




Sustainable Energy Unit | وحدة الطاقة المستدامة
Kingdom of Bahrain | مملكة البحرين

The background features a large, stylized wireframe outline of the Burj Khalifa skyscraper. Overlaid on the bottom right is a photograph of the Bahrain city skyline at dusk, with the Burj Khalifa and other buildings illuminated against a purple and orange sky. The image is framed by a geometric, multi-colored shape in shades of blue, purple, and grey.

The Kingdom of Bahrain
**National Energy
Efficiency**
Action Plan
(NEEAP)

**January
2017**

Endorsed by the Cabinet Resolutions No 2384-08 (2016) and No 2392-1 (2017)

Disclaimer: The SEU team has made efforts to use the latest data available and to ensure the accuracy of the content. Nevertheless, the Government of Bahrain, the UNDP, and the SEU accept no liability nor give any guarantee for the validity, accuracy, and completeness of the information provided. They assume no legal liabilities for damages, material or immaterial in kind, caused by the use or non-use of provided information or the use of erroneous or incomplete information. This Plan is a living document that looks out to long-term needs and will be modified to reflect new information and changing conditions.

ACKNOWLEDGEMENTS

The Minister of Electricity and Water Affairs would like to thank the First Deputy Prime Minister's Office, the Electricity and Water Authority, the National Oil and Gas Authority, the Ministry of Housing, the Ministry of Works, Urban Planning and Municipalities, the Ministry of Industry Commerce and Tourism, the Ministry of Transport and Telecommunications, the Bahrain Defense Force, the Economic Development Board, the Supreme Council for Environment, large industry groups, academia, and all others who provided support in the preparation of this Plan with their valuable inputs, time, guidance, and expertise.

“Bahraini nationals and residents enjoy a sustainable and attractive living environment

Protecting our natural environment will include implementing energy-efficiency regulations (e.g., for buildings and electrical appliances); and directing investments to technologies that reduce carbon emissions, minimize pollution and promote the sourcing of more sustainable energy”.

- Bahrain Economic Vision 2030



**His Royal Highness
Prince Khalifa Bin Salman Al Khalifa**
The Prime Minister



**His Majesty
King Hamad Bin Isa Al Khalifa**
The King of Bahrain



**His Royal Highness
Prince Salman Bin Hamad Al Khalifa**
The Crown Prince and Deputy Supreme
Commander and First Deputy Prime Minister



Foreword



The Minister of Electricity and Water Affairs:
His Excellency, **Dr. Abdul Hussain bin Ali Mirza**

The government of the Kingdom of Bahrain is committed to the sustainability of the country's natural resources for future generations, as well as the protection of the environment. There is considerable potential for undertaking energy efficiency and renewable energy initiatives in Bahrain, which will extend the lifetime of oil and gas reserves, and enable long-term sustainable development. Bahrain's Economic Vision 2030 puts special emphasis on providing incentives for reducing and managing electricity demand, and investing in clean energy technologies; promoting energy efficiency standards to ensure sustainability; and ensuring better energy and water demand management.

Progress has already been achieved, indeed Bahrain has been a pioneer on the way to a more sustainable future. The Kingdom was one of the first countries to install utility-scale wind turbines on a new commercial development, the iconic World Trade Center in 2008; and Bahrain was the first country in the GCC to have a district cooling system. There are already several private sector renewable energy systems in operation; and a number of initiatives are underway to facilitate more efficient energy use.

In order to unify and consolidate efforts on energy efficiency and renewable energy, the Sustainable Energy Unit was established in November 2014. The Sustainable Energy Unit is mandated to develop strategies and policies for the integrated planning of energy sources in the Kingdom, as well as the rationalization of energy use, and to raise efficiency in all sectors through coordination with all concerned parties. To this end, the Sustainable Energy Unit, in consultation with key stakeholders, has formulated the National Renewable Energy Action Plan and the National Energy Efficiency Action Plan, which were endorsed by the Cabinet (resolution no. 2384-08).

These plans are an important milestone in setting out Bahrain's national targets for renewable energy deployment and the adoption of energy efficiency initiatives. As such, they represent the Kingdom's efforts to deliver the sustainable energy transition envisioned in the Economic Vision 2030 and the Government Action Plan 2015-2018. The plans also represent the implementation of the Kingdom's regional and international commitments under the Paris Agreement, the United Nations Sustainable Development Goals, and the League of Arab States Renewable Energy Framework and Guidelines on Energy Efficiency.

The initiatives within the plans, with the support of leadership across all ministries, and from key stakeholders and members of society, will enable the Kingdom's sustainable future. By working together, Bahrain can achieve its sustainable energy objectives, which will benefit the Kingdom economically and environmentally.



SUSTAINABLE DEVELOPMENT GOALS

1 NO POVERTY 	2 ZERO HUNGER 	3 GOOD HEALTH AND WELL-BEING 	4 QUALITY EDUCATION 	5 GENDER EQUALITY 	6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY 	8 DECENT WORK AND ECONOMIC GROWTH 	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 	10 REDUCED INEQUALITIES 	11 SUSTAINABLE CITIES AND COMMUNITIES 	12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION 	14 LIFE BELOW WATER 	15 LIFE ON LAND 	16 PEACE, JUSTICE AND STRONG INSTITUTIONS 	17 PARTNERSHIPS FOR THE GOALS 	

Foreword



United Nations Resident Coordinator and United Nations Development Programme Resident Representative:

Mr. Amin Al Sharkawi

In recognition of both the need and potential to diversify Bahrain's energy sector to include renewable sources, and to develop innovative ways to ensure the most efficient use of energy, the UNDP has been working with the Government of Bahrain for a number of years to respond to the important issue of sustainable energy. The UNDP is delighted to support the Office of the Minister of Electricity and Water Affairs in establishing the Sustainable Energy Unit, for the benefit of the people of Bahrain, and to further the sustainable development of the country.

The publication of the National Renewable Energy Action Plan and the National Energy Efficiency Plan is an important milestone in Bahrain's national development. The leadership of the Kingdom of Bahrain is to be applauded for taking active steps towards a sustainable future.

The plans align closely with the framework of the UN Secretary General's Sustainable Energy for All (SE4All) Initiative that supports universal access to modern energy services, acceleration in energy efficiency improvements, and the increased use of renewable energy in the energy mix.

It also supports the 2030 Agenda for Sustainable Development which includes the United Nation's 17 Sustainable Development Goals for social progress, economic growth and environmental protection. By focusing on renewable energy and energy efficiency, the Kingdom of Bahrain is supporting the realization of the United Nations Sustainable Development Goal No. 7: Ensuring access to affordable, reliable, sustainable and modern energy for all.

The Bahraini National Renewable Energy Action Plan and the National Energy Efficiency Action Plan are on par with similar initiatives in other Arab countries, and will help to promote the exchange of successful international experiences for the benefit of Bahrain's ambitious development agenda.

To achieve these objectives, the UNDP will facilitate access to expertise from within the UN system and the international energy community. Most importantly, the plans will become a building block to achieve Bahrain's Economic Vision 2030 and has energy efficiency and renewable energy as top priorities. This vision marks a new era of development and modernization for the Kingdom of Bahrain and the UNDP will continue to support Bahrain's leadership in implementing these important sustainable energy initiatives.

Table of Contents

Acronyms and Abbreviations	12
Executive Summary	13
Target	14
Benefits and Impact	14
The Initiatives	15
Governance	16
1. Energy Sector Overview	18
1.1 Oil and Gas	18
1.2 Energy Intensity and Greenhouse Gas Emissions.....	19
1.3 Power Sector	20
1.4 High Seasonal Peak Demand	23
1.5 Cost of Energy	23
2. Bahrain's Sustainable Energy Agenda	25
2.1 International Commitments	25
2.2 National Commitments.....	28
2.3 Sustainable Energy Unit.....	28
3. Energy Efficiency Action Plan	31
3.1 Introduction.....	31
3.2 Consolidating Existing Efforts	32
3.3 Establishing the Energy Baseline and Key Indicators	33
3.4 The National Energy Efficiency Target.....	35
3.5 Projected Energy Savings	35
4. Energy Efficiency Initiatives.....	37
4.1 Residential and Commercial.....	37
4.2 Government	50
4.3 Industry	56
4.4 Electricity	59
4.5 Transport.....	66
4.6 Cross Sectoral	70
5. Going Forward.....	77
5.1 Implementation	77
5.2 Coordination	78
5.3 Oversight	78
5.4 Monitoring and Evaluation	79
References.....	81

LIST OF TABLES AND FIGURES

List of Tables

Table 1: Bahrain’s Expected Energy Savings from the NEEAP	15
Table 2: Baseline Energy Indicators	34
Table 3: Sector-specific Energy Savings from the NEEAP.....	36
Table 4: Energy Efficiency Initiatives for the Residential and Commercial Sectors.....	39
Table 5: Energy Efficiency Initiatives for the Government Sector	50
Table 6: Energy Efficiency Initiatives for the Industrial Sector	57
Table 7: Energy Efficiency Initiatives for the Electricity Supply Sector.....	59
Table 8: Energy Efficiency Initiatives for the Transport Sector	67
Table 9: Cross Sectoral Energy Efficiency Initiatives.....	70

List of Figures

Figure 1: Overview of NEEAP Initiatives	15
Figure 2: Bahrain’s GDP composition	19
Figure 3: CO2 Emissions Per capita Comparison	19
Figure 4: Energy Intensity Comparison in 2014.....	20
Figure 5: Grid Electricity Consumption by Sector, 2014.....	21
Figure 6: Monthly Electricity Consumption by Sector, 2014.....	21
Figure 7: Per Capita Electricity Consumption: Top 5 Countries Last Decade	22
Figure 8: Projected Electricity Consumption Demand.....	22
Figure 9: Electricity and Water Tariff Increases	24
Figure 10: Bahrain’s National and International Commitments.....	25
Figure 11: Disaggregating Total Primary Energy Supply into Total Final Consumption	34
Figure 12: Grid Electricity Consumption by Sector over the Baseline Period	35
Figure 13: Disaggregating the National Target across the Sectors	36
Figure 14: Overview of Energy Efficiency Initiatives per Sector.....	37

ACRONYMS AND ABBREVIATIONS

AC	air conditioning
BHD	Bahraini dinar
CCGT	combined cycle gas turbine
CO ₂	carbon dioxide
EWA	Electricity and Water Authority
GCC	Gulf Cooperation Council
GDP	gross domestic product
GWh	gigawatt hours
HVAC	heating, ventilation, and air conditioning
INDC	intended nationally determined contribution
IWPPs	independent power and water producers
ktoe	thousand tonnes of oil equivalent
kW	kilowatt
kWh	kilowatt hours
LED	light-emitting diode
MEPS	minimum energy performance standard
MMbtu	million British thermal units
MW	megawatts
NEEAP	National Energy Efficiency Action Plan
NOGA	National Oil and Gas Authority
PEE	primary energy equivalent
PV	photovoltaic
RT	refrigeration tons
SDGs	sustainable development goals
SEU	Sustainable Energy Unit
SME	small and medium-sized enterprises
TFC	total final consumption
UNDP	United Nations Development Programme

EXECUTIVE SUMMARY

BACKGROUND

The Kingdom of Bahrain has witnessed significant growth over the past two decades, GDP has grown by almost 5% per year, driven by an increasingly diversified economy and an educated population, as well as substantial investment in infrastructure. Bahrain is classified as a high-income country, with per capita wealth in 2015 double the world average. The Kingdom's economic growth has been underpinned by a secure energy system, which has seen a corresponding growth in energy demand.

Over the past twenty years, Bahrain's total primary energy supply grew by 4.2%, total final energy consumption grew by 5.3%, and non-industrial electricity consumption grew by 6.6% per year. This growth has placed increasing strain on the energy system. Today the Kingdom's power generation system relies exclusively on natural gas, which is a scarce and diminishing resource. Current projections on the availability of gas reserves suggest that Bahrain will no longer be able to meet its domestic consumption, and will have to rely on imported gas as early as 2018. An increased reliance on imported energy is highly likely to mean an increase in energy prices for consumers.

Ensuring the availability of oil and gas for future generations, and reducing the growth in Bahrain's CO₂ emissions, requires resources to be consumed as efficiently as possible. Bahrain has high potential to realize multiple benefits from a national energy efficiency programme. Pursuing energy efficiency can help the Kingdom to stimulate more efficient use of electricity and optimize the use of indigenous gas resources, decrease peak electricity demand, and promote investment, employment and innovation in energy efficient products and services.

The government of Bahrain has taken a number of critical steps to shift the country towards more efficient consumption of energy. It has implemented electricity and transport subsidy reforms, and introduced important regulations, such as minimum energy performance standards for air conditioners and lighting products.

The National Energy Efficiency Action Plan (NEEAP) builds on existing achievements, and includes a comprehensive set of initiatives to unlock further energy efficiency potential in the Kingdom. The Plan identifies specific programs and new initiatives across various sectors, and encompasses energy efficiency plans developed by individual institutions. The Plan sets a national target for energy savings, identifies implementing mechanisms, and provides estimates of energy and monetary savings.

The Plan is in line with the Economic Vision 2030 and the Government Action Plan 2015-2018, which call for conservation of natural resources through implementing energy efficiency programs. It also represents the implementation of the Kingdom's regional and international

commitments under the Paris Agreement, the United Nations Sustainable Development Goals, and the League of Arab States Guidelines on Energy Efficiency.

The NEEAP has been prepared by the Sustainable Energy Unit (SEU) which reports directly to HE Minister of Electricity and Water affairs through broad consultation with key stakeholder groups, including the Electricity and Water Authority; the National Oil and Gas Authority; the Ministry of Housing; the Ministry of Works, Urban Planning and Municipalities; the Ministry of Industry, Commerce and Tourism; the Supreme Council for the Environment; the Bahrain Defense Force; large industry groups; and academia.

TARGET

A comprehensive process of consultation and engagement was undertaken to determine a feasible national energy efficiency target for Bahrain. Based on a balance between technical and economic potential, and taking into account institutional capacity to deliver energy savings, a national target of 6% has been adopted. The target is set as a reduction of energy consumption in the year 2025, expressed as a percentage of the average final energy consumption during the baseline period (2009-2013).

BENEFITS AND IMPACT

Pursuing energy efficiency can help Bahrain to stimulate more efficient use of electricity and optimize the use of indigenous gas resources, decrease peak electricity demand, and promote investment, employment and innovation in energy efficient products and services. The expected outcomes from the NEEAP will reduce greenhouse gas emissions, make the economy more competitive, and improve energy security in the long-term.

Achieving the 6% national energy efficiency target will result in:

- Energy savings of 5,800 GWh on a primary energy equivalent basis in year 2025
- Cumulative government monetary savings of BHD 82 million
- Avoided investments in electricity generation of BHD 172 million
- Anticipated financial impact of BHD 230 million, after deducting the cost of implementation
- Cumulative reduction in greenhouse gas emissions of 3.4 million tonnes of CO₂

The target and savings in GWh are calculated on a Primary Energy Equivalent (PEE) basis, and includes transport, industry, and electricity supply as sectors covered under the Plan.

THE INITIATIVES

To achieve the national target, and realize energy and monetary savings, a total of 22 initiatives are included within the Plan. The initiatives cover all sectors of the economy, and target efficiency improvements in both energy supply and demand, as shown in Figure 1.

Figure 1: Overview of NEEAP Initiatives

RESIDENTIAL & COMMERCIAL	Building Energy Efficiency Code	Min Energy Performance Standards & Labeling: Lighting	Min Energy Performance Standards & Labeling: AC	Min Energy Performance Standards & Labeling: Appliances
	Building Energy Labeling	Green Building Initiative	District Cooling	
GOVERNMENT	Government Building Energy Management	Government Building Lighting Replacement	Street Lighting Refurbishment	Green Public Procurement
INDUSTRY	Industry Program			
ELECTRICITY	Electricity Production Efficiency	Transmission & Distribution Efficiency	Power Factor Correction	Smart Metering
TRANSPORT	Vehicle Efficiency Standards & Labeling	Transport Subsidy Reform		
CROSS SECTORAL	Electricity Subsidy Reform	Awareness & Information Dissemination	Training for Market Actors	Institutional Infrastructure

The NEEAP initiatives are expected to generate energy savings in all sectors, as shown in Table 1.

Table 1: Bahrain's Expected Energy Savings from the NEEAP

Sector	Expected Savings in 2025 (GWh on Primary Energy Equivalent Basis)
	Target
Residential & Commercial	3,010
Government	308
Industry	786
Electricity	975
Transport	253
Cross Sectoral	460
6% National Target	5,792

Achieving the national energy efficiency target will involve concerted action on the part of all stakeholders, including multiple ministries. The following entities will be directly engaged in the implementation of the initiatives:

- Electricity and Water Authority;
- Ministry of Finance;
- Ministry of Industry, Commerce and Tourism;
- Ministry of Housing;
- Ministry of Transportation and Telecommunication;
- Ministry of Works, Municipalities and Urban Planning;
- National Oil and Gas Authority;
- Supreme Council for the Environment;
- Large industrial companies such as Alba, BAPCO, Tatweer, GPIC, and Foulath Holding; and
- Sustainable Energy Unit.

GOVERNANCE

I. SUSTAINABLE ENERGY UNIT

The Sustainable Energy Unit (SEU) was established in November 2014 and is the designated agency for promoting sustainable energy policies and practices in the Kingdom of Bahrain. As such, SEU will lead the coordination efforts in implementing the NEEAP, and will provide technical assistance in the design and implementation of specific initiatives. SEU's responsibilities are to:

- Coordinate implementation activities among all stakeholders through developing partnerships and organizing regular coordination meetings;
- Inform stakeholders on the progress of implementing the NEEAP;
- Draft energy efficiency policies and regulations, and support the establishment of standard operating procedures for their implementation;
- Carry out feasibility studies, cost-benefit analysis of various technology options and business models, as well as oversee the implementation of pilot projects;

- Conduct monitoring and evaluation of initiatives, and calculate energy and monetary savings;
- Provide technical assistance in developing tendering documents, drafting requests for proposals, and assessing outcomes of pilot projects;
- Carry out information dissemination and awareness raising campaigns through launching a dedicated website, organizing press conferences, and promoting energy efficiency at various public events;
- Organize and support capacity building and training activities for government and non-government stakeholders.

II. NEEAP IMPLEMENTATION FOLLOW-UP COMMITTEE

The Committee will be composed of high-level representatives of key government and non-government institutions who would play the role of change agents to provide guidance, support and oversight of the implementation process of NEEAP. The Committee will be chaired by the Minister of Electricity and Water Affairs and may include representatives from the Electricity and Water Authority, the Ministry of Finance, the Office of the First Deputy Prime Minister, the Ministry of Industry and Commerce, the Ministry of Housing, the Ministry of Works, Urban Planning and Municipalities, the Ministry of Oil, and the Supreme Council for Environment. The Committee will meet on a quarterly basis. The Committee's responsibilities are to:

- Oversee the implementation of the NEEAP and facilitate its execution;
- Identify action items to overcome implementation issues and challenges;
- Put recommendations and suggest actions to relevant ministries;
- Decide on making changes to the NEEAP if required;
- Discuss the progress on the implementation process.

SEU under the guidance of the Minister of Electricity and Water Affairs will lead the coordination of the implementation of the Plan. SEU will also act as the 'national mandated entity' for the purposes of reporting under the Arab Guidelines on Energy Efficiency.

1. ENERGY SECTOR OVERVIEW

1.1 OIL AND GAS

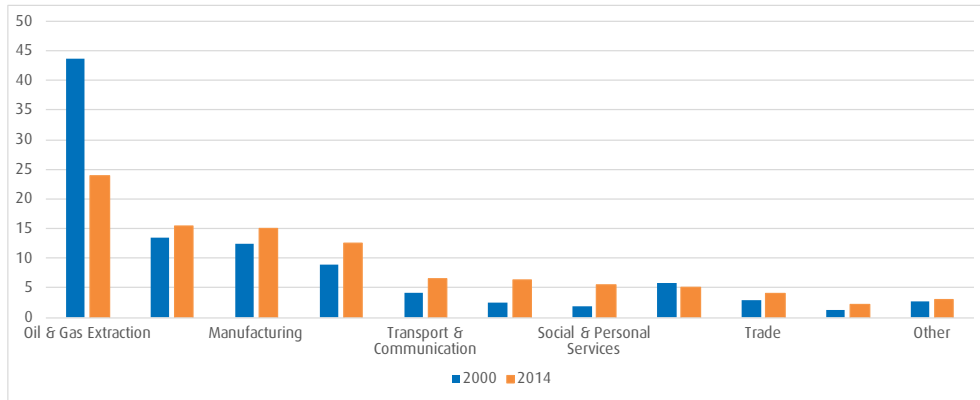
The Kingdom of Bahrain has witnessed significant growth over the past two decades, GDP has grown by almost 5% per year, driven by an increasingly diversified economy and an educated population, as well as substantial investment in infrastructure. Bahrain is classified as a high-income country, with per capita wealth double the world average in 2015. The Kingdom's economic growth has been underpinned by a secure energy system, which has seen a corresponding growth in energy demand. Over the past twenty years, Bahrain's total primary energy supply grew by 4.2%, total final energy consumption grew by 5.3%, and electricity consumption excluding industry grew by 6.6% per year [1]. This growth has placed increasing strain on the energy system.

To meet domestic energy demand, Bahrain relies entirely on its indigenous hydrocarbon resources. In 2014, Bahrain's total energy consumption came from two sources: oil (17%) and natural gas (83%). Bahrain was the first country in the GCC region to discover oil reserves in 1932, crude oil production reached its peak in 1970, and since then it has been gradually declining. In 2014, crude oil production amounted to 202,000 barrels a day [2], and at current production levels, the oil reserves have a projected lifetime of around 11 years.

Natural gas is the backbone of the energy system and economy of Bahrain. It is the sole energy source for Bahrain's power and water generation. Natural gas is also economically critical for the operation of the Kingdom's industries. Today all natural gas is used for domestic consumption: 41% by the manufacturing sector; 33% for power and water generation; and 25% is re-injected for enhanced oil recovery [3]. The projected lifetime of natural gas reserves is around 15 years. Current projections on the availability of gas reserves suggest that Bahrain will no longer be able to meet its domestic consumption, and will have to rely on imported gas as early as 2018, at an expected price higher than that currently paid by Bahrain's gas users. Ensuring the availability of oil and gas for future generations, and reducing the growth in Bahrain's CO₂ emissions, requires resources to be consumed as efficiently as possible.

To realize Bahrain's Economic Vision 2030, the government has adopted a policy of diversifying the economy. Figure 2 shows how the Kingdom's economy has transitioned from a dominant hydrocarbon sector to a more diversified economy, over the period to 2014. However, the relatively limited hydrocarbon exports continue to be one of the main sources of national income. In 2014, oil & gas extraction was the largest contributor to GDP (around 24%), followed by financial services (16%) and manufacturing (around 15%) [4]. Currently, Bahrain has developed the most diversified economy in the GCC region. The three fastest growing sectors over the past decade were social and personal services; construction; and transportation and communication.

Figure 2: Bahrain's GDP composition

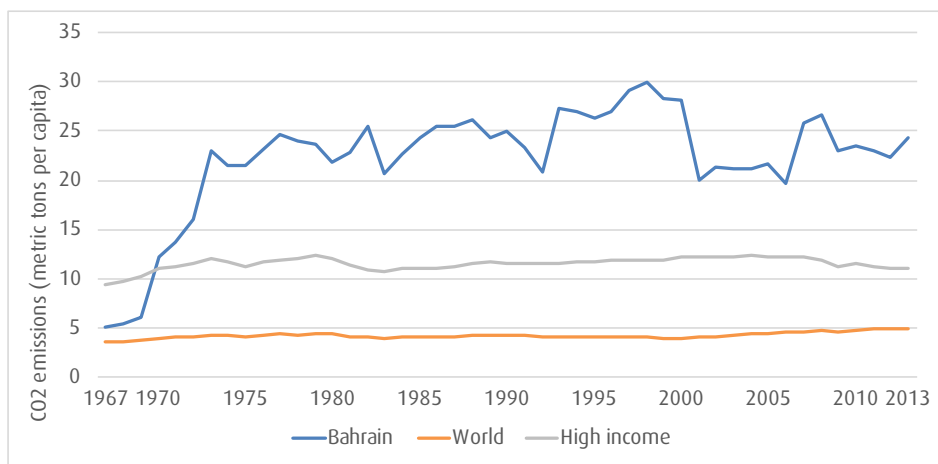


Data Source: Information & eGovernment Authority

1.2 ENERGY INTENSITY AND GREENHOUSE GAS EMISSIONS

The energy sector in Bahrain remains the largest source of greenhouse gas emissions in the Kingdom, contributing 77% to total emissions [5]. Figure 3 shows Bahrain's CO₂ emissions per capita over the last fifty years [6]. Although Bahrain makes relatively minor contributions to global greenhouse gas emissions, Bahrain's per capita emissions are amongst the highest in the world and continue to trend upwards. In 2013, Bahrain's per capita CO₂ emissions were twice the average of the high-income country, and almost five times higher than the world average. Relatively high per capita emissions are attributed to Bahrain's small land size, population density, harsh climate conditions, scarcity of water resources, and heavy reliance on energy intensive desalination plants [5]. Implementing energy efficiency and renewable energy policies has high potential to reduce the Kingdom's greenhouse gas emissions.

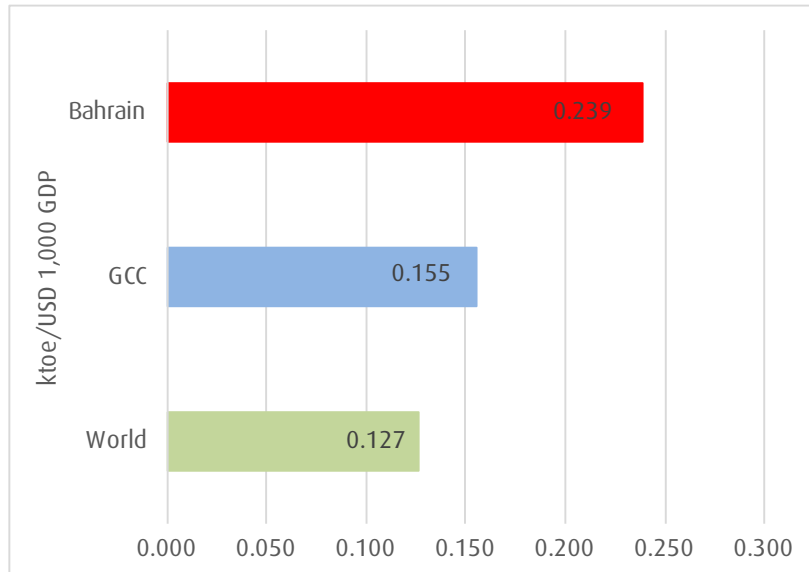
Figure 3: CO₂ Emissions Per Capita Comparison



Data Source: World Bank, World Development Indicators, 2016

Energy intensity is the ratio of energy consumption to GDP, and is a standard measure for how efficiently energy is used in a country. Bahrain's energy intensity is 54% higher than the GCC average, and 88% higher than the world average [6], as depicted in Figure 4.

Figure 4: Energy Intensity Comparison in 2014



1.3 POWER SECTOR

In 2014, the Kingdom had 6,204 MW of installed electricity generation capacity. Of this, 2,274 MW are captive power plants, owned and operated by large industry groups such as Alba, BAPCO and GPIC. Independent power and water producers (IWPPs) own and operate 3,100 MW, and EWA owns and operates 825 MW [9]. In addition, Bahrain can import and export electricity through its 600 MW capacity interconnection with the GCC Interconnection Authority. Power produced by captive power plants is consumed on site by large industry groups. Power produced by the IWPPs and EWA is distributed and sold to customers by EWA. EWA is the sole body responsible for electricity transmission, distribution, and grid operation.

In 2014, the Kingdom consumed 24,705 GWh. Grid electricity supplied by EWA accounted for 15,186 GWh, or 66% of total electricity consumption. The remaining 34% was generated and consumed by large industry. The residential sector uses most of the grid electricity, at 46% of total grid consumption, as shown in Figure 5. The commercial sector is the second-largest user accounting for 36.4%, followed by industry at 17.3%.

Figure 5: Grid Electricity Consumption by Sector, 2014

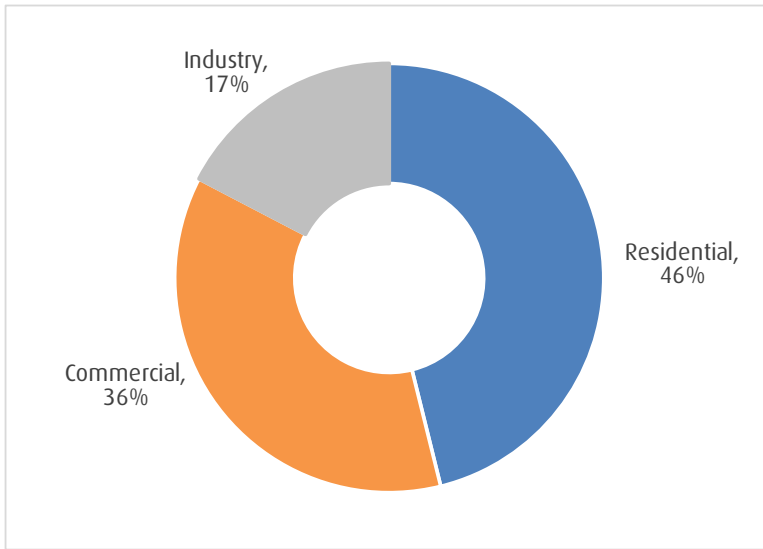
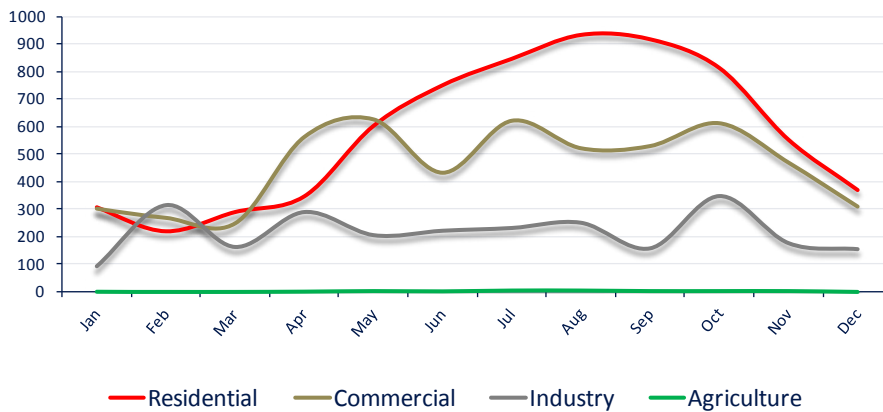


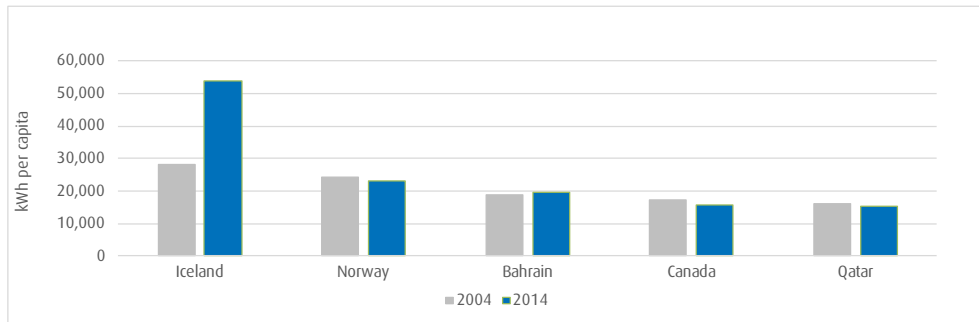
Figure 6 shows the monthly electricity consumption by sector in 2014. The electricity consumed by industry can be considered baseload, given the consumption profile. The residential and commercial sectors demonstrate much higher demand during the summer months, when the weather necessitates increased use of air conditioners for cooling.

Figure 6: Monthly Electricity Consumption by Sector, 2014



Despite the global trend for consumption per capita to decrease, with per capita electricity consumption of 19,592 kWh in 2014, Bahrain remains in the top five countries with the highest per capita electricity consumption in the world [6], as shown in Figure 7.

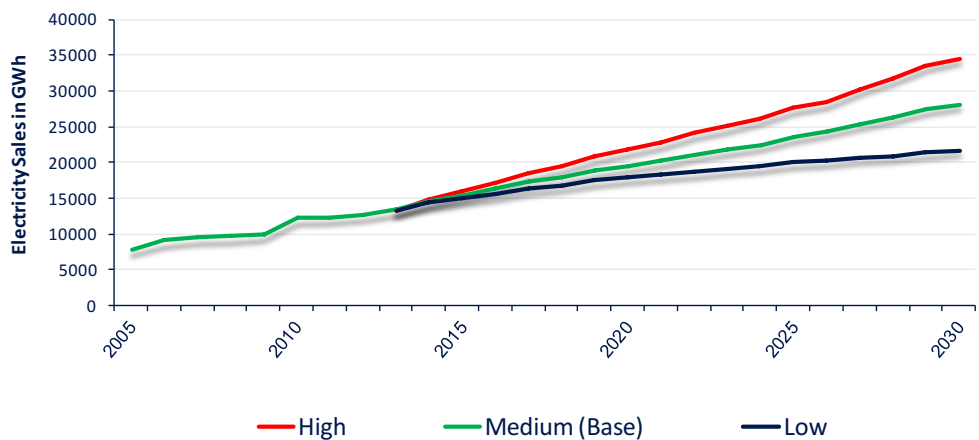
Figure 7: Per Capita Electricity Consumption: Top 5 Countries Last Decade



Bahrain’s high consumption figures are a result of the energy system being characterized by the large presence of energy intensive industries such as aluminum smelting, oil refining, petrochemicals, and steel. Many of these industries have their own captive power plants. Industry accounts for (41%) of final energy consumption, followed by the transport sector (31%), the residential sector (18%), and the government sector (11%) [1].

Grid electricity consumption grew from 5,516 GWh in 2000, to 15,186 GWh in 2014 (an annual average growth rate of 7.5%) [9]. With the current projections of population growth, economic development, and expansion of industries, the demand for energy will increase. EWA has projected electricity demand for 2020 and 2030 under three growth scenarios starting from 2013: low, medium, and high, depicted in Figure 8. According to these projections under the low growth scenario the demand for grid-supplied electricity will reach 21,700 GWh in 2030, under the medium growth scenario demand will nearly double reaching 28,180 GWh, and under the high scenario demand will reach 34,550 GWh in 2030.

Figure 8: Projected Electricity Consumption Demand



Source: EWA

1.4 HIGH SEASONAL PEAK DEMAND

Similar to other GCC countries, Bahrain has a large seasonal variation in electricity consumption. Due to very hot summers, electricity consumption during the months from May to October increases significantly. This is mainly due to the heavy use of AC units, which account for 60%-65% of electricity usage in buildings. In 2014, the highest peak electricity consumption occurred in August (1,720 GWh) and the lowest electricity consumption occurred in January (701 GWh) [9]. Total electricity consumption in August was two and a half times higher electricity consumption in January.

Aside from seasonal peaks, Bahrain also has daily electricity consumption peaks. Bahrain has two daily peaks: the first peak occurs between 11:00 and 16:00, and the second occurs between 18:00 and 19:00. On a typical summer day (30 August 2015), the first peak consumption occurred at 13:39 reaching 3,441 MW, and the second peak occurred at 18:36 reaching 3,189 MW. These numbers are compared with electricity consumption during a typical winter day (30 January 2015), when the first peak occurred at 12:06 reaching 1,137 MW, and the second peak occurred at 18:09 reaching 1,208 MW [9].

To meet peak demand, the government needs to maintain extra generation capacity, which is a costly activity. According to the World Bank analysis of the 2014 demand curve, the network required an additional 500 MW which operates for less than 50 hours a year. The estimated cost to the government to maintain 500 MW over a 20-year period is over USD 600 million. This amount excludes fuel costs of producing electricity, and variable operation and maintenance costs [8]. Energy efficiency initiatives can contribute to significantly reducing peak load demand.

1.5 COST OF ENERGY

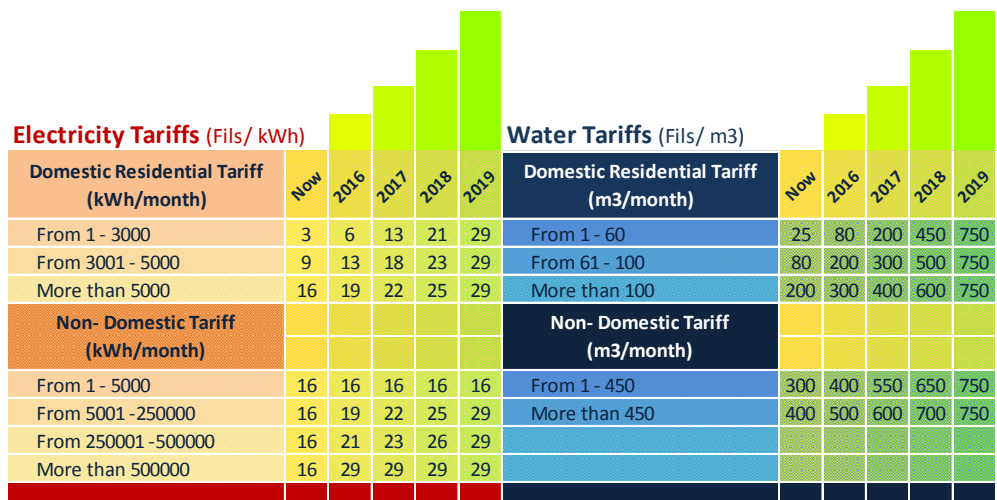
As the population continues to grow, and the limited amount of fossil fuels begins to diminish, it may not be possible for Bahrain to meet its growing energy demand without relying on imported energy. Bahrain is already planning to import natural gas as early as 2018, and steps are underway to complete the construction of an LNG import facility. An increased reliance on imported energy is highly likely to mean an increase in energy prices for consumers.

In anticipation of the diminishing gas supply, the government adopted a new gas pricing policy in 2015. Under this policy, the price of natural gas sold to domestic companies will increase by USD 0.25 per MMBtu each year on 1 April. The pricing policy will be reviewed when the price reaches USD 4 per MMBtu by 1 April 2021 [3]. The first price increase took place on 1 April 2015, from USD 2.25 to 2.50 per MMBtu. Adopting energy efficiency policies will help Bahrain reduce its reliance on imported energy, prolong the lifetime of the indigenous natural gas resource, and optimize its economic value. This approach will improve energy security in the long-term and will have a positive impact on Bahrain's economic competitiveness, and the environmental performance of the energy sector overall.

Electricity in Bahrain is entirely produced from natural gas; therefore, the cost of power generation largely depends on the gas price. The current cost of power generation is 22 fils/kWh. Electricity transmission costs 3.3 fils/kWh, and distribution costs 3.7 fils/kWh. Therefore, it costs 29 fils/kWh for EWA to supply power to end customers. This cost is based on a natural gas price of USD 2.5 per MMBtu. As the cost of natural gas will increase by USD 0.25 per year, the cost of electricity supply will also increase. According to estimations, the cost of electricity supply (including transmission and distribution costs) from natural gas could increase to 36 fils/kWh by 2020, based on the planned gas price increases.

Up until recently electricity and water tariffs were subsidized. Effective from 1 March 2016, new electricity and water tariffs have been applied to electricity and water consumers, in accordance with the new tariff schedule announced by EWA. The electricity tariffs will be gradually increased to meet the cost of power generation of 29 fils/kWh by 2019. The new tariffs are applicable to all residential, commercial and industrial consumers. Bahraini citizens holding a single EWA account are exempt from tariff increases [10].

Figure 9: Electricity and Water Tariff Increases

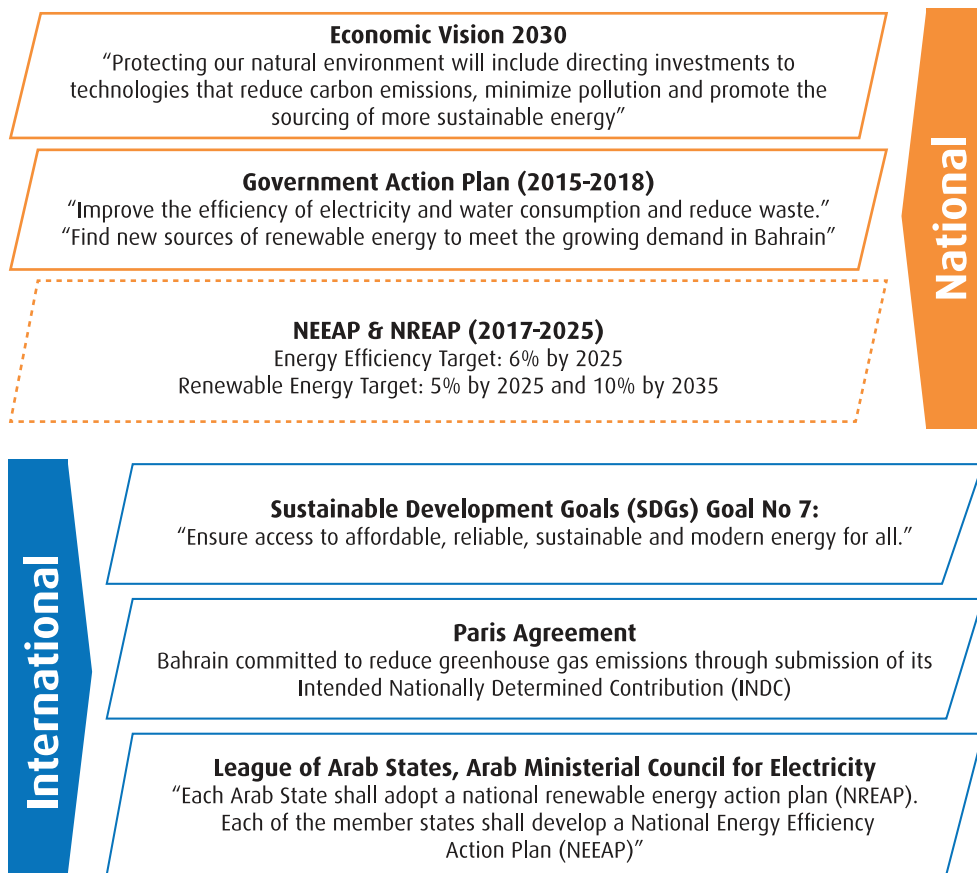


* Electricity and water tariff increases do not apply to Bahraini nationals holding a single EWA account

2. BAHRAIN'S SUSTAINABLE ENERGY AGENDA

The Kingdom of Bahrain is committed to the development of sustainable energy envisioned in the Economic Vision 2030, the Government Action Plan 2015-2018, and as a party to regional and international agreements.

Figure 10: Bahrain's National and International Commitments



2.1 INTERNATIONAL COMMITMENTS

THE PARIS AGREEMENT

In December 2015, the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change took place in Paris (COP21). As a result, 195 nations adopted the Paris Agreement to take action toward holding the increase of global average temperature to well below 2°C above pre-industrial levels. The Paris Agreement is a historic agreement to combat climate change, and accelerate actions and investments needed for a sustainable

low carbon future. On 22 April 2016 Bahrain signed the Paris Agreement, and expressed its support through publication of its Intended Nationally Determined Contribution (INDC) in November 2015 [11].

The INDC is an official pledge by the Kingdom to support the global efforts in combating climate change by taking specific actions to reduce the country's greenhouse gas emissions. Energy efficiency and renewable energy represent key initiatives in Bahrain's INDC, as both hold great potential to reduce greenhouse gas emissions, as well as to promote sustainable development.

THE UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

In September 2015, at the United Nations Sustainable Development Summit, world leaders officially adopted a new agenda entitled "Transforming Our World: The 2030 Agenda for Sustainable Development." The new global agenda includes 17 Sustainable Development Goals (SDGs) and 169 targets. The SDGs represent a consensus of the 193 member states of the United Nations to end poverty, protect the planet, and ensure the prosperity for all. SDG 7 calls on countries to "Ensure access to affordable, reliable, sustainable and modern energy for all." [12]. This goal is supported by five targets to be achieved by 2030:

- Ensure universal access to affordable, reliable and modern energy services
- Increase substantially the share of renewable energy in the global energy mix
- Double the global rate of improvement in energy efficiency
- Enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology
- Expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programs of support.

The government of the Kingdom of Bahrain embraced the challenge of meeting the Millennium Development Goals by 2015, and expressed its commitment to the post-2015 development agenda process at the press conference in the UN Sustainable Development Summit held on 20 September 2015.

LEAGUE OF ARAB STATES – ENERGY EFFICIENCY GUIDELINES

In November 2010, the Arab Ministerial Council for Electricity of the League of Arab States adopted “The Arab Guideline for Improving Electricity Efficiency and Rationalizing its Consumption at The End User” [13]. The main purpose of the Guidelines is to promote the cost-effective improvement of end use electricity in Arab countries (efficiency and conservation) through guidance, methodologies and templates for setting an energy efficiency target and developing energy efficiency measures.

The Guidelines mandate the member states to develop National Energy Efficiency Action Plans (NEEAPs) to achieve comprehensive energy savings by 2020. The Guidelines prescribe Arab country member states to:

- Disclose key indicators and set an energy efficiency indicative target calculated in accordance with the methodology in Annex “a” (Article III)
- Identify suitable energy efficiency measures to achieve the target (Article III:1)
- Assign responsibility to an entity for overall control of the NEEAP (Article III:2)
- Ensure an exemplary role of public sector (Chapter III)
- Ensure that energy distributors, distribution system operators and retail energy companies contribute to energy efficiency through various measures (Article V)
- Ensure that information about energy efficiency measures and mechanism reaches the relevant stakeholders (Article VI)
- Revise national legislation impeding or restricting the use of financial instruments (Article VIII)
- Consider restructuring electricity tariffs to encourage energy efficiency (Article IX)
- Provide necessary financial resources to support energy efficiency measures (Article X)
- Ensure availability of effective programs for energy audit services by independent bodies such as energy service companies or electric power distribution companies. (XI)

This Plan is drafted in accordance with the requirements of the Arab Guidelines. The target is calculated in accordance with the suggested methodology. The Plan ensures the exemplary role of the government sector and designates the SEU as the national mandated agency responsible for the preparation of the NEEAP.

2.2 NATIONAL COMMITMENTS

Pursuing energy efficiency is not only an international commitment of Bahrain, but also of national importance and is in line with the Kingdom's Economic Vision 2030. Economic Vision 2030 recognizes economic, social, and environmental sustainability as its key principles. It indicates explicitly that economic growth must never come at the expense of the environment and the long-term well-being of the people. Furthermore, it calls for implementing energy efficiency regulations and investment in technologies that reduce carbon emissions, minimize pollution and promote sustainable energy [14]. In clear recognition of the benefits of energy efficiency, Bahrain is committed to foster the development of low-carbon energy initiatives by unlocking the Kingdom's energy efficiency potential.

In 2015, the government adopted the Government Action Plan 2015-2018 to deliver sustainable change in line with the Economic Vision 2030. The Government Action Plan reflects Bahrain's strategic priorities over the next four years and seeks to capitalize on the Kingdom's resources and capabilities to meet the needs of all Bahrainis. Under the "Environment and Urban Development" pillar, the government made commitments to improve the efficiency of electricity and water consumption [15]. To achieve this, the government will seek to

- Increase education and awareness to reduce the waste of electricity and water;
- Adjust the cost of services and encourage the take up of technologies geared towards rationalization;
- Work on the adoption of smart distribution mechanisms, where possible and appropriate, in order to improve the management of energy and water resources;
- Develop building regulations to contribute to the rationalization of electricity consumption in all new buildings.

2.3 SUSTAINABLE ENERGY UNIT

In November 2014, under Cabinet Resolution 4/2238, the government established the Sustainable Energy Unit (SEU) to lead and promote sustainable energy policies and practices in the Kingdom of Bahrain. SEU was established under the office of the Minister of Energy with the support of the United Nations Development Programme (UNDP) [16]. Due to the broad central government restructuring in summer 2016, SEU became one of the initiatives governed by the Office of the Minister of Electricity and Water Affairs.

The key objectives of SEU are to develop a cohesive sustainable energy policy framework to promote renewable energy, energy efficiency, and conservation in the country. SEU will also work towards bridging the legal, institutional, and capacity gaps in order for Bahrain's energy sector to meet future challenges.

The mandate of SEU includes:

- Synergizing and consolidating existing efforts of public, private and international institutions in achieving goals as stated in the Bahrain Economic Vision 2030;
- Supporting the creation of an enabling environment for energy efficiency and renewable energy technology transfer, and private sector investments;
- Supporting the development of necessary policies, regulations, and standards across various sectors;
- Promoting replication and up-scaling of successful pilot projects and initiatives across the Kingdom;
- Strengthening national capacity on the deployment of renewable energy and energy efficiency technologies;
- Coordinating the implementation of national, regional, and international obligations relating to energy efficiency and renewable energy; and
- Raising public awareness on the benefits of energy efficiency and renewable energy.

The NEEAP represents one of the key components of the Kingdom's efforts to implement its national, regional, and international commitments in the field of energy efficiency and climate change mitigation. It identifies feasible energy efficiency initiatives, sets the national target, and proposes policies and actions to unlock Bahrain's energy efficiency potential.

SEU under the guidance of the Minister of Electricity and Water Affairs will lead the coordination of the implementation of the Plan. SEU will also act as the 'national mandated entity' under the Arab Guidelines on Energy Efficiency.



3. ENERGY EFFICIENCY ACTION PLAN

3.1 INTRODUCTION

Energy efficiency means using less energy for the same output or service, and in some cases the service can be improved (for example, the replacement of incandescent lamps with LEDs reduces energy consumption and produces fewer emissions, and also provides higher quality lighting). Energy efficiency is considered to be the first fuel by the International Energy Agency [17], a preferred source of energy that should be utilized ahead of other more costly sources, such as investing in new capacity. It has a key role in ensuring the competitiveness of businesses, in terms of financial and environmental considerations, by way of productivity gains throughout the economy, as a result of more efficient resource use and lower greenhouse gas emissions.

The practical aspect of energy efficiency is to reduce energy consumption, without degrading the quality of the final services or products, and it very often results in tangible monetary savings that can be used for other purposes. In the case of industry, energy efficiency initiatives improve productivity and competitiveness, and can reduce exposure to energy price volatility. For households, energy efficiency frees money for spend on other goods and services, or for savings and investments.

Bahrain has high potential to realize multiple benefits from a national energy efficiency programme. Pursuing energy efficiency can help the Kingdom to stimulate more efficient use of electricity and optimize the use of indigenous gas resources, decrease peak electricity demand, and promote investment, employment and innovation in energy efficient products and services.

The National Energy Efficiency Action Plan represents one of the key components of the Kingdom's efforts to implement its national, regional, and international commitments in the field of sustainable energy development and climate change. It takes a multi-pronged approach and builds on existing achievements, and presents a comprehensive set of initiatives to further unlock Bahrain's energy efficiency potential across its economy. The Plan identifies specific programs and new initiatives for all sectors, and encompasses energy efficiency plans developed by individual institutions.

The Plan sets a national target for energy savings, identifies implementing mechanisms, and provides estimates of energy and monetary savings. It encourages government to act as an exemplar, and in doing so, it provides the necessary guidance and leadership for all related parties. The initiatives encompass primary energy savings and end-use measures. A variety of policy mechanisms will be utilized as appropriate to deliver the national energy efficiency target, such as minimum energy performance standards and labeling, an energy efficiency building code, energy management in buildings, electricity and fuel price reforms, sectoral targets, as well as awareness raising and training.

The NEEAP has been prepared by SEU through broad consultation with key stakeholder groups including the Electricity and Water Authority; the National Oil and Gas Authority; the Ministry of Housing; the Ministry of Works, Urban Planning and Municipalities; the Ministry of Industry and Commerce; the Supreme Council for the Environment, the Bahrain Defense Force; large industry groups; and academia.

3.2 CONSOLIDATING EXISTING EFFORTS

The NEEAP draws together initiatives identified in “The EWA Energy Efficiency Action Plan for the Kingdom of Bahrain 2015-2020 (EWA-EEAP)”, and the “Kingdom of Bahrain Energy Efficiency Program (KEEP)” prepared by the World Bank in 2016, on behalf of the Ministry of Finance. Energy efficiency initiatives in Bahrain’s Intended Nationally Determined Contribution submission to the United Nations Framework Convention on Climate Change [11] have also been incorporated into this Plan.

In order to ensure coordination and that all relevant sectors are addressed, the NEEAP also includes initiatives to improve energy efficiency in other sectors as well, such as setting minimum vehicle emission standards for the transport sector, and the NEEAP also encompasses improving efficiency in electricity supply.

EWA ENERGY EFFICIENCY ACTION PLAN

In 2016, the Electricity and Water Authority (EWA) published the EWA-EEAP [18], the key measures of which have been directly incorporated into this Plan. As noted in the foreword to the EWA plan, “...this Plan includes 8 independent but correlated measures in the field of energy efficiency with respect to the various sectors of energy consumption. EWA-EEAP aims to achieve an indicative target for energy efficiency of 19% of the total expected electricity consumption in the year 2020, taking into consideration the present total electricity consumption and a consumption growth rate of 7%.” Achievement of the savings set out in the EWA-EEAP will make a significant contribution to achieving Bahrain’s national energy efficiency target. The 19% reduction equates to 4,394 GWh of savings (measured on a final energy basis).

In addition to taking responsibility for the delivery of a number of the important initiatives captured under the NEEAP, EWA has a critical role in the collection of data, to enable the calculation of savings delivered under this Plan.

THE KINGDOM OF BAHRAIN ENERGY EFFICIENCY PROGRAM

KEEP [8] was developed by a World Bank team in close coordination with key stakeholders, and under the leadership of the Ministry of Finance. It sets out several initiatives to reduce electricity consumption, in the residential, commercial, government, and SME sectors.

KEEP focuses on demand-side energy efficiency among grid-connected consumers; as such it excludes production and transmission. It sets a 20% national target for energy efficiency improvements by the year 2030, as well as a pathway for the design, implementation, and evaluation of 15 energy efficiency initiatives. KEEP provides the overall strategy and high-level design of the draft initiatives for the electricity sector. Those initiatives commencing prior to 2020 have been incorporated into the NEEAP.

BAHRAIN'S INTENDED NATIONALLY DETERMINED CONTRIBUTION

Bahrain is a party to the Paris Agreement, and expressed its support through publication of its Intended Nationally Determined Contribution (INDC) in November 2015 [11]. Several energy efficiency initiatives from the EWA-EEAP are included in the INDC, as well as key transport initiatives and those from large industry. These initiatives have been incorporated into the NEEAP.

3.3 ENERGY BASELINE AND KEY INDICATORS

According to the Arab Guidelines [13], the energy efficiency target should be expressed both as a percentage of the baseline consumption and specific GWh to be saved. Calculation of the baseline energy consumption should be the average amount of energy consumed during the last five years prior to adopting the NEEAP. To better characterize the baseline energy situation in Bahrain, the energy balance statistics compiled by International Energy Agency (IEA) have been used as a source [1]. The NEEAP takes the average of the last five years of published IEA energy balance data (2009-2013) for the Kingdom of Bahrain as the baseline period.

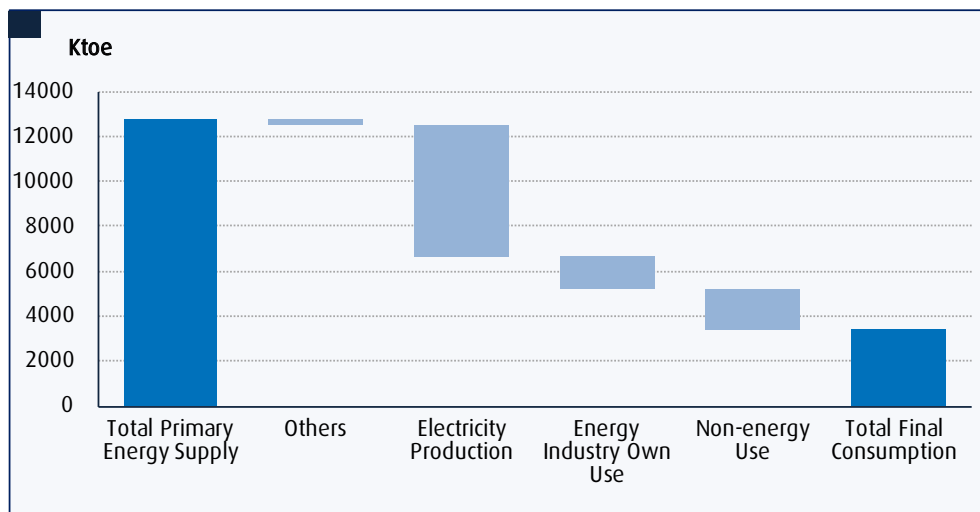
The target and savings in GWh are calculated on a Primary Energy Equivalent (PEE) basis, and includes transport, industry, and electricity supply as sectors covered under the Plan. PEE takes into account conversion losses in electricity generation and makes units of different energy streams (kWh of electricity, cubic feet of gas, and liters of gasoline) more comparable. A key principle underpinning the Plan is that all sectors of the economy should, if possible, contribute to the NEEAP.

According to IEA data [1], Bahrain uses almost three-quarters of its primary energy for electricity production, energy industry own use (includes gas reinjection) and non-energy use (such as to produce chemicals) as shown in Figure 11, resulting in total final consumption¹

¹ In the IEA energy balance, conversion of natural gas into chemicals is included in total final energy consumption. Bahrain converts a large percentage of its natural gas into chemicals, therefore there is a large difference between 'Total Final Consumption' and 'Total Final Consumption Excluding Non-Energy Use'. For clarity, the term 'Total Final Consumption' (TFC) refers to the TFC excluding non-energy use

equal to 27% of total primary energy supply This is due to the current relatively inefficient electricity production system, and the reinjection of a relatively large quantity of gas to support enhanced oil recovery.

Figure 11: Disaggregating Total Primary Energy Supply into Total Final Consumption



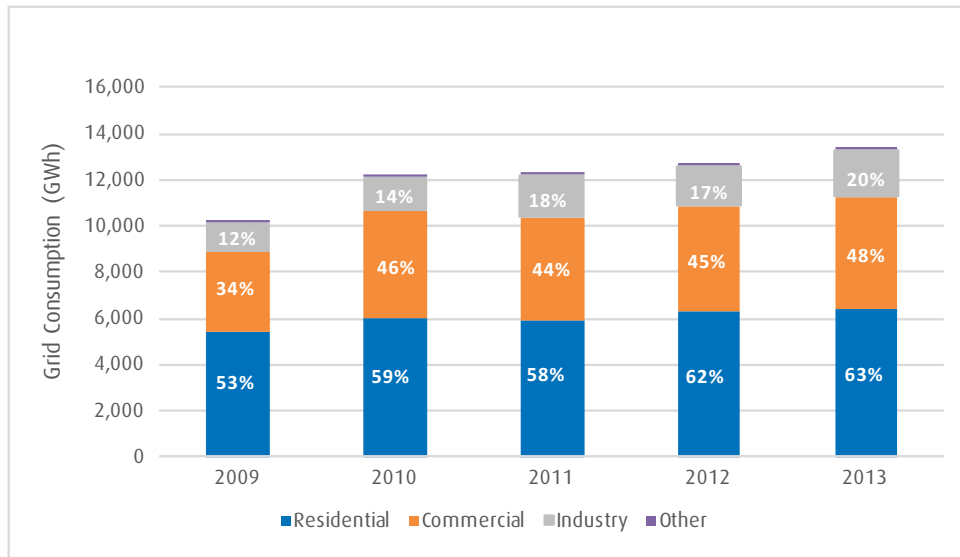
The Arab Guidelines on Energy Efficiency require reporting on key energy indicators (see Table 2). These indicators are computed based on statistics from EWA, the IEA, and the Arab Union of Electricity [19].

Table 2: Baseline Energy Indicators

	Indicator	Unit	2009 - 2013
1	Electricity intensity	GWh/GDP (USD)	0.801
2	Gross annual electricity generation (including IWPPs)	GWh	24,283
3	Imported electric power	GWh	138
4	Exported electric power	GWh	92
5	Electricity demand growth rate	%	%6.7
6	Primary energy consumption at the national level	Mtoe	12.73
7	Electricity share of primary energy consumption	%	%45.6
8	Share of grid electricity consumption by sector :		
	Residential	%	%49.5
	Commercial	%	%36.6
	Industry	%	%13.6
	Other	%	%0.4
9	Marginal Cost of Producing One kWh	USD/kWh	0.08
10	Electrification Rate	%	100.0

Aside from the agriculture sector (included in Other in Figure 12), the residential, commercial and industry sectors have experienced progressive growth in grid electricity consumption throughout the baseline period.

Figure 12: Grid Electricity Consumption by Sector over the Baseline Period



3.4 THE NATIONAL ENERGY EFFICIENCY TARGET

A comprehensive process of consultation and engagement was undertaken to determine a feasible national energy efficiency target for Bahrain. Based on a balance between technical and economic potential, and taking into account institutional capacity to deliver energy savings, a national target of 6% has been adopted. The target is set as a reduction of energy consumption in the year 2025, expressed as a percentage of the average final energy consumption during the baseline period (2009-2013).

3.5 PROJECTED ENERGY SAVINGS

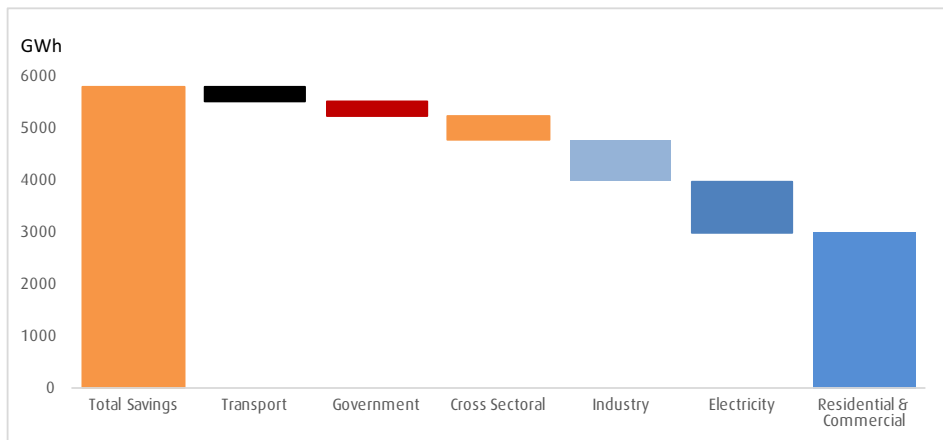
To achieve the national energy efficiency target, and realize energy savings, a total of 22 initiatives are set out in the Plan. The initiatives cover all sectors of the economy, and target efficiency improvements in energy supply and demand. As shown in Table 3, the initiatives are expected to collectively produce energy savings of 5,800 GWh on a primary energy equivalent basis in the year 2025, which is considered prudent given realized outcomes in other jurisdictions (including rebound effects).

Table 3: Sector-specific Energy Savings from the NEEAP

Sector	GWh (Primary Energy Equivalent Basis)		
	Baseline 2009-2013	Savings 2025	Cumulative 2016 - 2025
Residential & Commercial	35,372	3,010	8,559
Electricity		975	3,208
Government	2,259	308	962
Industry	46,642	786	1,966
Transport	12,253	253	643
Cross Sectoral		460	1,332
Total	96,527		
6% National Target		5,792	16,669

Initiatives grouped under the residential and commercial sectors are expected to make the largest contribution to the national target, as shown in Figure 13. Significant savings are also expected to be realized from the ongoing electricity and industry energy efficiency initiatives.

Figure 13: Disaggregating the National Target across the Sectors



It should be noted that the projected savings are best estimates, based on current data and assumptions. These estimations will be refined in the future as part of the detailed initiative design process and upon receipt of updated data from the key stakeholders. Developments among League of Arab States' members to harmonize calculation methodologies will also inform this process. SEU, in conjunction with the relevant stakeholders, will report back to the government of Bahrain on progress towards achieving the national energy efficiency target.

4. ENERGY EFFICIENCY INITIATIVES

To achieve the national target, and realize energy and monetary savings, the initiatives cover all sectors of the economy and target efficiency improvements in energy supply and demand, as summarized in Figure 14. This chapter presents a description of the initiatives and the accompanying implementation plan for each initiative, grouped by sector.

Figure 14: Overview of Energy Efficiency Initiatives per Sector

RESIDENTIAL & COMMERCIAL	Building Energy Efficiency Code	Min Energy Performance Standards & Labeling: Lighting	Min Energy Performance Standards & Labeling: AC	Min Energy Performance Standards & Labeling: Appliances
	Building Energy Labeling	Green Building Initiative	District Cooling	
GOVERNMENT	Government Building Energy Management	Government Building Lighting Replacement	Street Lighting Refurbishment	Green Public Procurement
INDUSTRY	Industry Program			
ELECTRICITY	Electricity Production Efficiency	Transmission & Distribution Efficiency	Power Factor Correction	Smart Metering
TRANSPORT	Vehicle Efficiency Standards & Labeling	Transport Subsidy Reform		
CROSS SECTORAL	Electricity Subsidy Reform	Awareness & Information Dissemination	Training for Market Actors	Institutional Infrastructure

4.1 RESIDENTIAL AND COMMERCIAL

OVERVIEW

Buildings consume nearly 40% of energy demand and account for around one third of greenhouse gas emissions globally. Energy efficiency initiatives deployed in buildings have long lasting implications because buildings last for 40-50 years or more. As such, if known energy efficiency best practices are implemented, global building energy demand could be reduced by one-third by 2050 [20].

Residential properties represent around 76% of Bahrain's housing stock, with commercial buildings accounting for around 17%. Total housing demand (Bahraini and non-Bahraini) is expected to increase to 263,536 housing units in 2020, and to 346,718 in 2030, from a current stock of 145,181 in 2013 [21]. The residential and commercial sectors therefore have high potential for significant energy efficiency improvements.

There are two major energy efficiency opportunities for the residential and commercial sectors in Bahrain; first to significantly reduce the electricity used in buildings, and second, to improve the thermal efficiency of buildings. The two are inextricably linked. Inefficient appliances and lighting generate heat, and inadequate thermal insulation allows heat from outside to enter the building. These three sources of heat place an extra load on the air conditioning system, which requires significant electricity during the summer months.

New build, or renovation, creates the opportunity to improve efficiency by building to a higher standard, and by introducing more efficient equipment. Alternative modes of cooling can also be considered, where technically and economically feasible, such as converting to district cooling instead of using standalone air conditioning.

The residential sector used most of the grid electricity, at 49.5% of total grid consumption, during the baseline period. The commercial sector was the second-largest user, accounting for 36.6% during the same period [8].

In recognition of the sectors' large consumption share, Thermal Insulation regulations were introduced in 1999 (Ministerial Order No. 8/1999), which mandated all buildings over four stories to be insulated, and stipulated minimum requirements for the efficiency of the envelope of residential and commercial buildings. In 2012, the regulations were extended to cover all buildings (Ministerial Order No. 63/2012).

Around 60% of the residential sector's annual electricity use is related to air conditioning, which is similar for the commercial sector, at 55% annual electricity use [8]. To improve the efficiency of AC units available for retail, the government enacted a Minimum Energy Performance Standard (MEPS) and energy efficiency labeling of small AC units (Ministerial Order No. 70/2015).

In regard to lighting, two regulations are in force which effectively ban the use of incandescent lamps in Bahrain: Cabinet Order. No. 6-14/2013 was enacted and implemented in 2014 on the minimum efficiency of household lamps; and a regulation for nondirectional household lamps was enacted (Ministerial Order No. 3/2015) to facilitate the phase out of incandescent lamps.

PROPOSED SECTOR INITIATIVES

Seven initiatives to improve energy efficiency in the residential and commercial sectors are summarized in Table 4. Some of these initiatives, such as minimum energy performance standards for lighting and small AC, have been already adopted and are in the process of implementation. Other initiatives are either in the early stages of development, or will be developed.

Table 4: Energy Efficiency Initiatives for the Residential and Commercial Sectors

Energy Efficiency Initiatives (Residential and Commercial)		Implementation Period	Potential Savings Year 2025 (GWh) PEE	Cumulative Savings 2016- 2025 (GWh) PEE
Green Building Initiatives:			1,814	4,909
1	Building Energy Efficiency Code	2017 - 2025	1,763	4,790
2	Building Energy Labeling Program	2017 - 2025	26	70
3	Green Building Certification Program	2019 - 2025	25	48
MEPS & Labeling:			1,129	3,547
4	Lighting	2015 - 2025	658	2,416
5	Air Conditioning	2016 - 2025	430	1,066
6	Appliances	2018 - 2025	41	64
7	District Cooling	2017 - 2025	66	103
Expected Contribution to 6% National Target			3,010	

The **Green Building Initiatives** aim to reduce the energy demand of buildings. Many countries have revised their building codes to require more efficiency to help to lock in energy savings in new buildings and renovations of existing buildings. Bahrain's **Building Energy Efficiency Code** initiative is an evolution of the existing thermal insulation regulations and will include additional requirements for various types of building systems. It will apply to new buildings and the renovation of existing buildings. For residential buildings, the Code might require increased efficiency of AC systems, lower shading coefficients for windows, reflective roofs and more efficient lighting systems. For commercial buildings, the Code might require improved building envelopes (including insulation, reflective roofs, window to wall limitations) and increased efficiency in HVAC, lighting, and water heating systems [8]. The Code will also need to align with the pending GCC building code. The Code will be complemented by the **Renewable Energy Mandate for New Buildings**, which is being implemented under the National Renewable Energy Action Plan. The Mandate will require renewable energy technologies to be integrated into the design of new buildings.

Under the **Building Energy Labeling** initiative an energy performance label for buildings will be developed. It will enable prospective tenants and buyers to take energy performance into consideration in their rental or purchase decision. International experience demonstrates that energy efficient buildings are commanding a premium when being rented or sold, and it therefore encourages building owners to implement energy efficiency measures to improve their rating. The key components of the initiative will include the development of energy audit procedures and tools, professional capacity building to conduct audits, and a national database.

The **Green Building Certification** initiative promotes the construction of more resource-efficient buildings through the adoption of a formal certification scheme. The Ministry of Works, Urban Planning and Municipalities has already implemented a set of green building criteria for new build and renovations of public buildings (CPD Green Building Design Guidelines, see Figure 15). A voluntary certification scheme based on the award of danats (a point system based meeting a set criteria) is being considered. In the meantime, real estate developers can apply, if they so wish, to international certification bodies such as LEED (Leadership in Energy & Environmental Design from the US), BREEAM (Building Research Establishment Environmental Assessment Methodology from Europe), or EDGE (Excellence in Design for Greater Efficiencies developed by the IFC) for independent certification of their projects.

Figure 15: CPD Green Building Design Guidelines

B-Green Green Building Design Guidelines

Project Title: _____
Job No: _____

Category UC	Urban Context	Compliance	
		Yes	No
UC.1	Load on Local Traffic Conditions		
UC.2	Pedestrian Pathways		
UC.3	Proximity to Amenities		
UC.4	Light Pollution		
UC.5	Noise Pollution		
UC.6	Public Transportation		
UC.7	Private Transportation		
UC.8	Sewer & Waterway Contamination		
UC.9	Shading of Adjacent Properties		
Category S	Site	Compliance	
		Yes	No
S.1	Ecological Value of Land		
S.2	Vegetation & Shading		
S.3	Desertification		
S.4	Rainwater Runoff		
S.5	Mixed Use		
S.6	Heat Island Effect		
S.7	Adverse Wind Conditions		
S.8	Acoustic Conditions		
S.9	Landscape Management		
Category W	Water	Compliance	
		Yes	No
W.1	Water Consumption		

1 of 2

Category E	Energy	Compliance	
		Yes	No
E.1	Energy Demand Performance		
E.2	Energy Delivery Performance		
E.3	Fossil Fuel Conservation		
E.4	CO ₂ Emissions		
E.5	NO _x , SO _x , & Particulate Matter		
Category M	Materials	Compliance	
		Yes	No
M.1	Regional Materials		
M.2	Responsible Sourcing of Materials		
M.3	Structure Reuse: On-site		
M.4	Materials Reuse: Off-site		
M.5	Recycled Materials		
M.6	Design for Disassembly		
M.7	Life Cycle Assessment (LCA)		
Category IE	Indoor Environment	Compliance	
		Yes	No
IE.1	Thermal Comfort		
IE.2	Low-Emitting Materials		
IE.3	Natural Ventilation		
IE.4	Mechanical Ventilation		
IE.5	Indoor Chemical & Pollutant Source Control		
IE.6	Views		
IE.7	Glare Control		
IE.8	Illumination Levels		
IE.9	Acoustic Quality		
IE.10	Daylight		
Category CE	Cultural & Economic Value	Compliance	
		Yes	No
CE.1	Heritage & Cultural Identity		
CE.2	Support of National Economy		
Category MO	Management & Operations	Compliance	
		Yes	No
MO.1	Commissioning Plan		
MO.2	Energy Use Sub-metering		
MO.3	Leak Detection		
MO.4	Organic Waste Management		
MO.5	Recycling Management		
MO.6	Intelligent Building Control System		

2 of 2

Minimum Energy Performance Standards (MEPS) can be a cost-effective option for a country to transition toward more energy efficient products, because MEPS encourage manufacturers to improve the efficiency of their products and introduce more efficient replacements [22]. Labeling initiatives aim to encourage consumers to make a preference towards more efficient products, by providing energy consumption information. In Bahrain, the **MEPS and Labeling for Lighting, Air Conditioning, and Appliances** initiatives extends the scope of the regulations which have already been implemented, and aims to reduce the electric consumption of these products by establishing higher energy efficiency specifications. The scope will be extended to household and commercial lamps (including directional lamps, fluorescent tubes, LED tubes and ballasts); large AC units; and refrigerators. Freezers and washing machines will be included in 2020

District cooling is a localized cooling system where water is chilled in a central plant and supplied to multiple buildings through a network of underground pipes. This form of cooling is more energy (and water) efficient than other forms of cooling (central air or water-cooled chillers)² and therefore removes the need for additional substations, and frees up roof to areas for other uses. Bahrain was the first country in the GCC to adopt district cooling, in Awali in 1948. The Kingdom currently has several district cooling networks in various locations totaling around 150,000 RT (refrigeration tons), another key differentiator for Bahrain. However, several technical and financial barriers exist which means the current infrastructure is underutilized, such as market distortions in regard to subsidies, and allocation of costs between developers and consumers. The **District Cooling** initiative seeks to address the barriers and introduce a regulatory framework to revitalize and expand the existing capacity. Until district cooling regulations are in place, real estate developers must conduct a cost benefit analysis demonstrating why they cannot connect to the existing district cooling infrastructure.

² "District cooling typically consumes 40 to 50 percent less energy for every refrigeration ton hour than conventional in-building technologies... A district cooling system tends to serve diverse loads — such as residences, offices, and commercial establishments — that do not require simultaneous cooling. District cooling is more efficient because it aggregates peak demand from these diverse loads." [23]

1

Building Energy Efficiency Code

Objective

This initiative aims to reduce energy demand in buildings by putting in place comprehensive mandatory energy efficiency specifications for the construction of new buildings and renovation of existing buildings.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	0	862	1191	1195	3248
Identified Savings (PEE)	GWh	0	0	3016	4168	4183	11367
Target Savings (PEE)	GWh	0	0	1271	1757	1763	4790
Contribution to 6% National Target	%					30%	29%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	30	42	44	116
Government Savings	BHD mn	0	0	14	17	18	48
Consumer Savings	BHD mn	0	0	16	26	26	67

Target Sectors & Key Stakeholders

Target Group Real-estate Developers and Construction Industry

Lead Ministry/Agency Ministry of Works, Municipalities and Urban Planning

Status & Implementation Timeline

Planned

Initiative

Building Energy Efficiency Code

Design and Initiation

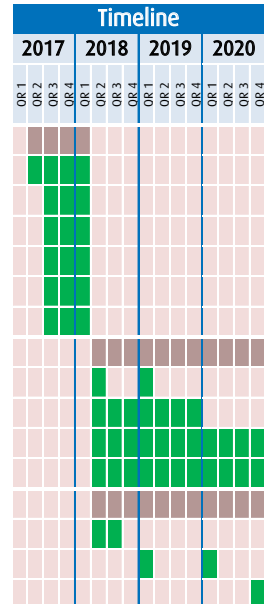
- Prepare draft of Building Energy Efficiency Code (BEEC)
- Review draft BEEC with stakeholders
- Obtain government approval of BEEC
- Prepare implementation and enforcement scheme
- Prepare training materials and develop communication plan
- Identify compliance verification scheme (building certification program)

Implementation

- Deliver training to market players and government authorities
- Execute communication and awareness raising activities
- Implementation and enforcement scheme
- Execute compliance verification scheme (measure EE level in buildings)

Monitoring and Evaluation

- Develop monitoring and evaluation scheme (methodology, timeline)
- Data collection and analysis of effectiveness of BEEC
- Prepare recommendations for further update of BEEC



The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

2

Building Energy Labeling

Objective

This initiative aims to reduce energy consumption in buildings through making energy performance of buildings explicit through the use of building energy labels

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	0	12	17	18	47
Identified Savings (PEE)	GWh	0	0	43	60	62	166
Target Savings (PEE)	GWh	0	0	18	25	26	70
Contribution to 6% National Target	%					0%	0%

Expected Monetary Savings

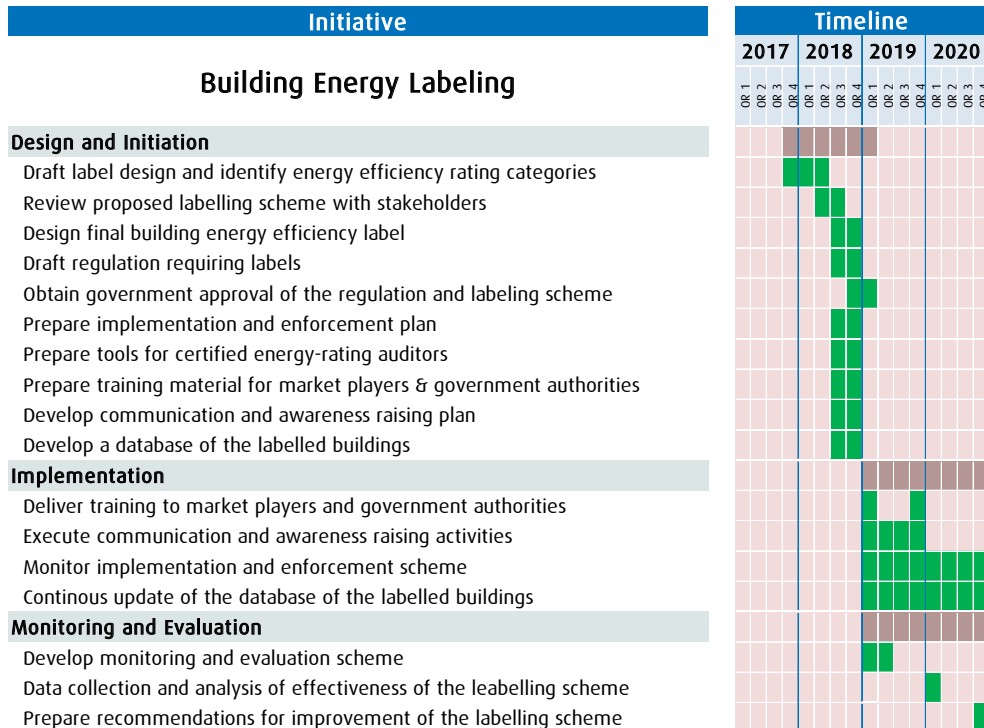
	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	0	1	1	2
Government Savings	BHD mn	0	0	0	0	0	1
Consumer Savings	BHD mn	0	0	0	0	0	1

Target Sectors & Key Stakeholders

- Target Group** Owners & tenants of buildings
- Lead Ministry/Agency** Ministry of Works, Municipalities & Urban Planning

Status & Implementation Timeline

Planned



The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

3

Green Building Certification

Objective

This initiative aims to promote the construction of more resource-efficient buildings by establishing a green building certification program.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	0	0	16	17	33
Identified Savings (PEE)	GWh	0	0	0	55	59	115
Target Savings (PEE)	GWh	0	0	0	23	25	48
Contribution to 6% National Target	%					0%	0%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	0	1	1	1
Government Savings	BHD mn	0	0	0	0	0	0
Consumer Savings	BHD mn	0	0	0	0	0	1

Target Sectors & Key Stakeholders

Target Group Real-estate Developers and Construction Industry

Lead Ministry/Agency Ministry of Works, Municipalities and Urban Planning

Status & Implementation Timeline

Not started

Initiative

Green Building Certification

Design and Initiation

- Determine merit for green building certification scheme
- If taken forward, review proposed green building certification schemes
- Prepare final green building rating & certification scheme
- Prepare training materials for construction industry
- Prepare voluntary compliance scheme
- Identify compliance verification scheme (building certification process)
- Develop a plan for communication and marketing campaign
- Develop a database of certified green buildings

Implementation

- Deliver training to construction industry
- Implement voluntary compliance scheme
- Execute communication and marketing campaign
- Continous update of the database of certified green buildings

Monitoring and Evaluation

- Develop monitoring and evaluation scheme
- Data collection and analysis of effectiveness of the scheme
- Prepare recommendations for improvement of the scheme

		Timeline															
		2017				2018				2019				2020			
OR 1	OR 2	OR 3	OR 4	OR 1	OR 2	OR 3	OR 4	OR 1	OR 2	OR 3	OR 4	OR 1	OR 2	OR 3	OR 4		

The implementation timeline has been projected till year 2020 only
It will be constantly reviewed with concerned stakeholders and is subject to change

4

MEPS & Labeling: Lighting

Objective

This initiative aims to improve energy efficiency in buildings through (1) implementing minimum energy performance standards for household lamps; and (2) setting minimum energy performance standards for commercial lamps.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	167	374	397	421	446	1638
Identified Savings (PEE)	GWh	586	1310	1389	1474	1562	5734
Target Savings (PEE)	GWh	247	552	585	621	658	2416
Contribution to 6% National Target	%					11%	14%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	5	12	14	15	16	57
Government Savings	BHD mn	4	9	9	10	11	39
Consumer Savings	BHD mn	1	3	4	5	6	18

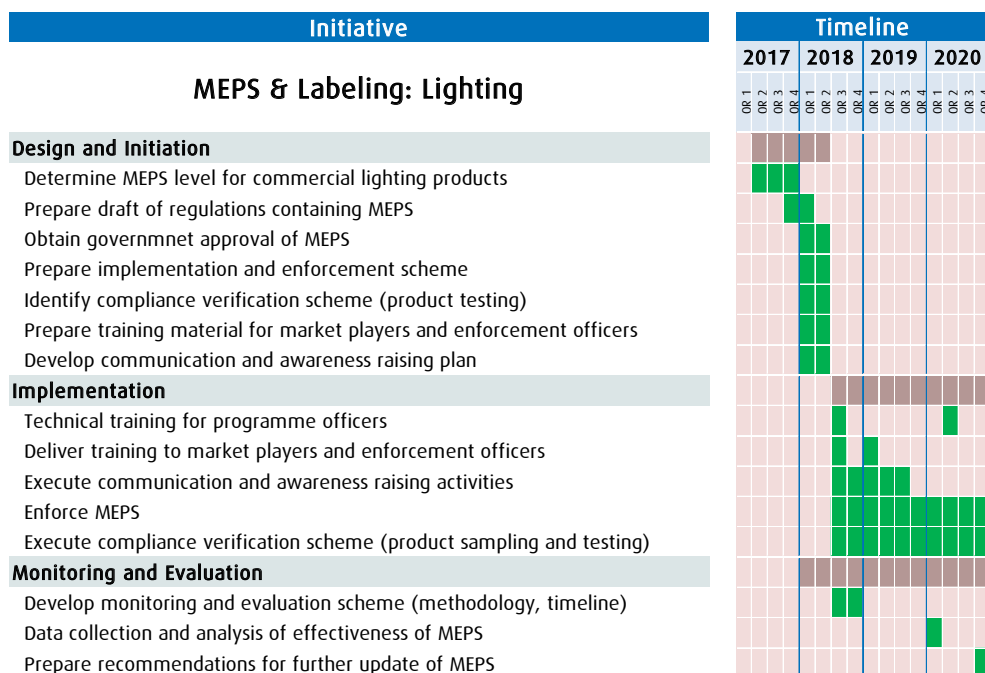
Target Sectors & Key Stakeholders

Target Group Product Suppliers, Contractors and Building Owners

Lead Ministry/Agency Ministry of Industry, Commerce & Tourism

Status & Implementation Timeline

Under Implementation



The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

5

MEPS & Labeling: Air Conditioning

Objective

This initiative aims to improve energy efficiency in buildings through (1) implementing minimum energy performance standards for small AC units; and (2) setting minimum energy performance standards and labeling requirements for large AC units.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	49	159	223	292	723
Identified Savings (PEE)	GWh	0	173	557	781	1021	2531
Target Savings (PEE)	GWh	0	73	235	329	430	1066
Contribution to 6% National Target	%					7%	6%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	2	5	8	11	26
Government Savings	BHD mn	0	1	4	5	6	16
Consumer Savings	BHD mn	0	0	2	3	4	10

Target Sectors & Key Stakeholders

Target Group Product Manufacturers, Suppliers, Building Developers

Lead Ministry/Agency Ministry of Industry, Commerce & Tourism

Status & Implementation Timeline

Under Implementation

Initiative

MEPS & Labeling: Air Conditioning

Design and Initiation

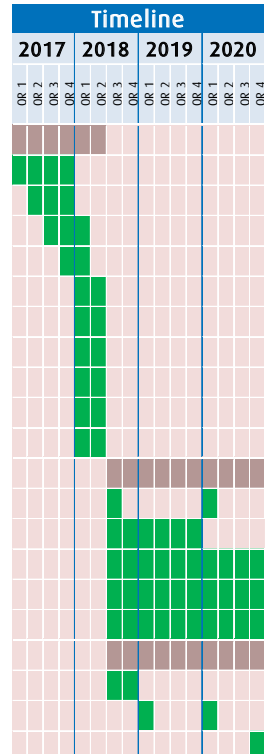
- Determine MEPS level for large AC units, EE categories and label
- Prepare draft regulations containing MEPS for large AC units
- Obtain government approval of MEPS for large AC units
- Update MEPS level for small AC units
- Obtain government approval of updated MEPS for small AC units
- Prepare implementation and enforcement scheme for MEPS
- Prepare training material for market players and enforcement officers
- Develop communication and awareness raising plan
- Identify compliance verification scheme (product testing)
- Prepare database of products compliant with MEPS

Implementation

- Technical training for market players & programme officers
- Execute communication and awareness raising activities
- Enforce MEPS & labelling
- Execute compliance verification scheme (product sampling and testing)
- Continous update of database of products compliant with MEPS

Monitoring and Evaluation

- Develop monitoring and evaluation scheme (methodology, timeline)
- Data collection and analysis of effectiveness of MEPS
- Prepare recommendations for further update of MEPS



The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

6

MEPS & Labeling: Appliances

Objective

This initiative aims to improve energy efficiency in buildings through (1) setting minimum energy performance standards for appliances; and (2) making the energy performance of the product an explicit part of the purchase decision through the use of energy labeling.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	0	5	11	28	43
Identified Savings (PEE)	GWh	0	0	18	37	97	152
Target Savings (PEE)	GWh	0	0	7	16	41	64
Contribution to 6% National Target	%					1%	0%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	0	0	1	2
Government Savings	BHD mn	0	0	0	0	1	1
Consumer Savings	BHD mn	0	0	0	0	0	1

Target Sectors & Key Stakeholders

Target Group Product manufacturers, suppliers, vendors and retailers

Lead Ministry/Agency Ministry of Industry, Commerce & Tourism

Status & Implementation Timeline Planned

MEPS & Labeling: Appliances/ Refrigerators

Design and Initiation

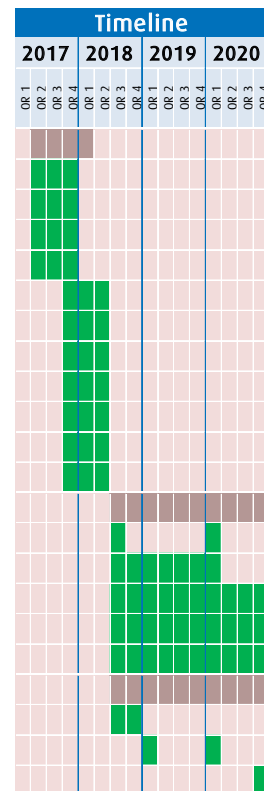
- Conduct market research to identify baselines of stock and efficiency
- Determine MEPS level for refrigerators
- Determine EE categories and Label design
- Prepare draft regulations containing MEPS & labeling requirements
- Obtain government approval of MEPS & labeling requirements
- Prepare implementation and enforcement scheme
- Prepare training material for market players and enforcement officers
- Prepare implementation and enforcement scheme for labeling
- Develop communication and awareness raising plan
- Identify compliance verification scheme (product testing)
- Prepare database of products compliant with MEPS

Implementation

- Technical training for market players & programme officers
- Execute communication and awareness raising activities
- Enforce MEPS and labelling
- Execute compliance verification scheme (product sampling and testing)
- Continuous update of products compliant with MEPS

Monitoring and Evaluation

- Develop monitoring and evaluation scheme (methodology, timeline)
- Data collection and analysis of effectiveness of MEPS
- Prepare recommendations for further update of MEPS



The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

6

MEPS & Labeling: Appliances

Objective

This initiative aims to improve energy efficiency in buildings through (1) setting minimum energy performance standards for appliances; and (2) making the energy performance of the product an explicit part of the purchase decision through the use of energy labeling.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	0	5	11	28	43
Identified Savings (PEE)	GWh	0	0	18	37	97	152
Target Savings (PEE)	GWh	0	0	7	16	41	64
Contribution to 6% National Target	%					1%	0%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	0	0	1	2
Government Savings	BHD mn	0	0	0	0	1	1
Consumer Savings	BHD mn	0	0	0	0	0	1

Target Sectors & Key Stakeholders

Target Group Product manufacturers, suppliers, vendors and retailers

Lead Ministry/Agency Ministry of Industry, Commerce & Tourism

Status & Implementation Timeline

Planned

Initiative

MEPS & Labeling: Appliances/ Freezers & Washing Machines

Design and Initiation

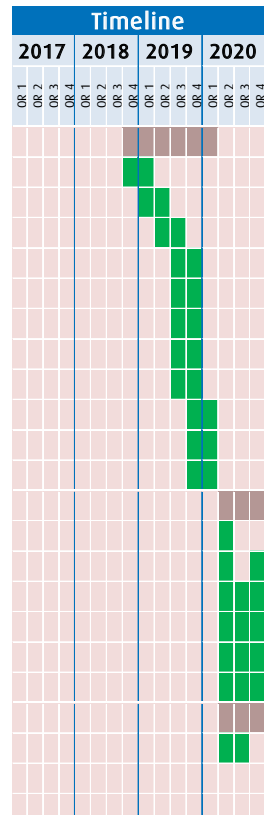
- Conduct market research to identify baselines of stock and efficiency
- Determine MEPS level for freezers and washing machines
- Prepare draft regulations containing MEPS and requiring labeling
- Obtain government approval of MEPS and labeling
- Prepare implementation and enforcement scheme
- Prepare training material for market players and enforcement officers
- Determine EE categories and Label design
- Prepare implementation and enforcement scheme for labeling
- Develop communication and awareness raising plan
- Identify compliance verification scheme (product testing)
- Prepare database of products compliant with MEPS

Implementation

- Technical training for programme officers
- Deliver training to market players
- Execute communication and awareness raising activities
- Enforce MEPS and labeling
- Execute compliance verification scheme (product sampling and testing)
- Continuous update of products compliant with MEPS

Monitoring and Evaluation

- Develop monitoring and evaluation scheme (methodology, timeline)
- Data collection and analysis of effectiveness of MEPS
- Prepare recommendations for further update of MEPS



The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

7

District Cooling

Objective

This initiative aims to revitalise and expand the existing capacity of district cooling in Bahrain, by establishing a regulatory framework

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	0	0	25	45	70
Identified Savings (PEE)	GWh	0	0	0	88	158	245
Target Savings (PEE)	GWh	0	0	0	37	66	103
Contribution to 6% National Target	%					1%	1%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	0	1	2	3
Government Savings	BHD mn	0	0	0	0	0	1
Consumer Savings	BHD mn	0	0	0	1	1	2

Target Sectors & Key Stakeholders

Target Group Real-estate Developers & District Cooling Service Providers

Lead Ministry/Agency Ministry of Works, Municipalities and Urban Planning

Status & Implementation Timeline

In the design process

Initiative	Timeline			
	2017	2018	2019	2020
District Cooling				
Design and Initiation				
Prepare draft of district cooling (DC) regulations	Q1-17			
Conduct stakeholder consultation to review the draft regulations	Q2-17			
Implement first pilot scheme according to district cooling regulations	Q3-17			
Prepare final draft DC regulations for government approval	Q4-17			
Obtain government approval of district cooling regulations	Q1-18			
Establish institutional set up to issue permits to DC service providers	Q2-18			
Develop marketing plan to brand DC as a sustainable energy initiative	Q3-18			
Prepare training material for government authorities	Q4-18			
Prepare training material for building developers	Q1-19			
Implementation				
Deliver trainings to building developers and government authorities		Q1-19	Q2-19	Q3-19
Implementation and enforcement scheme		Q4-19	Q1-20	Q2-20
Execute communication and marketing campaign		Q3-19	Q4-19	Q1-20
Monitoring and Evaluation				
Develop monitoring and evaluation scheme		Q3-19	Q4-19	Q1-20
Data collection and analysis of effectiveness of DC regulations		Q4-19	Q1-20	Q2-20
Prepare recommendations for improvement of DC regulations		Q1-20	Q2-20	Q3-20

The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

4.2 GOVERNMENT

OVERVIEW

Bahrain is committed to implementing energy efficiency programs in line with the Economic Vision 2030 and the Government Action Plan 2015-2018. The government has already taken a number of critical steps to shift Bahrain towards more efficient consumption of energy, and can also provide leadership by strongly addressing energy efficiency within the government sector, notably in regard to its building stock.

The purchasing power of government can drive energy efficiency by requiring suppliers to provide goods and services with the highest energy efficiency standards. For example, a requirement could be included that goods and services are sourced from suppliers with an energy management system (EMS), who report energy data and have implemented energy efficiency plans, alternatively the supplier should hold an internationally recognized EMS certification (such as ISO 50001). The government can also act as a pioneer by piloting new technologies to demonstrate their feasibility to the private sector.

PROPOSED SECTOR INITIATIVES

For the purposes of the national target, the government sector is considered to encompass the government, non-commercial state bodies, the defense force, the police, hospitals and other health facilities, local municipalities, schools and universities, as well as housing for which the Ministry of Housing is responsible. Four initiatives are set out for the government sector as summarized in Table 5.

Table 5: Energy Efficiency Initiatives for the Government Sector

	Energy Efficiency Initiatives (Government)	Implementation Period	Potential Savings Year 2025 (GWh) PEE	Cumulative Savings 2016- 2025 (GWh) PEE
8	Government Buildings Energy Management	2017 - 2025	41	77
9	Government Buildings Lighting Replacement	2015 - 2025	58	292
10	Street Lighting Refurbishment	2017 - 2025	104	341
11	Green Public Procurement	2017 - 2025	104	252
Expected Contribution to 6% National Target			308	

An Energy Management System (EMS) is a methodology and systematic process for continually improving energy performance, and maximizing energy savings and productivity by achieving the full cost-effective potential offered by energy efficiency. Implementation experiences in many European countries, have shown that a fully implemented EMS can achieve average annual energy performance improvements of 2-3% [24]. The **Government Buildings Energy Management** initiative will help the various public sector actors to measure and understand their energy use, commit to savings, design and implement projects to drive a reduction in their energy use (such as retrofitting), and measure and verify the savings.

The **Government Buildings Lighting Replacement** initiative is in the implementation phase. In August 2013, Ministerial Order No. 6-14/2013 mandated the replacement of all incandescent and halogen lamps in government buildings with energy efficient lamps. The Order was circulated by the Cabinet to all government ministries and agencies. The use of energy efficient lamps became mandatory effective 13 February 2014.

In Bahrain, almost 135,000 High Pressure Sodium (HPS) luminaires are used in street lighting, ranging from 70W to 1,000W. Street lights consume around 1% of grid electricity and the annual cost of street lighting (electricity and maintenance) is around BHD 4.7 million [25]. Bahrain has the opportunity to significantly improve the efficiency and the annual cost of street lighting through the **Street Lighting Refurbishment** initiative. Options include revising Bahrain's lighting standards; installation of proven, more efficient, and cost-effective products, such as LEDs with smart management; and a strategy for the timing and scale of lamp replacement.

The government sector is a major purchaser of goods, works and services in Bahrain, with the annual value of public procurement contracts amounting to approximately BHD 1.3 billion [26]. Due to its size, the government sector has the opportunity to influence the supply by directing the demand. The **Green Public Procurement** initiative aims to improve energy efficiency in the government sector through procurement of products and equipment with higher energy efficiency performance. Acquiring higher efficiency products and services demonstrates the government's commitment to environmental stewardship and sustainability, by becoming a model consumer of green products and services. In turn, this can drive higher energy standards in the private sector by following government's leadership when purchasing goods and services.

Objective

This initiative aims to pursue energy efficiency on a continuous basis in government buildings by establishing an energy management system for government buildings.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	0	6	18	28	52
Identified Savings (PEE)	GWh	0	0	21	63	98	182
Target Savings (PEE)	GWh	0	0	9	27	41	77
Contribution to 6% National Target	%					1%	0%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	0	1	1	2
Government Savings	BHD mn	0	0	0	1	1	2
Consumer Savings	BHD mn	0	0	0	0	0	0

Target Sectors & Key Stakeholders

Target Group All government departments and agencies

Lead Ministry/Agency Ministry of Works, Municipalities and Urban Planning

Status & Implementation Timeline

Planned

Initiative

Government Buildings Energy Management Program

Design and Initiation

- Prepare detailed concept note on energy management program
- Identify government buildings to conduct energy audits
- Conduct energy audits in selected buildings to identify baseline
- Identify and formalise the establishment of energy management entity
- Prepare energy management protocol for government buildings
- Prepare training material for energy managers
- Develop communication and awareness raising plan

Implementation

- Deliver trainings to energy managers
- Deliver trainings to government authorities
- Execute energy management program for government buildings
- Execute communication and awareness raising activities

Monitoring and Evaluation

- Develop monitoring and evaluation scheme
- Data collection and analysis of effectiveness of the program
- Prepare recommendations for improvement of the program

Timeline

	2017	2018	2019	2020
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				

The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

9

Government Buildings Lighting Replacement Program

Objective

This initiative aims to improve the energy efficiency of lighting in all government premises

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	40	40	40	40	40	198
Identified Savings (PEE)	GWh	139	139	139	139	139	693
Target Savings (PEE)	GWh	58	58	58	58	58	292
Contribution to 6% National Target	%					1%	2%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	1	1	1	1	1	7
Government Savings	BHD mn	1	1	1	1	1	7
Consumer Savings	BHD mn	0	0	0	0	0	0

Target Sectors & Key Stakeholders

Target Group All government departments and agencies

Lead Ministry/Agency Ministry of Works, Municipalities and Urban Planning

Status & Implementation Timeline

Planned

Initiative	Timeline											
	2017			2018			2019			2020		
	08.1	08.2	08.3	08.1	08.2	08.3	08.1	08.2	08.3	08.1	08.2	08.3
Government Buildings Lighting Replacement Program												
Design and Initiation												
No prep phase - Ministerial Order is in place												
Implementation												
Min Order 6-14/2013 on replacement of inefficient lamps												
Monitoring and Evaluation												
Develop monitoring and evaluation scheme												
Data collection and estimation of energy savings												

The implementation timeline has been projected till year 2020 only
It will be constantly reviewed with concerned stakeholders and is subject to change

Objective

This initiative aims to improve energy efficiency in street lighting through replacement of high pressure sodium lamps with LED lamps.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	24	68	69	70	231
Identified Savings (PEE)	GWh	0	84	236	242	247	809
Target Savings (PEE)	GWh	0	35	100	102	104	341
Contribution to 6% National Target	%					2%	2%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	1	2	2	3	8
Government Savings	BHD mn	0	1	2	2	3	8
Consumer Savings	BHD mn	0	0	0	0	0	0

Target Sectors & Key Stakeholders

Target Group EWA, street lighting manufacturers and suppliers

Lead Ministry/Agency Electricity & Water Authority

Status & Implementation Timeline

In the design process

Initiative

Street Lighting Refurbishment

Design and Initiation

- Prepare technical specifications for street lighting
- Prepare plan for street lighting replacement
- Obtain government approval of the plan

Implementation

- Prepare tendering documents
- Execute tendering process
- Installation and commissioning of efficient street lighting

Monitoring and Evaluation

- Develop monitoring and evaluation scheme
- Data collection and estimating of energy savings

Timeline

	2017	2018	2019	2020
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				

The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

Objective

This initiative aims to improve energy efficiency in government operations through requiring all public institutions to give preference to energy efficient and sustainable products when purchasing products, equipment and services.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	0	37	64	70	171
Identified Savings (PEE)	GWh	0	0	129	222	247	598
Target Savings (PEE)	GWh	0	0	54	94	104	252
Contribution to 6% National Target	%					2%	2%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	1	2	3	6
Government Savings	BHD mn	0	0	1	2	3	6
Consumer Savings	BHD mn	0	0	0	0	0	0

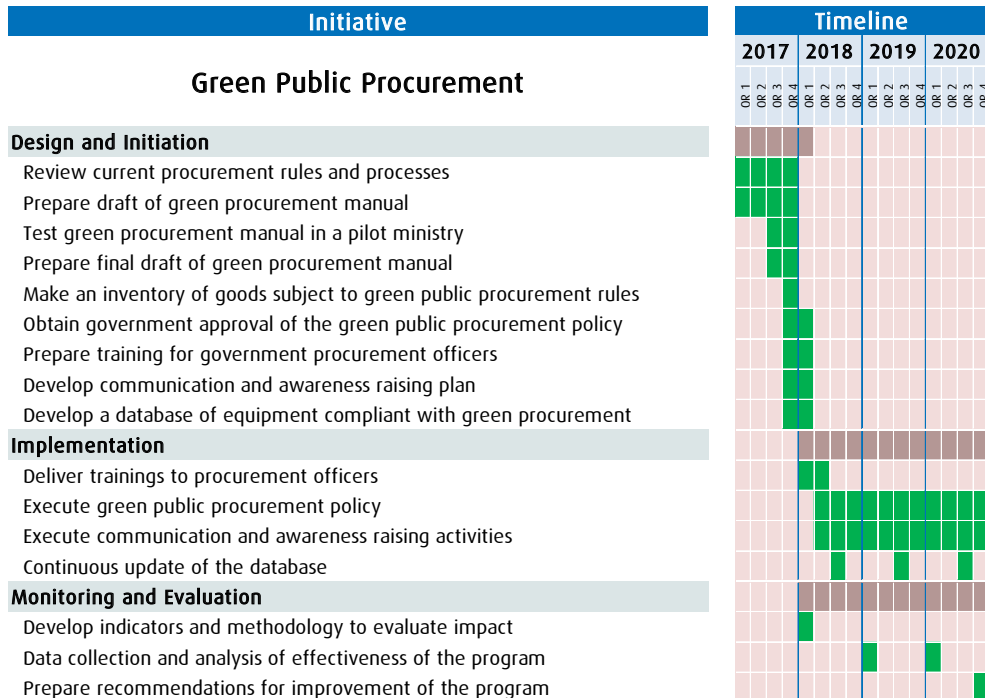
Target Sectors & Key Stakeholders

Target Group All government ministries and agencies

Lead Ministry/Agency Ministry of Finance

Status & Implementation Timeline

Planned



The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

4.3 INDUSTRY

OVERVIEW

Adopting energy efficiency as a core business element has multiple benefits for the industry sector, it improves productivity and profitability; increases competitiveness; and helps to reduce the impact of industrial activities on the environment to meet national, regional and international obligations. Energy costs have increased for the sector in Bahrain following the gas and transport fuel price increases that were recently implemented, and the revised EWA tariffs. In addition, export-oriented, energy intensive companies with products that are subject to international pricing, have experienced major declines (around 40% since 2010) in the price of commodities [27]. Given this combination of factors, companies have been pursuing energy efficiency initiatives to reduce energy consumption, and as a result maintain and in many cases, decrease operating costs.

The industry sector contributes over 40% to GDP, and in 2014 employed over 16% of the workforce [28]. Given the presence of energy intensive industries, sector is the largest consumer of energy in Bahrain. During the baseline period (2009-2013) the industry sector consumed on average 16,156 GWh of final energy per annum, accounting for 21% of natural gas consumption, and 41% of total final energy use [1]. Even though many industries have captive power plants, the sector's share of grid electricity was 13.6% for the baseline period [9]. Five major energy users dominate the sector, namely: ALBA (aluminum smelting) GPIC (chemicals), BAPCO (refining), Tatweer (oil and gas), and Bahrain Steel. The two major sectoral challenges are addressing rising energy prices, and continuing to drive incremental reductions in energy intensity.

PROPOSED SECTOR INITIATIVES

The **Industry Program** initiative has a three-fold purpose: to coordinate the energy efficiency activities of the major industry players and large energy consumers; to share best practice between the companies through workshops and other knowledge-sharing activities; and to facilitate the collection of energy saving data between the companies and SEU, in order to demonstrate that each party is making progress towards meeting its target.

The initiative has two parts. Major industry companies and large energy consumers will sign a compact with the Minister of Electricity and Water Affairs, whereby they commit to meeting energy savings of 1% every two years to reach an overall target of 4% of baseline consumption in 2025 (as shown in Table 6); and a network will be introduced to help coordinate and share best practice between the members.

Table 6: Energy Efficiency Initiatives for the Industrial Sector

Energy Efficiency Initiatives (Industry)		Implementation Period	Potential Savings Year 2025 (GWh) PEE	Cumulative Savings 2016- 2025 (GWh) PEE
12	Industry Program	2015 - 2025	786	1,966
Expected Contribution to 6% National Target			786	

The companies that make up Bahrain’s industry sector are heterogeneous, and as such the manner in which they deliver savings under the Industry Program initiative will differ. In some cases, the energy savings contributed by an energy efficiency project will count directly to the target; in other cases, a reduction in a company’s energy intensity arising from a plant expansion (where the production rises at a rate faster than the plant’s energy consumption) can be converted into a savings figure. The reduction in a company’s primary energy consumption arising from the installation of solar PV (for example), will also be counted, as each kWh of PV produced decreases the demand for grid electricity and thereby reduces primary energy consumed.

The industry sector will be encouraged to implement and achieve ISO 50001 certification, which is the Energy Management Standard, released in June 2011. ISO 50001 provides a robust framework for optimizing energy efficiency in public and private sector organizations. Certification to this standard recognizes an organization’s efforts of continual improvement in energy management. Furthermore, the implementation of ISO 50001 will enable organizations to lead by example within their respective industries.

The commitment by industry to deliver an additional 1% energy reduction each year is substantial and, because the sector accounts for such a large percentage of Bahrain’s energy use, the sector’s contribution to the national energy efficiency target is significant.

Objective

This initiative aims to drive a 1% improvement in annual energy consumption to reach a 4% energy efficiency improvement by 2020

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	162	323	485	646	1615
Identified Savings (PEE)	GWh	0	466	933	1399	1866	4664
Target Savings (PEE)	GWh	0	197	393	590	786	1966
Contribution to 6% National Target	%					14%	12%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	4	9	14	19	46
Government Savings	BHD mn	0	2	3	3	5	13
Consumer Savings	BHD mn	0	3	6	10	14	33

Target Sectors & Key Stakeholders

Target Group Industrial Companies & Large Consumers

Lead Ministry/Agency NOGA (Oil & Gas) and SEU (non Oil)

Status & Implementation Timeline

Planned

Initiative

Industry Program

Design and Initiation

- Develop industry specific energy efficiency indicators
- Agree baseline consumption according to these indicators
- Identify reporting system and methodology
- Prepare draft of compact to be signed with specific industry groups
- Prepare concept note for "Large Energy Network"
- Review concept note and proposed plan of activities with stakeholders
- Develop communication and awareness raising plan
- Prepare training material on industry specific EE indicators

Implementation

- Sign compact with industries
- Deliver trainings
- Execute network activities as agreed in the plan
- Execute communication and awareness raising plan

Monitoring and Evaluation

- Develop monitoring and evaluation scheme
- Data collection and analysis of effectiveness of industry program
- Prepare recommendations for improvement of industry program

Timeline

	2017	2018	2019	2020
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				

The implementation timeline has been projected till year 2020 only
It will be constantly reviewed with concerned stakeholders and is subject to change

4.4 ELECTRICITY

OVERVIEW

The natural gas used in making electricity accounts for almost half of Bahrain's total primary energy supply [1], therefore the efficiency of supply (the production, transmission and distribution of electricity) is as important as demand side energy efficiency initiatives.

Electricity supply consumed an average of 91,700 GWh of primary energy per annum during the 2009 – 2013 baseline period. In the 20 years from 1993 to 2013, the consumption of natural gas for electricity production, transmission and distribution grew from 44,159 GWh to 97,448, an increase of 120% or 4.0% per annum (compared to GDP growth of 4.8%). During the same period, total electricity consumed rose by 3.9% per annum, from 11,339 GWh to 24,516 GWh [9].

The ratio of natural gas used to electricity produced is calculated to be 3.5 during the 2009 – 2013 baseline period, higher than the GCC average of 3, and takes into account the energy used in the co-production of desalinated water [1]. This is partly structural (the type and efficiency of the power plants in Bahrain's energy system) and partly operational (for example, the level of 'spinning reserve' provided to ensure the reliable operation of the system). In any case, it points to a significant opportunity to deliver energy savings by optimizing the ratio between natural gas in and electricity out.

PROPOSED SECTOR INITIATIVES

Four initiatives to improve efficiency in electricity supply are summarized in Table 7. All of these initiatives are led by the Electricity and Water Authority, and are in the implementation phase.

Table 7: Energy Efficiency Initiatives for the Electricity Sector

	Energy Efficiency Initiatives (Electricity Supply)	Implementation Period	Potential Savings Year 2025 (GWh) PEE	Cumulative Savings 2016- 2025 (GWh) PEE
13	Electricity Production Efficiency	2017 - 2025	386	773
14	Electricity T&D Efficiency	2017 - 2025	37	93
15	Power Factor Correction	2015 - 2025	468	1,978
16	Smart Metering Program	2016 - 2025	84	365
Expected Contribution to 6% National Target			975	

Current CCGT (combined cycle gas turbine) electrical efficiencies range from 45% - 60%. The commissioning of CCGTs during the period 2003-2013 has raised the average efficiency of electricity generation in Bahrain, from 28% to around 44% [29].

The **Electricity Production Efficiency** initiative aims to deliver a 1% improvement by 2025 in the efficiency by which natural gas is converted into electricity. International programs typically include the following elements:

- Reducing the reliance on the least efficient power plants, some of which are operated primarily to desalinate water;
- Utilizing aggregated demand reduction/response as an alternative to new capacity;
- Utilizing demand side frequency response as an alternative to spinning reserve;
- The use of real-time tariffs to better utilize the existing capacity; and
- A benchmarking exercise to compare the level of spinning reserve against the best-in-class.

Bahrain has a relatively efficient transmission and distribution system, with losses of 9.8% [9] compared to a GCC average of 9.2% over the baseline period [1]. The **Electricity T&D Efficiency Program** initiative aims to improve the efficiency of the system. Similar programs internationally typically include the following elements: conducting a dynamic line rating trial; undertaking a feasibility study into the use of capacity banks and battery storage in managing the system; or conductor, transformer and cable upgrading.

Electricity can be divided into three types:

- Working power, KW (actual, real or active power);
- Reactive power, KVAR (the power that magnetic equipment need to produce the magnetizing flux); and
- Apparent power, KVA (the vector summation of KW and KVAR).

The power factor is the ratio of working power to apparent power. A low power factor can result in overheating of equipment (conductors and devices); low efficiency of connected devices; high voltage drops in alternators and transformers in the supply network; and overall higher electricity consumption. The **Power Factor Correction Program** initiative aims to improve the power factor to be 0.9 or greater. In February 2011, Ministerial Order No 4/2011 was issued requiring the overall power factor for customer electrical installations to not be less than 0.9, otherwise the excess reactive power consumption will be calculated based on power factor value of 0.9. The order has been implemented for commercial, government and industry sectors. If the power factor is less than 0.9, then the excess reactive power consumed is charged at 0.016 BHD KVARh. The charges are included in the monthly customer bill.

There are multiple benefits to a smart metering program: more accurate meter reading, more efficient billing and ability to manage debtors; and better ability to manage daytime consumption peaks and electricity consumption through the use of real-time pricing. In addition, a more detailed understanding of consumer usage patterns is possible. Bahrain has 360,000 meters fitted in the network [9]. The **Smart Metering Program** initiative will initially target the implementation of smart meters for high consumers and new developments, before the implementation is rolled out to all consumers.

13

Electricity Production Efficiency

Objective

This initiative aims to deliver a 1% improvement by 2020 in the efficiency by which natural gas is converted into electricity.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	26	79	157	262	524
Identified Savings (PEE)	GWh	0	92	275	550	917	1834
Target Savings (PEE)	GWh	0	39	116	232	386	773
Contribution to 6% National Target	%					7%	5%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	1	2	4	7	13
Government Savings	BHD mn	0	1	2	4	7	13
Consumer Savings	BHD mn	0	0	0	0	0	0

Target Sectors & Key Stakeholders

Target Group Electricity & Water Authority

Lead Ministry/Agency Electricity & Water Authority

Status & Implementation Timeline

Planned

Initiative

Electricity Production Efficiency

Design and Initiation

To be designed by EWA

Implementation

Implement identified measures

Monitoring and Evaluation

Develop monitoring and evaluation scheme

Data collection and estimation of energy savings

Timeline

	2017				2018				2019				2020			
	OR 1	OR 2	OR 3	OR 4	OR 1	OR 2	OR 3	OR 4	OR 1	OR 2	OR 3	OR 4	OR 1	OR 2	OR 3	OR 4
Design and Initiation																
Implementation																
Monitoring and Evaluation																

The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

14

Electricity T&D Efficiency

Objective

This initiative aims to improve efficiency in the transmission and distribution system by reducing losses equivalent to 2% of the transmission and distribution losses during the baseline period.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	6	13	19	25	63
Identified Savings (PEE)	GWh	0	22	44	66	88	221
Target Savings (PEE)	GWh	0	9	19	28	37	93
Contribution to 6% National Target	%					1%	1%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	0	0	1	2
Government Savings	BHD mn	0	0	0	0	1	2
Consumer Savings	BHD mn	0	0	0	0	0	0

Target Sectors & Key Stakeholders

Target Group Electricity & Water Authority

Lead Ministry/Agency Electricity & Water Authority

Status & Implementation Timeline

Planned

Initiative	Timeline			
	2017	2018	2019	2020
Electricity Transmission & Distribution Efficiency	08.1			
	08.2			
	08.3			
	08.4			
	08.1			
	08.2			
	08.3			
	08.4			
	08.1			
	08.2			
	08.3			
	08.4			

Design and Initiation

To be designed by EWA

Implementation

Implement identified measures

Monitoring and Evaluation

Develop monitoring and evaluation scheme

Data collection and estimation of energy savings

The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

Objective

This initiative aims to enhance efficiency in the power supply system by improving the power factor to be > 0.9

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	185	263	280	297	317	1341
Identified Savings (PEE)	GWh	646	919	979	1040	1110	4693
Target Savings (PEE)	GWh	272	387	412	438	468	1978
Contribution to 6% National Target	%					8%	12%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	6	9	10	11	12	46
Government Savings	BHD mn	3	4	3	3	4	16
Consumer Savings	BHD mn	3	5	6	8	8	30

Target Sectors & Key Stakeholders

Target Group Commercial, government, and industrial users

Lead Ministry/Agency Electricity & Water Authority

Status & Implementation Timeline

Under implementation

Initiative

Power Factor Correction

Design and Initiation

Preparation phase has been completed by EWA

Implementation

Apply Power Factor Correction Charge

Monitoring and Evaluation

Develop monitoring and evaluation scheme

Data collection and estimation of energy savings

Timeline

	2017				2018				2019				2020			
	OR 1	OR 2	OR 3	OR 4	OR 1	OR 2	OR 3	OR 4	OR 1	OR 2	OR 3	OR 4	OR 1	OR 2	OR 3	OR 4
Design and Initiation																
Implementation																
Monitoring and Evaluation																

The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

16

Smart Metering

Objective

This initiative aims to reduce electricity peak demand by installing smart meters, first for industry, then government and commercial users, and lastly residential users.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	43	46	49	53	57	247
Identified Savings (PEE)	GWh	149	160	172	185	199	865
Target Savings (PEE)	GWh	63	68	73	78	84	365
Contribution to 6% National Target	%					1%	2%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	1	1	1	1	1	5
Government Savings	BHD mn	1	1	1	1	1	4
Consumer Savings	BHD mn	1	1	1	1	1	4

Target Sectors & Key Stakeholders

Target Group All customers

Lead Ministry/Agency Electricity & Water Authority

Status & Implementation Timeline

Under implementation

Initiative	Timeline			
	2017	2018	2019	2020
Smart Metering	08.1			
	08.2			
	08.3			
	08.4			
	08.1			
	08.2			
	08.3			
	08.4			
	08.1			
	08.2			
	08.3			
	08.4			

Design and Initiation

Preparation phase has been completed by EWA

Implementation

Install and commission smart meters and software

Execute communication and awareness raising activities

Monitoring and Evaluation

Data collection and estimation of energy savings

Prepare feasibility study on introducing time of use tariffs

The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

4.5 TRANSPORT

OVERVIEW

The transport sector consumed an average of 12,253 GWh per annum of final energy during the 2009 – 2013 baseline period, accounting for 31% of total final energy use. In the 20 years from 1993 to 2013, the transport sector's final energy use grew from 394 ktoe to 1,113 ktoe, an increase of 182% or 5.3% per annum, faster than GDP growth of 4.8% [1].

Energy use in transport depends on three elements, ranging from long-term to short-term: (1) the mode of travel (for example, rail versus road); (2) the technology (for example, a fuel efficient or electric car versus an inefficient light truck); and (3) driver behavior and choices. The initiatives underway and proposed address all three aspects. A train line to Saudi Arabia is in planning; the government recently invested in a new bus fleet and extended the network to cover a greater percentage of the population; and the 2016 changes to the fuel price will have both a short-term impact on fuel consumption and will drive alternative vehicle choices in the medium to long term.

Bahrain has in the last two years invested significantly in its public transport network. The bus network has been extended and upgraded, with new, fuel efficient, wifi-enabled and affordable buses servicing a wider percentage of Bahrain and with increased frequency. The Ministry of Transport is promoting the use of public transport, which currently accounts for less than 1% of all journeys. The number of buses has expanded from 35 to 140, coverage has risen from 25% to 77% and the number of routes from 13 to 32. Daily use has risen from 16,000 journeys per day in 2015, to 28,000 journeys per day by the start of 2016 [30].

The continued improvement of the public bus service is a key national project. Additional elements in the development of a more comprehensive transport network will focus on the development of a more holistic approach, incorporating taxi terminals, and park and ride facilities. Plans are being progressed to develop a light rail network, and Bahrain is working with its GCC neighbors on the development of a diesel-powered GCC rail link which will help reduce the energy intensity of goods transported within the GCC.

PROPOSED SECTOR INITIATIVES

It is a government policy to diversify the modal and fuel mix of the transport sector, as well as to maximize the efficient use of energy. Planned initiatives seek to decouple energy use from growth in activity and demand in the sector.

Table 8: Energy Efficiency Initiatives for the Transport Sector

Energy Efficiency Initiatives (Transport)		Implementation Period	Identified Savings Year 2025 (GWh) PEE	Cumulative Savings 2016- 2025 (GWh) PEE
17	Transport Subsidy Reform	2016 - 2025	192	462
18	Vehicle Efficiency Standards & Labeling	2017 - 2025	61	181
Expected Contribution to 6% National Target			253	

In the medium to long term, higher fuel prices encourages road users to purchase more efficient vehicles. The **Transport Subsidy Reform** initiative is in the implementation phase. In January 2016, Bahrain made significant modifications to the pricing of transport fuel which had remained unchanged for 33 years. The price was increased by up to 60%, with the price of 95 Octane (Mumtaz) increasing from 100 fils to 160 fils (USD 0.42) per litre, and the price of 91 octane (Jayyid) increasing from 80 fils to 125 fils (USD 0.33) per litre [30]. This initiative targets a transport fuel reduction of 4% (as a percentage of the baseline).

The **Vehicle Efficiency Standards & Labeling** initiative will introduce minimum energy performance standards and labeling for all vehicles to transform the market towards vehicles with higher fuel efficiencies. The initiative consists of four parts: setting the minimum standards; confirming the vehicle performance at the point of importation; working with dealers to ensure that the labels are appropriately displayed; and increasing consumer awareness by providing information.

The policy objectives in relation to transport encompass maximizing the efficiency of the transport network, reducing transport emissions, and improving the accessibility and affordability of transport. Energy demand reduction is a major driver, and for this reason, all savings realized under initiatives such as subsidy reform and new modes of transport (for example, light rail) will be included in the assessment of progress in achieving the national energy efficiency target.

Objective

This initiative aims to reduce the subsidisation of transport fuel in order drive more efficient consumption of fuel.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	47	107	188	299	455	1097
Identified Savings (PEE)	GWh	47	107	188	299	455	1097
Target Savings (PEE)	GWh	20	45	79	126	192	462
Contribution to 6% National Target	%					3%	3%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	1	2	4	6	9	21
Government Savings	BHD mn	0	1	1	2	2	6
Consumer Savings	BHD mn	1	2	3	4	6	16

Target Sectors & Key Stakeholders

Target Group	Vehicle users
Lead Ministry/Agency	Ministry of Finance

Status & Implementation Timeline

Under implementation

Initiative

Transport Subsidy Reform

Design and Initiation

No preparatory phase - Fuel price increases have taken place

Implementation

Apply increased fuel prices

Monitoring and Evaluation

Develop indicators & methodology to evaluate impact

Data collection and analysis of data (estimation of energy savings)

Timeline

	2017	2018	2019	2020
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				

The implementation timeline has been projected till year 2020 only
It will be constantly reviewed with concerned stakeholders and is subject to change

18

Vehicle Efficiency Standards & Labeling

Objective

This initiative aims to improve efficiency in the transport sector by (a) setting minimum energy performance standards for vehicles; and (b) making the energy performance of the vehicle an explicit part of the purchase decision through the use of fuel efficiency labeling

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	0	141	143	145	428
Identified Savings (PEE)	GWh	0	0	141	143	145	428
Target Savings (PEE)	GWh	0	0	59	60	61	181
Contribution to 6% National Target	%					1%	1%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	3	3	3	8
Government Savings	BHD mn	0	0	1	1	1	2
Consumer Savings	BHD mn	0	0	2	2	2	6

Target Sectors & Key Stakeholders

Target Group Car manufacturers, importers, suppliers and buyers

Lead Ministry/Agency Supreme Council for Transport

Status & Implementation Timeline

Planned

Vehicle Efficiency Standards & Labeling

Design and Initiation

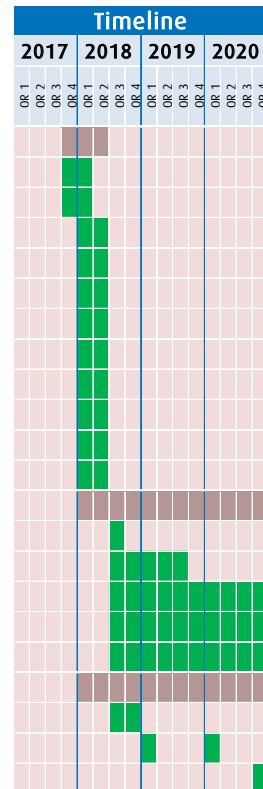
- Conduct market research to establish vehicle fuel economy baseline
- Identify vehicle types subject to minimum efficiency standards
- Determine MEPS level based on international best practice
- Determine EE categories and Label design for vehicles
- Prepare draft regulations containing MEPS for vehicles
- Obtain government approval of MEPS for vehicles
- Prepare implementation and enforcement scheme
- Prepare training material for enforcement officers
- Develop communication and awareness raising plan
- Identify compliance verification scheme (product testing)
- Prepare database of vehicles compliant with MEPS

Implementation

- Technical training for programme and enforcement officers
- Execute communication and awareness raising activities
- Enforce minimum efficiency standards & labeling
- Execute compliance verification scheme (vehicle sampling and testing)
- Update vehicles compliant with minimum efficiency standards

Monitoring and Evaluation

- Develop monitoring and evaluation scheme
- Data collection and analysis of effectiveness of MEPS
- Prepare recommendations for further update of MEPS



The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

4.6 CROSS SECTORAL

OVERVIEW

The challenges faced in delivering energy efficiency are common to multiple sectors of the economy such as lack of awareness, competing priorities, hidden costs, financial barriers, and access to timely and accurate information.

In order for Bahrain to meet its national target, the background conditions must be correct. Policies, institutional support, and market conditions can support energy efficiency initiatives by making sure the information is available and ensuring that signals and incentives are in place to reward the right choice. These enabling conditions are created by measures and policies that cut across all sectors of the economy.

PROPOSED INITIATIVES

Four initiatives are considered cross-sectoral as they relate to more than one sector as summarized in Table 9

Table 9: Cross Sectoral Energy Efficiency Initiatives

Energy Efficiency Initiatives (Cross Sectoral)		Implementation Period	Identified Savings Year 2025 (GWh) PEE	Cumulative Savings 2016- 2025 (GWh) PEE
19	Electricity Subsidy Reform	2016 - 2025	367	997
20	Raising Awareness & Information Dissemination	2017 - 2025	42	149
21	Training for Market Actors	2017 - 2025	52	186
22	Institutional Infrastructure	2017 - 2025	0	0
Expected Contribution to 6% National Target			460	

The **Electricity Subsidy Reform** initiative is in the implementation phase. In March 2016, Bahrain made significant modifications to the pricing of electricity and a new tariff schedule was published. After taking expected inflation into account, and in the absence of any other measures to reduce electricity use, the initiative could result in a 14% reduction in use compared to the 2009 – 2013 baseline.

A public program to raise awareness and disseminate information on energy efficiency complements the other initiatives proposed by increasing relevant knowledge and support amongst all stakeholders, including households and businesses. Information about the financial, environmental, and social benefits of energy efficiency can be communicated in various ways, such as via social media, mass media campaigns, pamphlets and stickers, and in-person interactions (including seminars, workshops, and presentations). The **Awareness Raising** initiative will focus on energy use, habits, and behaviors, and target energy-consuming equipment and appliances. Any efforts will not replace communication campaigns already under way, but instead complement them.

The **Training for Market Actors** initiative aims to build and increase capacity in the market to enable a workforce to develop and implement energy efficiency initiatives, and perform monitoring and impact evaluations. In particular, the initiative aims to establish energy efficiency training, accreditation and certification scheme for energy auditors, energy managers and energy service providers. It is proposed that this initiative will be delivered in conjunction with Tamkeen to maximize employment opportunities for Bahrainis.

The **Institutional Infrastructure** initiative will build and enhance the institutional capabilities necessary for the successful achievement of Bahrain's national energy efficiency target. Responsibility for the implementation of the initiatives is divided between multiple ministries, given their respective focus areas, and reflects how the NEEAP requires concerted action from all stakeholders. This diversified responsibility could create challenges for accountability, coordination, funding, and delivery of the expected energy savings. To this end, SEU is the designated agency to lead the coordination of the NEEAP, and as such needs to be properly resourced, in terms of staffing to implement the initiatives under its responsibility; to support the implementation of the other initiatives; and to measure and verify the associated savings. In addition to the specific initiatives functions, SEU requires the following capacity:

- Strategy, action plan and policy development;
- Initiative design and evaluation, including technical know-how;
- Implementation support, including coordination of stakeholder engagement;
- Research and analysis, including cost-benefit analysis and financial modelling;
- Statistics function, including energy savings measurement, monitoring and verification, to report on progress compared to the baseline;
- Capacity building and training activities support for stakeholders.

Along with SEU functions and capabilities, the following will facilitate the achievement of the national energy efficiency target:

- **Adoption and oversight** of the specific initiatives within respective government organizations, including dedicated staffing and budget allocations for energy efficiency.
- **Relationships** with end users (for example, through billing); and fostering public-private partnerships for awareness raising and collaboration;

- **Access to capital** sourced locally (or from the Green Climate Fund or other international financial mechanism) through a central fund or dedicated instruments (for example, a pay-as-you-save credit facility; or green sukuk) to encourage take up of energy efficient products and services,
- **Timely official data** on energy supply and consumption, as well as forecast demand, including peak demand. The data resource should also include a dataset of key statistics such as population; GDP; building stock; vehicle stock; and include an energy balance. Energy efficiency resources including staffing and funding should also be reported on and captured as part of national data.
- An **evaluation culture** whereby impact, process, market and cost evaluation is embedded in the implementation and oversight of each initiative.

Objective

This initiative aims to gradually increase electricity tariffs so they reflect the cost of power generation, in order to drive more efficient consumption of electricity.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	24	57	125	221	249	676
Identified Savings (PEE)	GWh	85	200	436	775	870	2366
Target Savings (PEE)	GWh	36	84	184	326	367	997
Contribution to 6% National Target	%					6%	6%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	1	2	4	8	9	24
Government Savings	BHD mn	0	1	1	2	2	7
Consumer Savings	BHD mn	0	1	3	6	7	17

Target Sectors & Key Stakeholders

Target Group Commercial, government, industrial & residential customers

Lead Ministry/Agency Ministry of Finance

Status & Implementation Timeline

Under implementation

Initiative	Timeline															
	2017				2018				2019				2020			
	OP 1	OP 2	OP 3	OP 4	OP 1	OP 2	OP 3	OP 4	OP 1	OP 2	OP 3	OP 4	OP 1	OP 2	OP 3	OP 4
Electricity Subsidy Reform																
Design and Initiation																
No prep phase - Electricity Tariff increases have taken place																
Implementation																
Apply increased electricity tariffs																
Monitoring and Evaluation																
Develop monitoring and evaluation scheme																
Data collection and estimation of energy savings																

The implementation timeline has been projected till year 2020 only
It will be constantly reviewed with concerned stakeholders and is subject to change

Objective

This initiative aims to encourage energy efficiency behavior by raising awareness on the importance and benefits of energy efficiency, and disseminating information on specific energy efficiency initiatives.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	24	26	28	30	107
Identified Savings (PEE)	GWh	0	79	85	91	98	353
Target Savings (PEE)	GWh	0	33	36	38	42	149
Contribution to 6% National Target	%					1%	1%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	1	1	1	1	3
Government Savings	BHD mn	0	0	0	0	0	1
Consumer Savings	BHD mn	0	0	0	1	1	2

Target Sectors & Key Stakeholders

Target Group All energy users in Bahrain

Lead Ministry/Agency SEU

Status & Implementation Timeline

Planned

Initiative

Awareness Raising

Design and Initiation

- Prepare awareness raising and information dissemination plan
- Develop logo, branding and marketing material
- Develop SEU website

Implementation

- Launch website and media campaign
- Execute awareness raising and info dissemination activities
- Continuous update of the website

Monitoring and Evaluation

- Develop program evaluation methodology
- Data collection and analysis of effectiveness of the campaign
- Prepare recommendations for improvement of the next campaign

Timeline

	2017	2018	2019	2020
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				
OR 1				
OR 2				
OR 3				
OR 4				

The implementation timeline has been projected till year 2020 only
It will be constantly reviewed with concerned stakeholders and is subject to change

Objective

This initiative aims to increase the capacity in the market to develop and implement EE initiatives, and perform monitoring and evaluations. It aims to establish EE training, accreditation and certification scheme for market actors.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	28	30	33	35	126
Identified Savings (PEE)	GWh	0	98	106	114	123	441
Target Savings (PEE)	GWh	0	41	45	48	52	186
Contribution to 6% National Target	%					1%	1%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	0	0	0	0
Government Savings	BHD mn	0	0	0	0	0	1
Consumer Savings	BHD mn	0	0	0	0	0	0

Target Sectors & Key Stakeholders

Target Group Professionals interested in training

Lead Ministry/Agency SEU

Status & Implementation Timeline

Planned

Initiative

Training for Market Actors

Design and Initiation

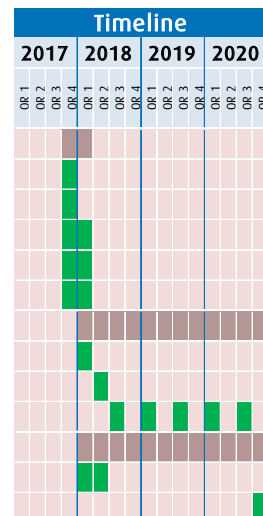
- Identify entities to host and deliver the training courses
- Draft proposal for a permanent energy auditor training program
- Evaluate options and develop an action plan
- Conduct training of trainers
- Develop a database of certified energy auditors

Implementation

- Deliver pilot training course for certified energy auditors
- Revise the program based on feedback from the pilot course
- Deliver training courses

Monitoring and Evaluation

- Develop program evaluation methodology
- Prepare recommendations for improvement of the training courses



The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

Objective

This initiative aims to build and strengthen the institutional infrastructure necessary for the successful achievement of the NEEAP target, through proper design and implementative of the initiatives, and monitoring and evaluation of the impacts.

Expected Energy Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Identified Savings (Final Energy)	GWh	0	0	0	0	0	0
Identified Savings (PEE)	GWh	0	0	0	0	0	0
Target Savings (PEE)	GWh	0	0	0	0	0	0
Contribution to 6% National Target	%					0%	0%

Expected Monetary Savings

	UNIT	2016-2017	2018-2019	2020-2021	2022-2023	2024-2025	Cumulative
Financial Savings	BHD mn	0	0	0	0	0	0
Government Savings	BHD mn	0	0	0	0	0	0
Consumer Savings	BHD mn	0	0	0	0	0	0

Target Sectors & Key Stakeholders

Target Group All government ministries & agencies

Lead Ministry/Agency SEU

Status & Implementation Timeline

Planned

Initiative

Institutional Infrastructure

Design and Initiation

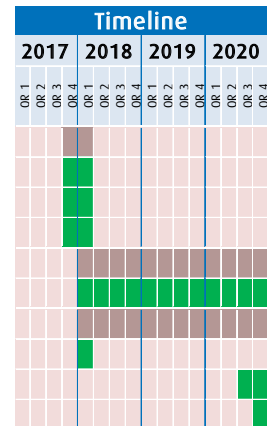
- Determine what institutional gaps exist for effective EE governance
- Based on the analysis, identify partner institutions to address the gaps
- Develop action plan to address the gaps

Implementation

- Implement activities according to the action plan

Monitoring and Evaluation

- Develop monitoring and evaluation scheme
- Update gap analysis to determine effectiveness of actions
- Prepare recommendations for further institutional improvements



The implementation timeline has been projected till year 2020 only. It will be constantly reviewed with concerned stakeholders and is subject to change.

5 GOING FORWARD

A number of factors must come together to ensure that the National Energy Efficiency Action Plan effectively transitions from a desk document, to actions that capitalize on the potential benefits described:

- A governance structure that provides guidance and executive sponsorship;
- Incorporation of energy efficiency initiatives in ministries' action plans and work programs;
- Tools enabling deployment of energy efficiency initiatives;
- Funding for projects and activities.

5.1 IMPLEMENTATION

There are 22 initiatives defined under this Action Plan, with multiple parties involved in implementing the initiatives. Many are currently being implemented; others still need to be designed, resourced and implemented by the relevant parties. Other actions will be added over the course of the plan and will contribute to the achievement of the target.

The following entities will be directly engaged in the implementation of the initiatives:

- Electricity and Water Authority
- Ministry of Works, Municipalities and Urban Planning
- Ministry of Industry and Commerce
- Ministry of Housing
- Ministry of Transportation and Telecommunication
- Directorate of Traffic Services
- Large industrial companies such as ALBA, BAPCO, Tatweer, GPIC, Foulath Holding.

Careful coordination and open, transparent collaboration between all relevant stakeholders will be required to deliver the savings set out in this action plan, and to enable the measures and savings to be adequately monitored and evaluated.

5.2 COORDINATION

SEU is the designated agency for promoting sustainable energy policies and practices in the Kingdom of Bahrain. As such, SEU will lead the coordination efforts in implementing the NEEAP, and will provide technical assistance in the design and implementation of specific initiatives.

Responsibilities:

- Coordinate implementation activities among all stakeholders through developing partnerships and organizing regular coordination meetings.
- Inform stakeholders on the progress of implementation of the NEEAP.
- Draft energy efficiency policies and regulations and standard operating procedures for their implementation.
- Conduct monitoring and evaluation of initiatives, and calculate energy and monetary savings.
- Carry out feasibility studies, cost-benefit analysis of various technology options and business models, as well as overseeing the implementation of pilot projects.
- Provide technical assistance in developing tendering documents, drafting requests for proposals, and assessing outcomes of pilot projects.
- Carry out information dissemination and awareness raising campaigns through launching a dedicated website, organizing press conferences, promoting energy efficiency at various public events.
- Organize and support capacity building and training activities for government and non-government stakeholders.

5.3 OVERSIGHT

The NEEAP Implementation Follow Up Committee will be established to oversee the implementation process. This Committee will be composed of high-level representatives of key government and non-government institutions who would play the role of change agents to provide guidance, support and oversight. The Committee will be chaired by the Minister of Electricity and Water Affairs, and may include representatives from the Electricity and Water Authority, the Ministry of Finance, the Office of the First Deputy Prime Minister, the Ministry of Industry and Commerce, the Ministry of Housing, the Ministry of Works, Urban Planning and Municipalities, the Ministry of Oil, and the Supreme Council for Environment. The Committee will meet on a quarterly basis.

Responsibilities:

- Oversee implementation of the NEEAP and facilitate its execution;
- Identify action items to overcome implementation issues and challenges;
- Put recommendations and suggest actions to relevant ministries;
- Decide on making changes in the NEEAP if required;
- Discuss the progress in the implementation process.

SEU will assist in preparing the agenda of the meeting, the minutes, including the action list; the progress report on the status of the implementation process since the last meeting; and any other documents to be discussed or considered during the meeting.

5.4 MONITORING AND EVALUATION

METHODS FOR CALCULATING ENERGY SAVINGS

The EU's Energy Efficiency Directive sets out four methods for calculating savings: deemed savings; metered savings; scaled savings; and surveyed savings [31]. It is anticipated that all methods will be utilized under the NEEAP:

Deemed Savings: savings made by reference to the results of previous independently monitored energy improvements in similar installations (ex-ante), for example, the street lighting refurbishment.

Metered Savings: the savings from the installation of a measure, or package of measures, is determined by recording the actual reduction in energy use, taking due account of factors such as additionality, occupancy, production levels and the weather which may affect consumption (ex-post). An example could be the savings arising from the energy upgrade of a government building.

Scaled Savings: where engineering estimates of savings are used. This approach may only be used where establishing robust measured data for a specific installation is difficult or disproportionately expensive, for example, replacing a compressor or electric motor with a different kWh rating than that for which independent information on savings has been measured. This could be an industrial savings project whereby the new energy reduction equipment is different in scale to the equipment for which well referenced savings are available.

Surveyed Savings: where consumers' response to advice, information campaigns, labeling or certification schemes, or smart metering is determined. This approach may only be used for savings resulting from changes in consumer behavior. It may not be used for savings resulting from the installation of physical measures.

PROGRAM AND MEASURE EVALUATION

Separately from the identification of savings, it will be necessary to evaluate each initiative to determine if it has cost effectively achieved its objectives. A less formal evaluation will be conducted after an initiative is in the implementation phase, to confirm that the initiative is on track to yield the expected results. In this way, deficiencies can be detected early and corrected to streamline delivery and maximize effectiveness.

REFERENCES

- [1] IEA, Statistics, <https://www.iea.org/countries/non-membercountries/bahrain/>
- [2] NOGA, Bahrain Oil and Gas Statistics, Jan – Dec 2014
- [3] Bahrain Economic Development Board, Maximizing the Economic Value of Bahrain's Natural Gas Resources, 2015
- [4] Information & e-Government Authority, 2015 Annual Report
- [5] Prof. Ibrahim Abdel Gelil, Energy Situation in Bahrain: Updated Gap Analysis, 2016
- [6] World Bank, World Development Indicators, 2016
- [7] World Bank, Delivering Energy Efficiency in the Middle East and North Africa, 2016
- [8] World Bank, Kingdom of Bahrain Energy Efficiency Program (KEEP), 2016
- [9] EWA, Statistics
- [10] EWA, Electricity and Water Tariffs, 2016
- [11] Bahrain Intended Nationally Determined Contribution (INDC), November 2015
- [12] United Nations, General Assembly Resolution A/RES/70/1 Transforming our world: the 2030 Agenda for Sustainable Development, September 2015
- [13] Arab Ministerial Council for Electricity, League of Arab States, The Arab Guideline for Improving Electricity Efficiency and Rationalizing its Consumption at The End User, 2010
- [14] Bahrain Economic Vision 2030
- [15] Government Action Plan 2015-2018
- [16] Cabinet Resolution No 4/2238 on the Establishment of the Sustainable Energy Unit
- [17] IEA, Energy Efficiency Market Report, 2016
- [18] EWA, Energy Efficiency Action Plan for the Kingdom of Bahrain 2015-2020 (EWA-EEAP), 2016
- [19] Arab Union of Electricity, Statistical Bulletin
- [20] Sustainable Energy for All, Building Efficiency Accelerator, 2015
- [21] EDB, Bahrain Economic Quarterly, Q3 2011
- [22] UNEP, Developing Minimum Energy Performance Standards for Lighting Products, June 2015
- [23] Strategy &, Unlocking the potential of district cooling, 2012
- [24] UNIDO, Practical Guide for Implementing an Energy Management System, 2015
- [25] World Bank, Energy-Efficient Streetlights in Bahrain: A Policy Note, May 2016
- [26] Tender Board, Annual Report 2014-2015
- [27] World Bank, Commodity Markets Outlook, January 2016
- [28] LMRA, Labour Market Indicators, 2014
- [29] Mahendra Vermaut, Tractebel Engineering, Improving Generation Efficiency of Power Plants in Arab Countries, December 2014
- [30] Ministry of Transport & Telecommunications, Statistics
- [31] European Commission, EU Energy Efficiency Directive, Annex V, 1(a) to 1(d), 2012



inquiry@seu.gov.bh
+973 17319429
P.O. Box 26814
Kingdom of Bahrain