

# ... A Rich Past... A Smart and Sustainable Future

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**Abstract**—The world’s energy requirements are expected to double in the next 50 years; a fact, which places energy use and conservation at the heart of the world sustainability challenge. This paper presents an overview of the an approach considered to meet this global sustainability challenge by the Redevelopment of Ahmadi Township spread over approximately 5.0 sqkm area, an existing Oil Town in Kuwait developed by the Kuwait Oil Company (KOC) in 1940s.

Since, the existing Ahmadi Township holds an important place in Kuwaiti society for its history, unique architecture, and green setting in light of the arid desert climate in the region, the approach considered taking the rich heritage further by becoming the flagbearer for a sustainable and smart growth in the region. Fundamental to this approach was redeveloping Ahmadi into a modern oil town, while taking into consideration, and retaining the rich, historical heritage of Ahmadi and Kuwait and include smart sustainable principles that connects the Township occupants and enhances the functioning of all the other services infrastructure across the township.

One of the goals is to redevelop the existing township within 10 years. During this period, all the existing facilities to have operations running at all times. The new Ahmadi Township seeks to preserve the rich past while incorporating the latest best practices integrating the sustainable practices and Smart City principles for Utilities, Waste Management, Building/Home Automation, and Infrastructure.

This paper illustrates various aspects such as the local context, history, vision and objectives, issues and challenges faced, approaches explored and considered, as well as Company’s commitment to the pillars of sustainability of environmental stewardship, community enhancement and the energy and water savings. The approach illustrates an enhanced corporate social responsibility in the region and uplifting the housing integrity in the surrounding context.

**Index Terms**—Sustainable, smart, environmentally friendly, energy saving, water saving.

## I. INTRODUCTION

Today, more than 3.9 billion people (~54% of the world’s population) live in cities, a number that is projected to rise to more than 6 billion by the year 2050 [1]. These urban environments - which only account for 2% of the planet’s land mass – are responsible for almost 80% of the world’s energy consumption and approximately equal share of its carbon emissions. [2]

The problems created by such dramatic urbanization place an increased emphasis on making the cities and neighborhood developments more resource-efficient and environmentally friendly.

In response to this approach and in line with the directives

of His Highness Amir of State of Kuwait Sheikh Sabah Al Ahmad Al Jaber Al Sabah, as well as the Company’s commitment to support the Kuwait’s 2030 Vision to reduce energy and water usage per capita and increase the energy supply from renewables to 15%. The redevelopment program is aimed at setting a positive precedent for sustainable urban development in the region.

The main objective is to re-structure the town-plan to transform the existing town it into a more effective modern oil town including all amenities necessary for its effective functioning using sustainable smart principles.

International consultants (i.e. M/s Atkins along with Gulf Consult and Ernst & Young) conducted comprehensive feasibility studies led by the KOC Ahmadi Township Redevelopment (ATR) Steering Committee to derive efficient project strategies for successful execution of the project.

Furthermore, one of the prime reasons for the Rebuilding Ahmadi Township development program was addressing the issue of high and the escalating maintenance and operation cost of the dilapidating houses of the existing township in addition to, providing better housing facilities and environment for the employees.

## II. BACKGROUND REVIEW

### A. Local Context

Ahmadi Township is located 40 km southeast of the Kuwait City center and occupied an area of approximately 5.12 sqkm.

Located in Kuwait it has an arid desert climate, huge temperature difference between winter and summer months and some marginal rain for a brief period each year. Kuwait experiences soaring temperatures in summers with average summer temperatures ranging from 42-48 °C. The highest ever temperature recorded in Kuwait was 54 °C in July 2016, which is the highest recorded temperature in Asia and the third highest in the world.

### B. Historical Context

Ahmadi is one of the most important suburbs of Kuwait City and has been crucial towards the development of the State of Kuwait.

Kuwait Oil Company (KOC) was established in 1934 through a joint venture between British Petroleum and Gulf Oil to manage oil production in Kuwait. In 1938, one of the world’s largest oil fields was discovered at Burgan, in the southeastern desert. In order to support the oil production in the Burgan field, the township of Ahmadi was developed in 1946 and it became the Headquarters for the Kuwait Oil Company (KOC) (see Fig. 1 and Fig. 2).

The following are the salient features of the Ahmadi Township, which provides a rich heritage to be preserved in

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future.

- 1) Strategic location in the Greater Burgan Oil Field area with proximity to the Ahmadi Port to facilitate the exploration and export operations.
- 2) The existing master plan illustrates a western layout, unique as compared to the rest of the settlements in Kuwait, to cater to the need of the British and American expatriate population in the 1940s.
- 3) It is famous for its vibrant green surroundings, beautiful parks and is one of the greenest settlements in Kuwait; which is a rarity in the given arid desert context.
- 4) Environmentally friendly and climate responsive design.
- 5) Served as a positive precedent in the region in the past.



Fig. 1. Ahmadi Township in 1960s.



Fig. 2. Existing Ahmadi Township.

### III. METHODOLOGY

#### A. Vision and Objectives for a Smart & Sustainable Future

In 2014, with KOC deciding to redevelop Ahmadi Township's future on the foundation of its rich historic past, a green building committee was formed by the Company to look into achieving the said goals for the residential & industrial sectors and formulate strategies and benchmark against global best practices.

An in-depth analysis on the current issues and challenges faced in the region and the State of Kuwait was carried out to form an accurate basis for formulating the goals and objectives for the redevelopment program.

An integrated approach was adopted involving several sessions with various stakeholders of the Company and consultants in order to derive goals/objectives for the proposed redevelopment program in order to fulfill the Company's vision:

"To transform Ahmadi into an oil town which reflects a modern oil industry image while taking into consideration and

retaining the historical and cultural heritage of Ahmadi and its contribution to the oil industry of Kuwait."

The following objectives were outlined for the redevelopment of the existing Ahmadi town:

#### 1) Redevelopment Stewardship:

Company's aspirations to be an employer of choice by providing quality service to the employees in the form of a modern, safe, secured and healthy living environment.

#### 2) Preserve Historic Heritage:

As it has been over 60 years since the inception of the township, the intent is to preserve and further enhance the outlook of the township by effectively modernizing it, being in line with the other modern cities of the world and to set a positive precedent in the region for sustainable and inclusive growth.

#### 3) Social Commitment:

To illustrate Company's social commitment not just towards its employees by uplifting the housing integrity, but extending beyond and contributing to the communities beyond its premises and Kuwait city.

#### 4) Support Kuwait's 2030 Vision:

To reduce energy and water usage per capita and increase the energy supply from renewables to 15%.

### IV. ANALYSIS AND RESULTS

#### A. Issues and Challenges

Kuwait has witnessed a steady increase in the power demands over the past decades in line with its economical and industrial growth (see Fig. 3 and Fig. 4).

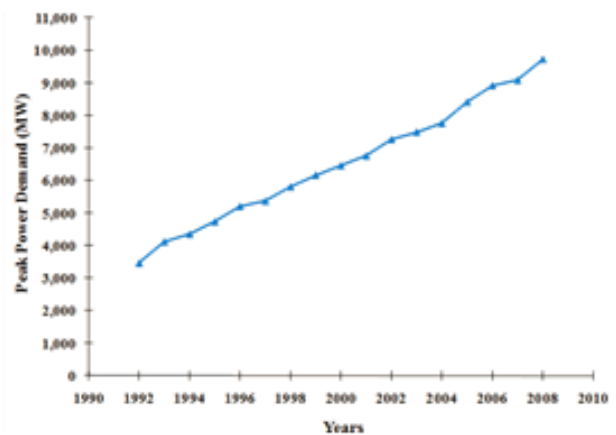


Fig. 3. Kuwait's power demand [3].

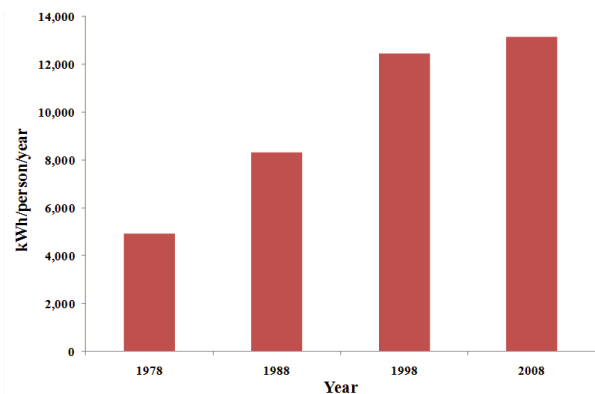


Fig. 4. Kuwait's electricity per capita [3].

Kuwait’s electricity consumption per capita has exceeded 18,000 kwh, and is one of the highest in the world. Electricity demand has been growing at an impressive rate estimated at an annual rate of 5.3% between 1999 and 2009 (de Boncourt, 2012).

For analyzing the extent of the energy savings to be targeted for the given project, statistical data including breakdown of the current average energy consumption in a Kuwait household was also derived from the research.

Based on the annual energy savings achieved per house in Ahmadi in kWh and the cost incurred per house, Return of Investment (ROI) period of 6.8 years was calculated.

An important factor in evaluating the target/ goals for the energy savings is the energy tariff applicable in Kuwait. The strong unbridled demands for water and electricity are only in part a consequence of inevitable factors such artificially low consumer prices set by the State of Kuwait.

The Kuwaiti government provides these basic utilities at a very low cost. Historically, the price of electricity had some links with the cost of production, but this link has been broken, and rather than raising electricity prices, the government has reduced them over time. These low prices, has resulted in a wide gap between production costs and electricity rates.

Another issue to be considered and addressed was that of the water security and water consumption in Kuwait and the projected water scarcity in the region by 2025.

Recent studies predict that global demand for water is going to be around 40 percent higher in 2030 than it is today, with population growth usually being the biggest cause of an increased demand. If the growth rate continues at the current level, approximately 60 per cent of the world’s population will suffer severe water shortages by 2025. The situation is only going to get worse for Kuwait with the lowest water security as shown in Table I:

TABLE I: THE AVAILABILITY OF WATER IN WORLD’S DRIEST PLACES IN 2035 [4]

Country	2010 population (million)	Projected 2035 population (million)	Per capita water supply (m3/person/year)
UAE	7.512	11.042	13.6
Qatar	1.759	2.451	21.6
Saudi Arabia	27.448	40.444	59.3
Bahrain	1.262	1.711	67.8
Yemen	24.053	46.196	88.8
<b>Kuwait</b>	<b>2.737</b>	<b>4.328</b>	<b>4.6</b>

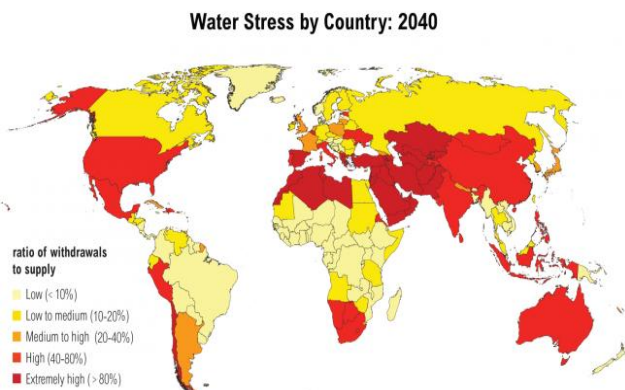


Fig. 5. Water-stressed countries in 2040 [5].

The research highlighted that these current trends in energy and water consumption needs to be reversed and addressed effectively in the given project in order to set a positive precedent in the region (see Fig. 5).

**B. Project Strategies**

An initial study was carried out, to check the relevance of the various development strategies for the three project related parameters namely, Finance, Logistics and Design outlined as follows:

For the financial aspect, three approaches were considered for the study namely,

- Built-Operate-Transfer (BOT)
- Private Sector Partnership (PSP)
- Do-It-Yourself (DIY)

The BOT and PSP approaches were excluded owing to the logistical and legal concerns highlighted during the study, and the Company decided to redevelop the township on its own following the Do-it-yourself (DIY) approach.

Owing to the logistical requirements for keeping the existing township and facilities operational at all times, a phased development strategy was adopted which included development of the vacant parcels of the land initially in order to enable the subsequent evacuation and shifting of the occupants of the existing units for redeveloping the existing developed areas of the township.

For the design aspect, the strategy included the study of the relationships and design components of the development models of various modern cities such as the Eco City, Green City, Sustainable City and Smart City/Digital City etc. This allowed the Company to choose the most comprehensive option with respect to the site context, concurrence with the Company’s objectives, cost implications and its benefits.

Assessment of existing infrastructure services was also carried out to determine the existing condition and derive the existing components in the township that could be retained, enhanced or integrated with the proposed design resulting in optimized utilization of resources.

A comprehensive design approach was adopted using Sustainable & Green design principles with the Smart Technology (ICT) as an enabler to achieve a more comprehensive sustainable development that is more relatable, simpler, better, faster and smarter (see Fig. 6).

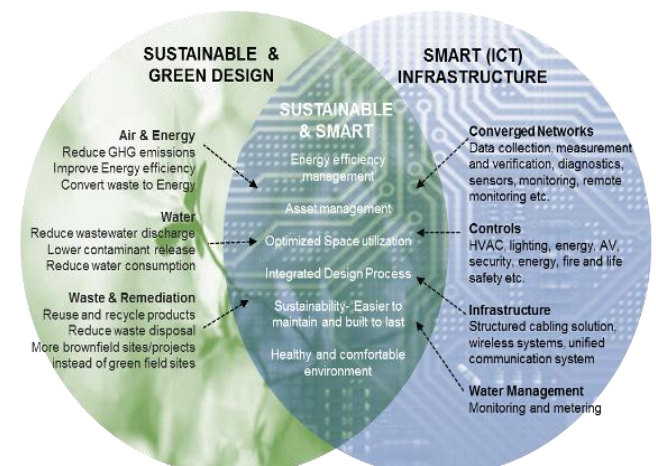


Fig. 6. Sustainable & green design and smart (ICT) infrastructure.

This required that the strategy was applied at macro level (in master plan & urban design) as well as micro level (in detailed design of houses and various facilities) of the township.

### C. Design Considerations & Mitigation Measures

At Macro level, the sustainable design approach in urban planning involved ascertaining the urban hubs and destination points in the existing Ahmadi Township and creating new nodes/hubs to ensure a good equal dispersion of retail, recreational, leisure, worship facilities across Ahmadi, thereby, easing or dispersing the traffic movement across the town. This also ensures easy accessibility for the residents across the town.

The uniqueness of Ahmadi town of being 'Green' is further enhanced by connecting the community nodes across the township through 'Green boulevards' forming a well-connected green network of pedestrian walkways and bicycle lanes across Ahmadi while integration the existing green spaces to increase its effectiveness. It also included provision of alternate mode of transport like bicycle lanes, bicycle pools etc. This also helped in enhancing the social environment; add vibrancy to the internal streets of the township while ensuring safety for the pedestrians and bicycles by including limited interaction with main vehicular traffic network.

Furthermore, the existing designated public open spaces and recreational areas were enhanced with the introduction of new functions and activities to meet the particular needs of Ahmadi residents. Improvements were also designed in terms of legibility, accessibility and connectivity. Improved levels of planting local plant species further resulted in the creation of new habitats and enhanced biodiversity.

Interventions such as widening of the existing pedestrian paths and defined site edges as well as the strategy for the formal arrangement of the hardscape and low maintenance softscape are introduced to create an elegant environment, while being easier to maintain.

The proposed master plan also optimizes the design interventions at macro level by retaining all the main streets & avenues of the existing urban fabric and restricting it to few minor enhancements to some roads and junctions required in order to cater to the future traffic for next 50 years based on traffic studies carried out for the township.

Sustainable design approach at building level included the following design considerations:

- 1) Provision of Renewable Energy Source- Solar PV cells for all houses and facilities in to achieve 15% of the energy demand without affecting the visual outlook from the streets and without altering the character of houses.
- 2) Provision of solar car parking ports for achieving 15% of energy demand for office building and other facilities in the township.
- 3) Provision of front and rear gardens for the houses, green shoulders along the streets and shaded streets and walkways to help reduce the effect of the heat island effect.
- 4) Design of the houses and buildings layouts, size and fenestrations of windows etc. optimize the use of natural

daylight to reduce the energy consumption in the lighting and cooling loads without any added cost.

- 5) Provision of insulated external walls with lightweight thermal blocks, 400mm thick with sand lime bricks cladding and higher U values to reduced cooling loads inside the houses and facilities.
- 6) Existing local sand lime bricks cladding used to retain the character of the existing Ahmadi town.
- 7) Design details to reduce thermal bridging and achieve air tightness to reduce energy losses in the building.
- 8) Use of water saving syphons and toilet fixtures to achieve 70% water saving.
- 9) Use of low maintenance landscaping and local trees and shrubs species reducing the irrigation water demand for the landscaped areas and using brackish water for irrigation to further reduce the use of potable water.
- 10) Use of locally sourced and manufactured building materials preferred and specified.

The following Smart Integrations were also considered in line with other Sustainable design strategies to optimize the benefits:

- 1) Optimize and upgrade the Main services infrastructure networks by including smart controls, meters etc. and GIS.
- 2) Provision of Home Automation system for houses (see Fig. 7).



Fig. 7. Provision of home automation system for houses.

- 3) Provision of Smart services such as Energy management system, environmental monitoring system, KOC communication platform for community, Outdoor signage system, security system, street lighting remote control system and waste management (see Fig. 8).



Fig. 8. Provision of smart services.

- 4) Provision of a centralized command and control center to control and monitor the operations of the overall town (see Fig. 9).



Fig. 9. Provision of a centralized command and control center to control and monitor the operations of the overall town.

## V. DISCUSSION AND CONCLUSION

The factors driving the feasibility of this sustainable & smart approach are as outlined below (see Fig. 10).

- Energy savings estimated at 36.5% energy savings.
- Up-front estimated cost premium (as compared to

conventional system) – 9.98%

- Return on Investment- less than 7 years. (Based on highly subsidized energy tariffs in Kuwait)
- Water conservation: 20% reduction of water consumption.
- Reduction in operation and maintenance cost.
- Enhanced Building transparency and visibility controlled by the Company through auditing, reporting and diagnostics.



Fig. 10. Comparison of Energy Consumption with other Residential buildings in Kuwait [6].

This not only caters to the future trends but also supports the Company to achieve its goals through the following:

- 1) Enriched Livability:
    - Comfortable, clean, engaged, healthy and safe lifestyle.
    - Diverse recreational and cultural options available.
    - More reliable services provided to the occupants.
    - Improve the quality of the urban management and create new modern values in life.
    - Improve employees' quality of life by improving the efficiency of the services.
  - 2) Better Health & Safety:
    - Vigilance and security aspects enhanced.
    - Safer neighborhood and community.
    - Faster emergency response system.
  - 3) Increased Sustainability:
    - Planning for future while catering to the present needs of the Company employees and occupants.
    - Efficient use of natural, human and economic resources also promoting cost saving.
  - 4) Improved Employee Workability:
    - Enhanced working environment and increased employee retention.
    - Easy Access to Company & Community services.
  - 5) Improved O&M efficiency:
    - Making services available to employees, company and authorities with reduction of the energy costs and operation/maintenance costs of the Company.
    - Reduced energy and water consumption.
    - Getting the Infrastructure do more and last longer for less.
- Thus, the Ahmadi Township redevelopment program

exemplifies Company's aspirations to set a positive precedent in the region and contribute towards meeting the global sustainability challenges, by addressing the three pillars of sustainability (see Fig 11).

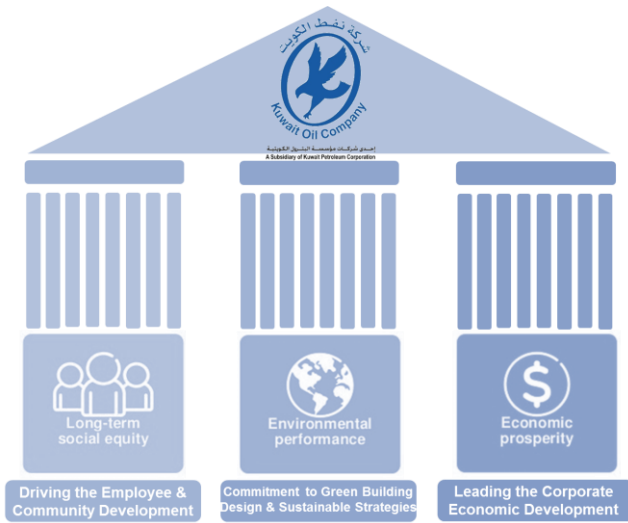


Fig. 11. The Ahmadi Township redevelopment program.

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