to combat urban heat island effect.

The Ministry of Municipalities and Agriculture Affairs is responsible for implementing the National Plan for Afforestation. Implementation is executed in coordination with various sectors within the ministry, including Municipal Affairs, Agriculture Affairs, and all four municipalities in the Kingdom – namely, the Capital Municipality, the Muharraq Municipality, the North Area Municipality, and the Southern Municipality. Implementation is also supported by collaboration with non-governmental organizations, most notably the National Initiative for Agricultural Development (NIAD).

Launched in 2010 by Her Royal Highness Princess Sabeeka bint Ibrahim Al-Khalifa, Consort of His Majesty the King and President of the Supreme Council for Women, NIAD aims to fulfill Her Royal Highness’ vision of safeguarding and advancing the agricultural sector.

NIAD has adopted an inclusive approach to its campaigns, fostering collaboration among public and private sector entities and civil society. A notable success of NIAD has been facilitating connections between public sector entities and private sector financers. This involves identifying locations requiring trees but lacking necessary funding and reaching out to potential private sector sponsors. Once a private company expresses such interest, NIAD communicates with the relevant municipality and contractor to commence the project and organizes for press coverage, an inauguration event, and permanent signage indicating sponsorship.

Figure 25: National Initiative for Agricultural Development "Forever Green" tree-planting campaign.

One of NIAD's key initiatives, the "Forever Green" campaign, focuses on advancing tree-planting projects and promoting environmental sustainability by expanding green areas within public spaces and facilitating cooperation between different actors. In addition to its environmental goals, the campaign has played a crucial role in raising public awareness about the importance of agriculture and greenery and their vital contributions to the Kingdom.

As of 2022, a total of 150,000 trees were planted since the launch of the implementation of the National Afforestation Plan. Planting locations include public parks, walkways, public transport stations, health centers, schools, waterfronts, and public roads.

3.3.2.2 Mangrove Habitats

The NDC component on mangrove habitats lists several strategies and activities that were under consideration to enhance the resilience of mangrove habitats in Bahrain. These activities include:

- Establishing an observatory in Tubli Bay to strengthen existing observation systems to better understand ecological services provided by mangrove habitats in the area
- Creating a blue carbon inventory to augment Bahrain's existing GHG emission tracking system to estimate and document carbon pools/fluxes in Tubli Bay consistent with international methodological guidance.
- Ecosystem valuation to introduce economic valuation as a basis to account for the value of the market (i.e. tourism) and non-market (i.e. regulating, provisioning, supporting) services that the Tubli Bay mangrove habitats provide.
- The Mangrove Transplantation Project

After consideration, the Bahrain decided to prioritize implementation of the Mangrove Transplantation Project due to its more immediate impact on mangrove habitats. This project and its indicators are further elaborated below.

The Mangrove Transplantation Project

The Mangrove Transplantation Project aims to increase the mangrove coverage in Bahrain. The activities of the project are focused in Tubli Bay and Ras Sanad, as mangroves populated by *Avicennia marina* are naturally present on the Tubli Bay coastline, with the largest natural aggregation being in Ras Sanad.

The Ministry of Municipalities Affairs and Agriculture aims to plant 1.6 million mangrove seedlings by 2035. This contribution is adopted under this BTR, to track progress towards the mangrove-related adaptation actions with mitigation co-benefits mentioned as part of Bahrain's NDC.

The indicator selected to track progress in implementing and achieving the NEEAP under the BTR is the **number of mangrove seedlings planted**. This indicator relates to the NDC as it tracks progress of mangrove-planting efforts, which is included as part of the NDC's adaptation actions with mitigation co-benefits. The indicator tracks the number of mangroves as a cumulative, meaning it reflects the aggregate count of mangroves planted each year, starting from the year of implementation towards (i.e. 2022). The reference point for this indicator is zero mangrove seedlings planted.

Figure 26: Mangrove-related efforts in Bahrain.

A comprehensive study was conducted to identify the most suitable options for mangrove cultivation in Bahrain. Subsequently, nurseries were expanded and established to cultivate mangrove seedlings that are then planted in specific locations, including Tubli Bay, Ras Sanad and the Arad Bay reserve.

Since then, the Mangrove Transplantation project has been implemented by the Ministry of Municipalities Affairs and Agriculture. The project is managed by the Ministry of Municipalities Affairs and Agriculture in coordination with the Supreme Council of

Environment. A dedicated team has been hired to supervise all mangrove activities in nurseries and mangrove plantation at various sites. The management team is divided into two sections: one responsible for plantation activities and reporting, and another responsible for nurseries and the tendering process. Weekly maintenance activities are carried out at all mangrove sites.

As of 2022, a total of 110,901 mangroves have been planted.

Mangrove forest in Ras Sanad
Photo by SCE

3.4 Mitigation Policies and Measures, Actions and Plans

Including those with Mitigation Co-Benefits Resulting from Adaptation Actions and Economic Diversification Plans, Related to Implementing and Achieving NDC under Article 4 of the Paris Agreement

Table 12 summarizes the key mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving Bahrain's NDC. These actions are discussed in more detail in Section 3.3.

Table 12: Key policies, actions and plans with mitigation co-benefits resulting from adaptation actions and economic diversification plans

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entities
1. National Energy Efficiency Action Plan (NEEAP)	Launched in 2017, the National Energy Efficiency Action Plan (NEEAP) sets a national target of reducing energy consumption by 6% in 2025 and identifies various initiatives to improve energy efficiency. In doing so, the NEEAP aims to stimulate more efficient use of electricity, optimize the use of natural resources, decrease peak electricity demand and enhance long-term energy security.	Reduce energy consumption by 6% in 2025.	National strategy	In progress	Energy Cross-cutting	CO_2 CH_4 N_2O	2017	• Ministry of Water and Electricity Affairs (GDEE) • The Implementation Follow-Up Committee

Table 12: Key policies, actions and plans with mitigation co-benefits resulting from adaptation actions and economic diversification plans

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entities
2. National Renewable Energy Action Plan (NREAP)	Launched in 2017, the National Renewable Energy Action Plan (NREAP) sets national renewable energy targets of 5% and 10% for 2025 and 2035, respectively. The added benefits of the NREAP include optimizing the use of natural resources, reducing greenhouse gas emissions, decreasing electricity demand, improving the Kingdom's economic competitiveness and enhancing energy security in the long-term.	National renewable energy installed capacity targets of 5% and 10% for 2025 and 2035, respectively.	National strategy	In progress	Energy Cross-cutting	CO_2 CH_4 N_2O	2017	• Ministry of Water and Electricity Affairs (GDEE) • The Implementation Follow-Up Committee

Table 12: Key policies, actions and plans with mitigation co-benefits resulting from adaptation actions and economic diversification plans

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entities
3. National Plan for Afforestation	The National Plan for Afforestation aims to increase green areas in Bahrain, by doubling the number of trees from 1.8 million to 3.6 million by 2035. The Plan specifies tree species that are well-suited to Bahrain's specific environmental conditions. Emphasis is also placed on trees varieties with large green canopies due to their ability to combat urban heat island affect.	Double the number of trees from 1.8 million to 3.6 million by 2035.	National strategy	In progress	Forestry	CO_2	2022	• Ministry of Municipalities Affairs and Agriculture • The National Initiative for Agricultural Development • The Capital Municipality, the Muharraq Municipality, the North Area Municipality, and the Southern Municipality

Table 12: Key policies, actions and plans with mitigation co-benefits resulting from adaptation actions and economic diversification plans

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entities
4. Mangrove Transplantation Project	The Mangrove Transplantation Project aims to increase the mangrove coverage in Bahrain. The activities of the project are focused in Tubli Bay and Ras Sanad, as mangroves populated by Avicennia marina are naturally present on the Tubli Bay coastline, with the largest natural aggregation being in Ras Sanad.	Plant 1.6 million mangrove seedlings by 2035.	National project	In progress	Forestry	CO_2	2022	• Ministry of Municipalities Affairs and Agriculture • SCE

3.5 Summary of Greenhouse Gas Emissions and Removals

Table 13 provides a summary of GHG emissions. Further details on GHG emissions can be found in Chapter 2.

Table 13: Summary of GHG emissions and removals

	Reference year/period for NDC (Gg CO_2e)	Base year (Gg CO_2e)	% Change from 2021 to latest reported year (i.e., 2022)
GHG Emissions and Removals			
CO_2 emissions without net CO_2 from LULUCF	NA	NA	-1.0%
CO_2 emissions with net CO_2 from LULUCF	NA	NA	-1.0%
CH_4 emissions without CH_4 from LULUCF	NA	NA	-1.9%
CH_4 emissions with CH_4 from LULUCF	NA	NA	-1.9%
N_2O emissions without N_2O from LULUCF	NA	NA	-18.2%
N_2O emissions with N_2O from LULUCF	NA	NA	-18.2%
HFCs	NA	NA	+0.01%
PFCs	NA	NA	+2.5%
Unspecified mix of HFCs and PFCs	NA	NA	NA,NE,NO
SF_6	NA	NA	NE,NO
NF_3	NA	NA	NE,NO
Total (with and without LULUCF, with indirect)	**NA**	**NA**	**-1.1%**
GHG Source and Sink Categories			
1. Energy	NA	NA	-1.2%
2. Industrial processes and product use	NA	NA	+0.1%
3. Agriculture	NA	NA	-1.2%
4. Land use, land-use change and forestry	NA	NA	IE,NA,NE,NO
5. Waste	NA	NA	-4.2%
6. Other	NA	NA	NA,NE
Total (with LULUCF)	**NA**	**NA**	**-1.1%**

3.6 Common Tabular Formats (CTFs) Tables

Further information on the Common Tabular Formats on NDC progress can be found in Annex 2.

Chapter 4

Information Related to Adaptation

4. CHAPTER 4: Information Related to Adaptation

As a densely populated, small, low-lying island state in the Arabian Gulf, the Kingdom of Bahrain is particularly vulnerable to the adverse impacts of climate change. Adapting to these impacts is a priority to Bahrain, which has incorporated various adaptation actions as part of its 2021 NDC.

The following chapter provides an overview of the primary climate change impacts, risks and vulnerabilities in Bahrain. It also highlights the progress of key adaptation actions included as part of Bahrain's NDC. Further details on national circumstances and institutional arrangements, including information on Bahrain's geography, demographics and climate, are provided in Chapter 1.

4.1 Climate Change Impacts, Risks and Vulnerabilities

Climate change is an inherently complex topic, manifesting in various long-term and short-term impacts on a global scale, with consequences across environmental, social, and economic domains. As a group of small low-lying islands, Bahrain faces considerable climate-related challenges. Bahrain's National Communications to the UNFCCC highlight three key climate hazards that pose a threat to the Kingdom, namely rising temperatures, changes in rainfall rates, and rising sea levels.

Table 14: Overview of key climate hazards in Bahrain

Climate hazard	Potential impacts
Rise in temperatures	• Decrease in scarce freshwater resources, due to increase in evapotranspiration rates, reducing soil moisture, rainfall infiltration and aquifer. • Increased demand for water for municipal consumption, agriculture, and industry • Extensive coral bleaching associated with loss of coral cover. • Increasing urban heat island effect.
Change in rainfall rate	• Increase rainfall rate unevenness will give rise to the risk of extreme events, including floods and droughts and that will lead to increase the water scarce condition in Bahrain.
Rise in sea levels	• Land loss due to increase in coastal inundation, flooding, and erosion. • Increase in saline intrusion into the soil and aquifer, affecting soil ecosystems, agricultural productivity, and reducing freshwater resources. • Inundation of intertidal mudflats, with potential impact on populations of migratory shorebirds and/or reduction of light levels, affecting photosynthetic rates of already threatened seagrass beds • Destruction of mangroves • Impact on infrastructure, including roads, buildings, electricity systems, and industry

Bahrain's National Adaptation Investment Plan (NAIP), further detailed in Section 4.2.2, assessed the vulnerabilities posed by climate change across key sectors that are adversely affected by its impacts. These sectors include: (a) water resources, (b) agriculture and food production, (c) ecosystem services and biodiversity, and (d) urban development.

A situational analysis was conducted whereby each sector's vulnerability was assessed in a systematic manner. This analysis drew upon scientific literature, existing national reports, current and planned policies, and stakeholder consultations. Vulnerability, defined in line with the IPCC as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes" was examined as a function of three factors:

- **Exposure:** The nature and degree to which a system is exposed to the effects of climate change.
- **Sensitivity:** The degree to which a system is affected by the effects of climate change. This is influenced by factors such as the physical characteristics of the system, its economic and social structure, and its ability to adapt.
- **Adaptive capacity:** The ability of a system to adjust to the effects of climate change. This includes the ability to make changes to infrastructure, policies, and practices in order to reduce the negative impacts of climate change.

The following sections provide an overview of each sector's exposure, sensitivity and adaptive capacity. These sectors may be understood as Bahrain's adaptation priorities.

4.1.1 Water

As an arid country with high temperatures and low rainfall, Bahrain has no surface water sources, and groundwater sources are the only natural source of fresh water supply. Bahrain faces a high demand for water due to its rapid population growth and urbanization and has been relying mainly on seawater desalination to meet this demand.

The water sector has been identified as a sector that is especially *exposed* to increases in temperature and rising sea levels. The main effects of these impacts are increased evapotranspiration rates, reduced soil moisture, rainfall infiltration and aquifer recharge, leading to an overall reduction of already scarce fresh-water resources; increased saline intrusion into the soils and aquifers reducing agricultural productivity and available freshwater resources; and increased water demand for municipal consumption, agriculture, and industry usage.

Bahrain's limited groundwater sources and reliance on desalination causes the water sector to be *sensitive* to climate change impacts. Measures related to *adaptive capacity* have included policy actions to protect water resources, the formation of a Water Resources Council (WRC), the development of a National Water Strategy, the establishment of a Water Resources Management Unit (WRM) and plans to expand the reuse of treated wastewater in irrigation, among others.

4.1.2 Agriculture and Food Production

Approximately 5.15% – 39.4 km^2 – of Bahrain's total land is arable. These lands are nutrient deficient, characterized by high infiltration rates and low water-holding capacity, in addition to being subject to challenging climatic conditions. Due to its small area and limited natural resources, Bahrain imports about 90% of its food requirements, which poses a major challenge to food security.

Bahrain's arable lands are *exposed* to arid desert-like conditions characterized by high temperatures, high humidity and erratic rainfall. Rising sea levels may also result in a loss of agricultural land. The potential effects of these impacts include seawater inundation of agricultural lands; soil salinization leading to gradual desiccation and destruction of coastal plantations; and an increase climate-related diseases with livestock due to increasing temperatures.

The agriculture sector is *sensitive* to climate change impacts, particularly due to its reliance on the water sector. Although fisheries and aquaculture sectors are less vulnerable to climate change impacts, they are threatened by long-term stresses caused by climate change. The *adaptive capacity* of the agriculture and food production sector has been supported by various measures, including the development of a national strategy for food security, increased investments in domestic agriculture, and national initiatives to support agricultural workers and enhance agricultural expertise.

4.1.3 Ecosystem Services and Biodiversity

Bahrain is an archipelago of approximately 33 natural and 51 artificial islands. Marine waters and coastal areas support several important ecosystems including mangroves, seagrass beds, coral reefs, and intertidal mudflats. These habitats provide a variety of ecosystem services to the country and its economy. There are a total of six marine protected areas and two terrestrial protected areas in Bahrain.

The terrestrial and marine areas in Bahrain are *exposed* to effects of warming oceans, sea-level rise, increased evaporation, and potential changes in storm patterns. These areas are also affected by anthropogenic activities, such as land reclamation. Marine organisms and associated fisheries are identified as especially *sensitive* to climate change impacts, mainly due to an increase in average sea temperature rather than ocean acidification.

Several initiatives, plans, and strategies enhance the *adaptive capacity* of these sectors. These efforts include the development of different national plans and strategies, such as the National Biodiversity Strategy and Action Plan 2016-2021 and the National Environmental Strategy. Notably, a review and update of the National Biodiversity Strategy and Action Plan, aligned with the Post-2020 Global Biodiversity Framework, is underway. National plans to increase the number of trees and mangroves in the Kingdom also support the adaptive capacity of these sectors.

4.1.4 Urban Development

Approximately 90% of Bahrain's population lives in urban areas and 40% of land is dedicated to residential areas and housing areas. Rapid population growth has led to considerable urban development, putting strain on the country's ecological resources, and reducing land availability. Land reclamation has increased Bahrain's land area; however, it remains insufficient to address the land-use needed for infrastructure.

Urban development and the built environment will be *exposed* to increases in temperature and rising sea levels. Coastal areas are densely populated and exposure to rising sea levels differ between the various islands that constitute Bahrain, depending on land elevation. Regarding increases in temperature, Bahrain is a country already situated in an arid region and even a comparatively small increase in temperature could have considerable impacts, particularly in the case of the urban heat island effect.

Bahrain has enhanced the *adaptive capacity* of the built environment, revising building codes in response to increasing temperatures and to improve coastal resilience, updating the 'Guidelines for coastal development lands and artificial islands', and most recently, conducting a comprehensive coastal resilience study and developing an accompanying action plan to be implemented through to 2050. The National Plan for Afforestation in Bahrain is also aimed at increasing open green spaces, which combats the effects of the urban heat island effect.

4.2 Key Adaptation Actions

The following section spotlights key adaptation actions undertaken in the Kingdom of Bahrain. More particularly, it provides an overview of the adaptation actions outlined in Bahrain's 2021 NDC. These actions include the formulation of a National Adaptation Investment Plan (NAIP) and targeted efforts to enhance the resilience of coastal zones and water resources.

Adaptation actions with mitigation co-benefits, such as afforestation and mangrove afforestation, are addressed in Chapter 3.

4.2.1 Water Resources Resilience

Water resource conservation is a key driver for action across various sectors, including food security, climate action, and public health. In Bahrain, rapid social and economic development has led to a growing demand for potable water, resulting in the expansion of desalination plants to meet this increasing need. Given the region's extreme heat and naturally arid environment, Bahrain faces significant challenges related to water scarcity. These challenges are compounded by the impacts of climate change, making the protection of natural water resources and enhancement of sanitation efforts even more critical. Simultaneously, the Kingdom has prioritized sustainable water consumption to safeguard its future supply.

The Government of Bahrain's approval of the National Water Strategy 2030 in 2021 reflects its dedication to addressing these challenges. This strategy, aligned with the GCC Unified Water Strategy (2016-2035), focuses on sustainable water management to meet the demands of economic sectors, thus supporting national sustainable development. The strategy's three pillars – coordination among water-related entities, monitoring implementation, and raising awareness – aim to ensure that water resource management is robust enough to face the evolving challenges, particularly those posed by climate change.

Climate change has introduced new risks to Bahrain's water sector, including increased temperatures, reduced rainfall, and more frequent droughts, all of which exacerbate water scarcity. Rising sea levels also threaten the country's freshwater reserves by increasing the salinity of groundwater. To mitigate these impacts, Bahrain has taken significant steps to adapt its water management systems to the realities of climate change.

One example of Bahrain's adaptation efforts is its progress in managing water stress. As part of the UN-Water Integrated Monitoring Initiative for SDG 6 (Clean Water and Sanitation), Bahrain was recognized for accelerating progress on SDG indicator 6.4.2 (Level of water stress), which measures freshwater withdrawal as a proportion of available freshwater resources. In 2000, the Kingdom was withdrawing 195% of its renewable freshwater resources, heavily reliant on non-renewable sources that face depletion risks. However, by 2021, Bahrain had reduced its water stress level to 156% by expanding non-conventional water sources, such as desalinated seawater and treated wastewater. This shift was further supported by modern irrigation techniques, such as encouraging the use of greenhouses and hydroponic systems, which enhance water use efficiency, particularly in the agricultural sector. These measures demonstrate Bahrain's efforts to adapt to climate-induced water scarcity while balancing increasing demand.

Adapting the water sector to climate change has been reinforced through international cooperation. In October 2018, Bahrain secured approximately USD 2.3 million in funding from the Green Climate Fund for the project titled "Enhancing Climate Resilience of the Water Sector in Bahrain". Led by the SCE, this project directly addresses the water sector's vulnerabilities to climate impacts and aims to strengthen institutional capacity for climate resilience.

The project focuses on four key adaptation activities:

1. **Knowledge Management for Climate Impacts:** Establishing a platform that improves understanding of how climate change affects Bahrain's water sector, enabling better water demand management in the context of evolving climate conditions.
2. **Climate-Resilient Integrated Water Resources Management (IWRM):** Enhancing institutional capacity to operate a climate-resilient IWRM framework across sectors, ensuring that Bahrain's water management systems can withstand climate shocks, such as prolonged droughts or sudden water shortages.
3. **Promoting Water Conservation Technologies:** Supporting the adoption of climate-smart technologies, including water-saving techniques in both residential and agricultural settings, to mitigate the stress on water supplies exacerbated by climate change.
4. **Rainwater Harvesting and Greywater Recycling Guidelines:** Developing guidelines that promote rainwater harvesting and greywater recycling, critical strategies for increasing the availability of non-conventional water resources to counteract the decreased reliability of natural freshwater supplies.

These efforts are part of Bahrain's broader strategy to adapt its water sector to future climate uncertainties. Comprehensive water audits have been planned to assess current usage patterns and optimize water demand management. This approach has allowed Bahrain to not only reduce wastage but also increase resilience by ensuring water is used more efficiently in all sectors. Additionally, a study exploring the potential for Zero Liquid Discharge (ZLD) in the oil sector was initiated, aiming to further enhance Bahrain's water recovery capacity. ZLD is a sustainable engineering method that recovers all wastewater for reuse, reducing water loss to an absolute minimum, which is vital in a climate-vulnerable context.

Furthermore, capacity-building initiatives have been a central part of Bahrain's adaptation strategy. Workshops tailored to governmental agencies, academia, and civil society have strengthened cross-sectoral cooperation in addressing climate impacts on water resources. These initiatives help ensure that climate resilience is mainstreamed into decision-making processes at all levels, reinforcing adaptive capacity across sectors. Public awareness campaigns are also critical, focusing on educating the community about water conservation and sustainable practices to foster resilience at the household level.

Adaptation action in this field has also extended to gender-sensitive policies, recognizing that women are disproportionately affected by water scarcity and climate change. Collaborative initiatives with the Supreme Council for Women and the Bahraini Women's Association ensure that gender perspectives are integrated into water management strategies, further enhancing the sector's adaptability to climate impacts.

By incorporating these adaptation measures, Bahrain is addressing the increasing risks posed by climate change to its water sector. The Kingdom's proactive approach reflects a dedication to building climate resilience, ensuring that its water resources are safeguarded for future generations even as the impacts of climate change become more pronounced.

4.2.2 National Adaptation Investment Plan

Developed in partnership with the Global Green Growth Institute (GGGI), the National Adaptation Investment Plan (NAIP) serves as the Kingdom's guiding document on adaptation action. It identifies sectors most vulnerable to climate change, outlines corresponding climate adaptation actions, and translates those actions into a portfolio of projects. The NAIP also examines the financing options for each of these adaptation actions, thus taking a pro-active approach to addressing the global challenge of mobilizing adaptation finance.

The formulation of the NAIP was guided by five key objectives:

- To systematically describe what adaptation to the adverse impacts of climate change means in Bahrain and to identify objectives for adaptation *(situational analysis)*.
- To identify the stakeholders in the different areas affected by the adverse impacts of climate change on which successful adaptation will depend *(stakeholder analysis)*.
- To identify interventions to increase resilience to climate change and achieve the objectives for adaptation *(project pipeline)*.
- To identify relevant options of how to finance these interventions *(finance strategy)*.
- To prescribe institutional arrangements across different departments and agencies to implement the identified interventions.

To meet these objectives, the SCE led a series of tasks under the oversight of the Ministerial Committee for Development and Infrastructure Projects.

Firstly, a situational analysis was conducted to identify key areas for adaptation and provide a systematic overview of the sectors that are most adversely affected by climate change in Bahrain, namely: (a) water resources, (b) agriculture and food production, (c) ecosystem services and biodiversity, and (d) urban development. The analysis focused on determining each sector's vulnerability to climate change, informed by the sector's exposure to phenomena related to climate change, its sensitivity to climate change impacts, and its adaptive capacity to cope with adverse climate change impacts.

Subsequently, a stakeholder analysis was conducted to pinpoint key stakeholder entities from the identified vulnerable sectors and invite their participation in the NAIP process. This included several stakeholder entities, including the Ministry of Municipalities Affairs and Agriculture, the Ministry of Works, the Water Resources Management Unit, the Ministry of Industry and Commerce, the Ministry of Health, the Ministry of Electricity and Water, and the Bahrain Institute for Pearls and Gemstones (DANAT).

Consultations with these stakeholders informed the development of a project pipeline that consisted of a total of 47 proposed adaptation actions, identified based on existing government priorities and the vulnerabilities pinpointed by the situational analysis. These adaptation actions were then prioritized and shortlisted by the SCE and line ministries relevant to implementation based on the action's expected economic, environmental and social impacts. This prioritization exercise resulted in the identification of 14 adaptation actions that were elaborated on and grouped into six "investment" concept notes based on sector. These projects, with a total investment requirement of approximately USD 1.61 billion, are summarized in Table 15.

Table 15: Summary of the NAIP's sectoral investment concept notes

Concept note	Sector	Adaptation Action	Estimated Cost (USD million)
1. Scaling Wastewater Reuse for Climate Resilience	Water	1. Expansion of Treated Sewage Effluent (TSE') transmission and distribution network	**651**
		2. Upgradation of feedwater treatment systems for industrial uses	
		3. Artificial groundwater storage and recovery	
2. Accelerating Climate Resilience in Agriculture and Crop Production	Agriculture & food production	1. Promotion of climate-smart agricultural systems	**56**
		2. Promoting cultivation of native and climate compatible crops	
3. Climate Resilient Livestock & Poultry Development	Agriculture & food production	1. Institutional strengthening for enhancing the surveillance, diagnostic and control of animal diseases	**53**
		2. Development of climate-resilient and low-carbon livestock and poultry value chain	

Table 15: Summary of the NAIP's sectoral investment concept notes

Concept note	Sector	Adaptation Action	Estimated Cost (USD million)
4. Climate Resilient Fisheries and Aquaculture Development	Agriculture & food production	1. Enhancing resilience of fish habitats 2. Development of climate-smart fisheries and aquaculture value chain	61
5. Restoration of Mangrove Ecosystems for Climate Resilience	Ecosystem services & biodiversity	1. Strengthening policy and institutions for mangrove management 2. Restoring and promoting sustainable mangrove ecosystems 3. Developing a blue carbon market	544
6. Afforestation and Nursery Development	Ecosystem services & biodiversity, urban development	1. Expansion of green cover in urban areas 2. Development of climate-smart nurseries for afforestation planning and management	243
Total investment requirement including 10% contingency and project management			1,608

To enable future implementation, the NAIP proposes institutional arrangements for each concept note through a dedicated project management arrangement section. This section identifies agencies relevant to project implementation based on their technical expertise and assigns roles and responsibilities accordingly.

Additionally, the NAIP suggests means of financing for each of the 14 prioritized adaptation actions, thereby facilitating the mobilization of necessary resources for implementation. This assessment leveraged the knowledge of a finance expert who identified potential funding sources and financing instruments for each adaptation action. These instruments include green bonds/sukuk, equity and debt capital, grants, sale of tourism development rights, sale of blue carbon credits, concessional debt and government funds. By considering the financing options available to each project, the NAIP uniquely addresses the challenge of mobilizing finance that besets adaptation action globally.

As of 2024, the NAIP document has been finalized and presented to the Ministerial Committee for Development and Infrastructure and Projects. The Committee is chaired by HE the Deputy Prime Minister and Minister for Infrastructure and enjoys the high-level participation of their Excellencies, the Minister of Oil and Environment, the Minister of Industry and Commerce, the Minister of Municipalities Affairs and Agriculture, the Minister of Works, the Minister of Electricity and Water Affairs, the Minister of Transportation and Telecommunications, the Minister of Housing and Urban Planning, and the Minister of Cabinet Affairs.

4.2.3 Coastal Zone Resilience

As a low-lying island state, coastal resilience is a pertinent aspect to Bahrain's long-term sustainability.

In 2019, the Government of Bahrain appointed Arup to conduct an initial assessment of risks to buildings infrastructure and land under coastal inundation due to future sea-level rise (SLR). This study successfully provided a national-level overview of the potential severity of such a threat under three high-level scenarios for the year 2100, based on existing literature.

Building on these efforts, additional stages of assessment and strategy development were taken forward, including:

1. **Baselining Flood Risk from Sea-level Rise:** Review of available scientific evidence and data on SLR and preliminary assessment of land and key assets at risk.
2. **Identifying Sources of Coastal Flood Risk:** Detailed investigation of sources of flood risk associated with SLR and storm events.
3. **Assessing Impacts on National Infrastructure:** Detailed assessment of the impact of SLR on key infrastructure and national assets.
4. **Developing a Success Strategy:** Development of master plan and strategy to mitigate impacts and identification of options and actions.

Work on the coastal resilience strategy was initiated in 2021 and focused on the most immediate risks for the period after 2050, based on an increase in sea levels of 0.5 m.

As illustrated in Figure 27, the principal data sources for the study include extensive asset data, land use maps and coastal and environmental datasets such as tide information, sea level rise and storm surge projections.

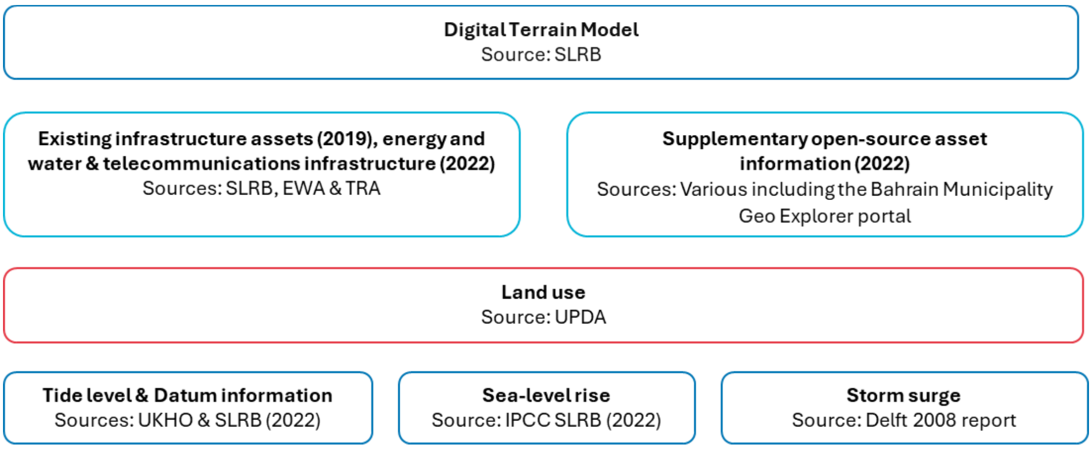

Figure 27: Data sources for SLR study.

This collated data was then processed and compiled into a Geospatial Information System (GIS) portal (Web-Map) to provide an interactive and data-driven means of developing the action plan and providing information to decisionmakers in a visual and accessible way. Moreover, the strategy derived five water scenarios which describe incremental flood risk from the present day to a future date beyond 2050. The strategy examined the exposure of critical assets to potential future sea conditions and storms with forecasts of climate change taken into consideration. These assets span a total of 14 sectors, including: residential, energy, water, food, tourism, commercial, health, transport, industry, ICT, government, finance, and emergency services sectors. All assessments were undertaken with the online Web-Map tool, which comprises a digital terrain model of the Kingdom, georeferenced asset locations, as well as current and future land use maps. The exposure assessment was done by overlaying the five water scenarios with the digital terrain model and existing asset data. Figure 28 shows the key findings under two main scenarios.

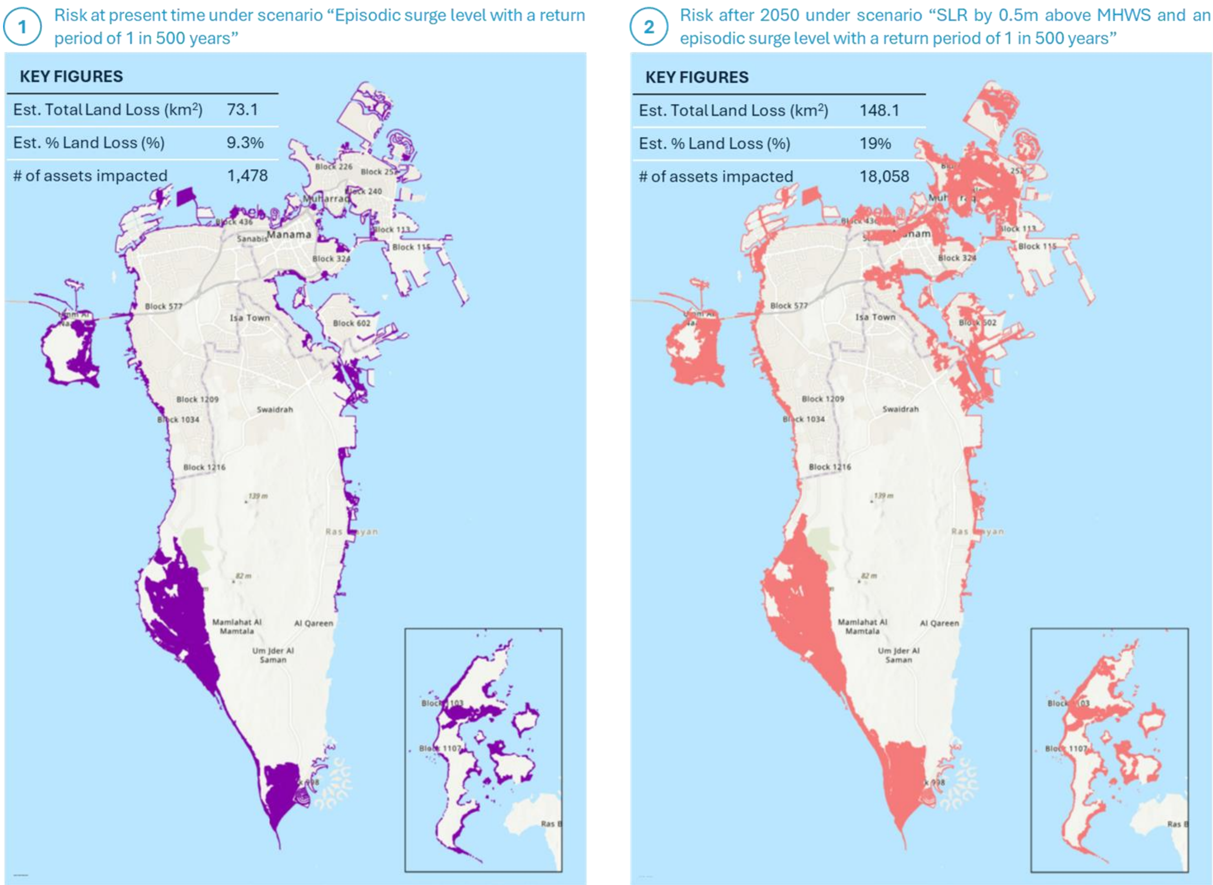

Figure 28:Estimated inundation risks of SLR.

Following this assessment, a prudent approach was taken whereby an action plan was developed to mitigate the risk of the most severe water scenario, despite its low probability. The plan was developed using a logical decision-making tree which provides the rationale for assigning typical interventions along the Bahrain coastline. The process ensures that approaches are applied consistently and, most importantly, can be adapted for future application. More than 200 physical and non-physical interventions were proposed to protect approximately 140 km of coastline. The total cost of interventions is estimated at 318 to 428 million USD.

As illustrated in Figure 29, physical interventions include landscaping and flood bunds, short walls, beach enhancement measures and asset-level protection walls. In some cases, these interventions are also an opportunity for enhancing public amenities. A priority order for the planning, design and construction of interventions was also proposed. Interventions were grouped based on their geographical location and it was suggested that implementation commences with coastal locations where the estimated flood damages are likely to be the highest.

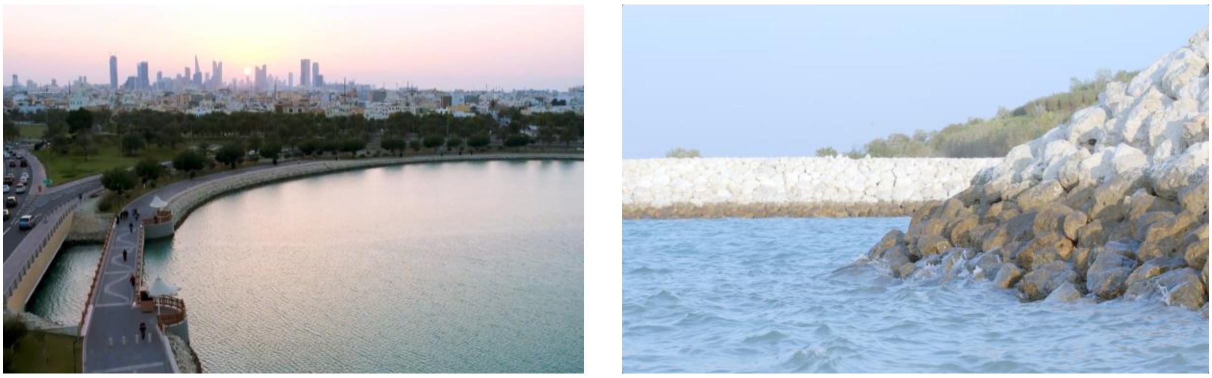

Figure 29: Pre-existing coastal boulevards and short walls in Bahrain.

The results of these efforts were presented and reviewed by a multi-stakeholder Sea-level Rise Committee, formed to adopt recommendations, agree action plans and decide priorities and timescales for implementation. The Committee consists of key stakeholders including the SCE, the Ministry of Works, the Electricity and Water Authority, the Ministry of Transportation and Telecommunications, the Telecommunications Regulatory Authority, the Supreme Defense Council, the Urban Planning and Development Authority, and the Survey and Land Registration Bureau.

The development of the coastal resilience strategy officially concluded in 2023 and was presented to the highest levels of government, including His Majesty King Hamad bin Isa Al Khalifa.

Aerial view of Bahrain Bay, Manama.
Photo from Four Seasons

Chapter 5

Information on Flexibility and Improvements in Reporting Over Time

5. CHAPTER 5: Information on Flexibility and Improvements in Reporting Over Time

The Kingdom of Bahrain has exercised the following flexibility options under this first submission of its Biennial Transparency Report, as per the Annex contained in Decision 18/CMA.1:

- Option to report only qualitative uncertainty information if quantitative input data are not available (as per para 29)
- Encouragement to develop a QA/QC plan and provide information on general QC procedures implemented (as per para 34 and 35)
- Option to report fewer GHGs (as per para 48)
- Option to report a shorter time-series (as per para 57 and 58)
- Estimates of expected and achieved greenhouse gas emission reductions for actions, policies and measures (as per para 85)
- Projections of mitigation policies and measures on future trends in greenhouse gas emissions and removals (i.e. projections of greenhouse gas emissions and removals under 'with measures', 'with additional measures' and a 'without measures' scenarios) (as per para 92)

These flexibility options are exercised in a self-determined manner due to limited capacity, whereby the reporting entity currently lacks the technical expertise to fulfil the necessary reporting requirements to their fullest extent. This challenge is exacerbated by resource constraints, which include a lack of funding for data collection and projection systems.

The Kingdom of Bahrain is in the process of enhancing its reporting. These efforts are led by the Supreme Council for Environment (SCE), which is the designated national entity responsible for coordinating the Kingdom's reporting requirements to the UNFCCC, including information on measuring, reporting and verifying GHG emissions and tracking progress in implementing and achieving the NDC.

Previously, the preparation of the national greenhouse gas inventory was conducted on an ad-hoc basis and compiled by national experts, overseen by the SCE. This outsourcing of the inventory has led to challenges in data accuracy, data collection as well as archiving. More importantly, it failed to establish reporting systems and embed capacity and capability within government. As a step forward, the SCE appointed GIZ International, Ricardo PLC, and Perspectives Climate Group to conduct a comprehensive Gaps and Needs Analysis of existing MRV processes. This analysis was completed in 2023, and the SCE is now working towards fulfilling these recommendations, which include:

- **Developing standard data collection templates** that define what is needed and when by key data providers.
- **Establishing a formal and defined National Inventory System (NIS)** with guidelines that describe the process of preparing the GHG inventory and a manual describing the procedural issues in preparing the GHG inventory (including the data needs, methods to be used, rules of procedures, confidentiality, etc.)
- **Developing quality assurance and quality control handbooks**

As of January 2024, the SCE has reviewed its compilation processes and formulated standard data collection templates for all sectors covered by the current BTR. The development of quality assurance and quality control handbooks, as well as a comprehensive manual that describes the process of compiling Bahrain’s GHG inventory, is also underway. These processes aim to replace and overcome the challenges posed by the previous ad-hoc project-based system of work. This first Biennial Transparency Report marks the SCE’s first independent compilation of Bahrain’s national greenhouse gas inventory.

Arad Fort is a 15th-century fort in Arad, Bahrain.
Photo by iStockphoto

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List of Tables

List of Figures

Abbreviations

ABBREVIATION	Definition/Meaning
AD	Activity Data
AFOLU	Agriculture, Forestry and Other Land Use
ALBA	Aluminum Bahrain B.S.C.
AR5	IPCC Fifth Assessment Report
BHD	Bahraini Dinar
BIM	Bahrain Investment Market
BToSW	Biological Treatment of Solid Waste
BTR	Biennial Transparency Report
Btu/h	British Thermal Units per Hour
C	Confidential
C&D	Construction and Demolition Waste
CAFE	Corporate Average Fuel Economy
CaO	Calcium oxide
CCSD	Climate Change and Sustainable Development Directorate
CCUS	Carbon capture, utilization and storage
CDK	Cement Kiln Dust
CDR	Carbon Dioxide Recovery
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COVID-19	Coronavirus Disease 2019
CRTs	Common Reporting Tables
CTF	Common Tabular Format
D	IPCC Default Value
DANAT	Bahrain Institute for Pearls and Gemstones
DRI	Direct Reduced Iron
DRP	Direct Reduction Plant
EAF	Electric Arc Furnace
EDB	Economic Development Board
EF	Emission Factor
ETF	Enhanced Transparency Framework
EVs	Electric Vehicles
EWA	Electricity and Water Authority

ABBREVIATION	Definition/Meaning
FDI	Foreign Direct Investment
FOD	First Order Decay
FX	Flexibility
GCC	Gulf Cooperation Council
GDEE	General Directorate of Energy Efficiency
GDP	Gross Domestic Product
Gg	Gigagram
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas
GIS	Geospatial Information System
GIZ	German Agency for International Cooperation
GWh	Gigawatt hours
GWP	Global Warming Potential
ha	Hectare
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
HIW	Hazardous Industrial Waste
HPMP	HCFCs phase-out management plan
ICT	Information and Communication Technologies
IE	Included Elsewhere
IEA	International Energy Agency
IFC	Implementation Follow-Up Committee
iGA	Information & eGovernment Authority
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ITMO	Internationally Transferred Mitigation Outcome
IWRM	Integrated Water Resources Management
IWW	Industrial Wastewater
KCA	Key Category Analysis
KSA	Kingdom of Saudi Arabia
kt	Kilo Tonnes
kt/y	Thousand Metric Tons per Year
kW	Kilowatt
LED	Light-emitting Diode
LMRA	Labor Market Regulatory Authority
LPG	Liquified Petroleum Gas

ABBREVIATION	Definition/Meaning
MEPS	Minimum Energy Performing Standards
MEWA	Ministry of Electricity and Water Affairs
MHWS	Mean High Water Springs
MMSCF	Million standard cubic feet
MoIC	Ministry of Industry and Commerce
MoMAA	Ministry of Municipalities Affairs and Agriculture
MOO	Ministry of Oil
MOW	Ministry of Works
MRV	Monitoring, Reporting and Verification
MSW	Municipal Solid Waste
MW	Megawatt
N_2O	Nitrous Oxide
NA	Not Applicable
NAIP	National Adaptation Investment Plan
NDC	Nationally Determined Contribution
NE	Not Estimated
NEEAP	National Energy Efficiency Action Plan
NEDC	New European Driving Cycle
NES	National Energy Strategy
NG	Natural Gas
NHIW	Non-Hazardous Industrial Waste
NIAD	National Initiative for Agricultural Development
NID	National Inventory Document
NIR	National Inventory Report
NIS	National Inventory System
NO	Not Occurring
NOU	National Ozone Unit
NREAP	National Renewable Energy Action Plan
O&G	Oil and Gas
ODS	Ozone Depleting Substances
OECD	Organization for Economic Co-operation and Development
PA	Paris Agreement
PEE	Primary Energy Equivalent
PFCs	Perfluorinated Compounds
PS	Plant Specific

ABBREVIATION	Definition/Meaning
QA	Quality Assurance
QC	Quality Control
RAC	Refrigeration and Air Conditioning
SCE	Supreme Council for Environment
SDB	SMEs Development Board
SEA	Sustainable Energy Authority
SEU	Sustainable Energy Unit
SLR	Sea-level Rise
SLRB	Survey and Land Registration Bureau
SMEs	Small and medium-sized enterprises
SWD	Solid Waste Disposal
SWDS	Solid Waste Disposal Site
t/y	Metric Tons per Year
T1	IPCC Tier 1
T2	IPCC Tier 2
T3	IPCC Tier 3
TACCC	Transparency, Accuracy, Consistency, Comparability, Completeness
TRA	Telecommunications Regulatory Authority
UKHO	The UK Hydrographic Office
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UPDA	Urban Planning and Development Authority
USD	United States Dollars
VRF	Variable Refrigerant Flow
WI	Waste Incineration
WRC	The Water Resources Council
WRM	The Water Resources Management Unit
WW	Wastewater
WWT	Wastewater Treatment
WWT&D	Wastewater Treatment and Discharge
WWTPs	Wastewater Treatment Plants
ZLD	Zero Liquid Discharge

Annexes

Annexes

Annex 1: Common Reporting Tables (CRTs)

Following the compilation of Bahrain's GHG Inventory for the reporting period using the IPCC software, the data has been exported to the UNFCCC ETF tool to generate the CRTs in Excel format. As illustrated in Table 16, a soft copy of all the CRTs is submitted in compressed folder format to the UNFCCC as an annex to this report. A total of 354 CRTs are submitted (59 CRTs per year x 6 years).

Table 16: Contents of the compressed folder submitted

#	File name	File content
1	BHR-CRT-2024-V0.2-2017-20250420-122954.xlsx	CRTs for the year 2017 exported from the ETF tool
2	BHR-CRT-2024-V0.2-2018-20250420-122954.xlsx	CRTs for the year 2018 exported from the ETF tool
3	BHR-CRT-2024-V0.2-2019-20250420-122954.xlsx	CRTs for the year 2019 exported from the ETF tool
4	BHR-CRT-2024-V0.2-2020-20250420-122954.xlsx	CRTs for the year 2020 exported from the ETF tool
5	BHR-CRT-2024-V0.2-2021-20250420-122954.xlsx	CRTs for the year 2021 exported from the ETF tool
6	BHR-CRT-2024-V0.2-2022-20250420-122954.xlsx	CRTs for the year 2022 exported from the ETF tool

Annex 2: Common Tabular Formats (CTFs) Tables

Bahrain's Common Tabular Formats have been submitted separately to the UNFCCC as an Excel file. Table 17 below presents an index sheet of the CTF tables submitted to the UNFCCC and reporting flexibilities exercised.

Table 17: CTF Tables index sheet

Table #	Name	Reported	Explanations
1	Structured summary: Description of selected indicators	Yes	-
2	Structured summary: Definitions needed to understand the NDC	Yes	-
3	Structured summary: Methodologies and accounting approaches – consistency with Article 4, paragraphs 13 and 14 of the Paris Agreement and with decision 4/CMA.1	NA	The Kingdom of Bahrain's NDC consists of adaptation actions and economic diversification measures with mitigation co-benefits. Bahrain does not have the capacity to account for the anthropogenic emissions and removals corresponding to these actions at this current reporting period.
4	Structured summary: Tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement	Yes	-
5	Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement (a), (b)	Yes	Bahrain exercises flexibility in light of its capacities with respect to the provision of estimates of expected and achieved GHG emission reductions for its actions, policies and measures. Bahrain is in the process of enhancing its reporting and projection capabilities in line with the reporting requirements of the Paris Agreement (See Table 12)

Table 17: CTF Tables index sheet

Table #	Name	Reported	Explanations
6	Summary of greenhouse gas emissions and removals in accordance with the common reporting table 10 emission trends – summary	Yes	-
7	Information on projections of greenhouse gas emissions and removals under a 'with measures' scenario	FX	Bahrain exercises flexibility in light of its capacities with respect to projections of greenhouse gas emissions and removals. Bahrain is in the process of enhancing its reporting and projection capabilities in line with the reporting requirements of the Paris Agreement
8	Information on projections of greenhouse gas emissions and removals under a 'with additional measures' scenario	FX	
9	Information on projections of greenhouse gas emissions and removals under a 'without measures' scenario	FX	
10	Projections of key indicators	FX	
11	Key underlying assumptions and parameters used for projections	FX	
12	Information necessary to track progress on the implementation and achievement of domestic policies and measures implemented to address the social and economic consequences of response measures	NA	-

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DATA PROVIDERS

Information and eGovernment Authority (iGA)
Electricity and Water Authority (EWA)
Ministry of Electricity and Water Affairs (MEWA)
Ministry of Municipalities Affairs and Agriculture (MOMAA)
Ministry of Oil (MOO)
Ministry of Transportation and Telecommunications (MTT)
Ministry of Works (MOW)
National Initiative for Agricultural Development (NIAD)
Supreme Council for Environment (SCE) - Waste Management Section
Supreme Council for Environment (SCE) - National Ozone Unit
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