HCU HafenCity University Hamburg

RESOURCE EFFICIENCY AND CLIMATE ADAPTION STRATEGIES IN NEW URBAN NEIGHBOURHOODS - SHEIKH ZAYED, EGYPT

Resource Efficiency in Architecture and Planning
winter semester 2017 / 2018

IMPRESSUM

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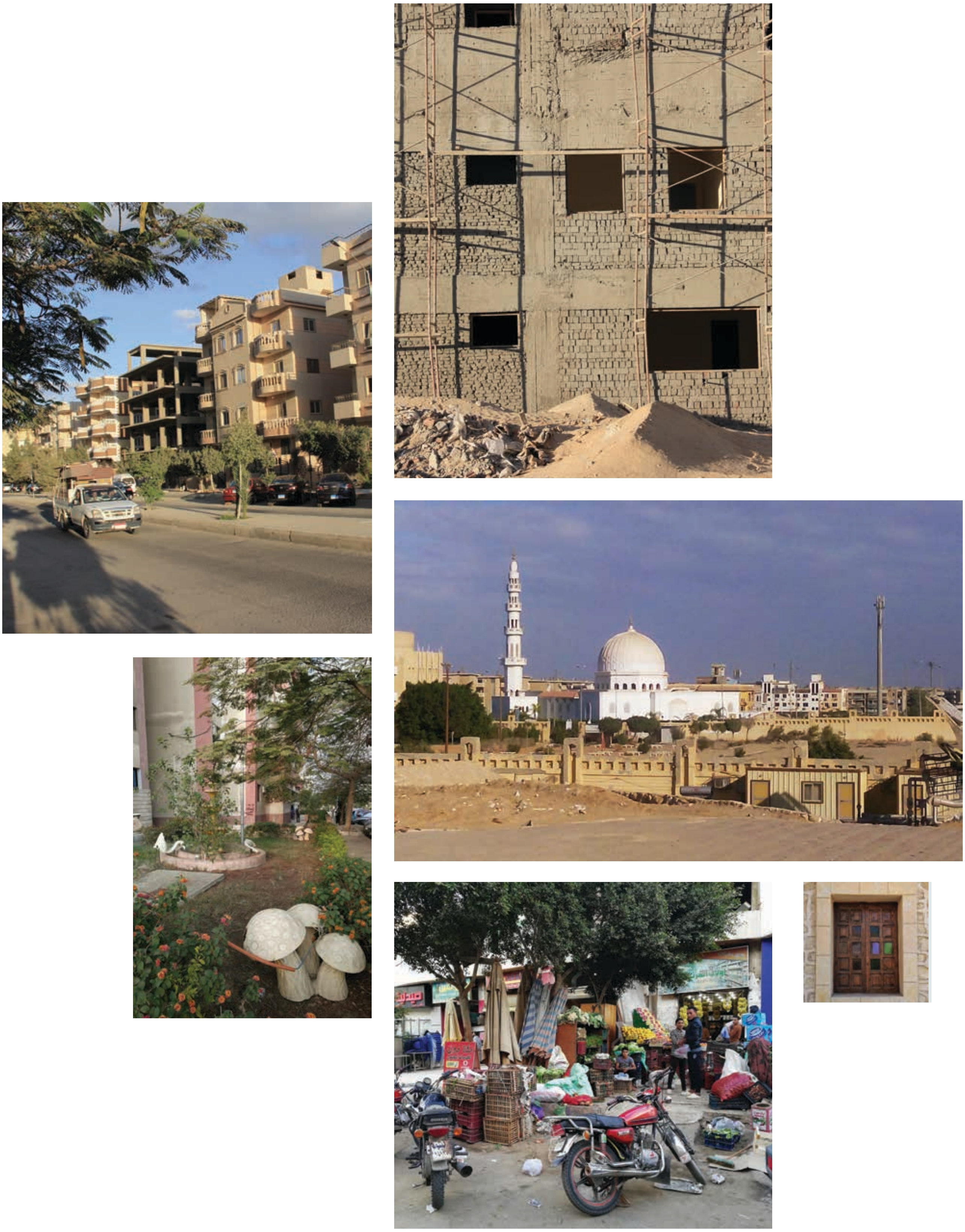

Photo collage, Sheikh Zayed (Authors, 2017)

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A PUBLIC [LAND] SCAPE
Solar Souq in Sheikh Zayed City

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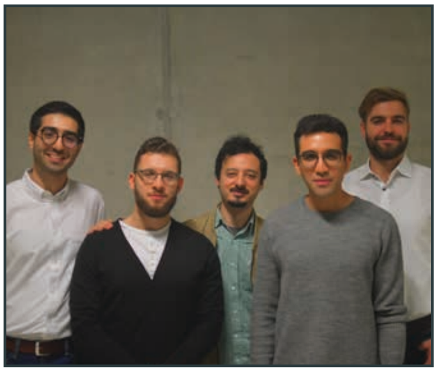
THE OASIS
A Climate Responsive Architecture Project



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MY NEIGHBOUR, MY HOOD
Community driven approach for sustainable urbanism in low-income neighbourhoods

INTRODUCTION

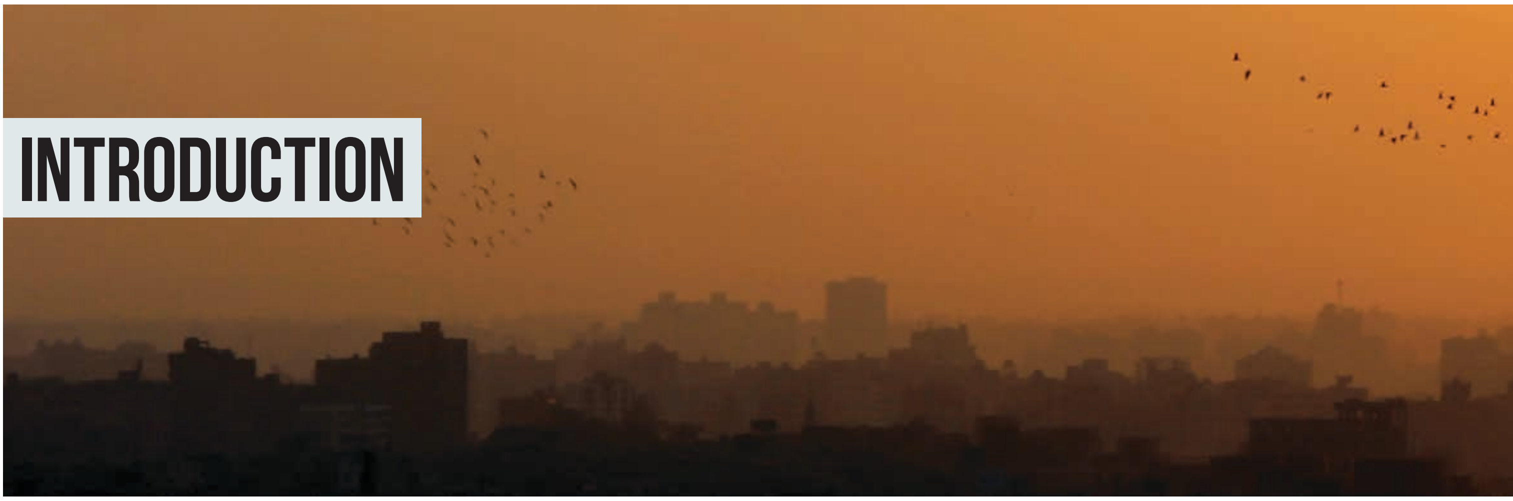


Figure 01: The skyline of Cairo (Vignola, 2017)

The Master of Science in Resource Efficiency in Architecture and Planning (REAP) is an international and interdisciplinary program offered by HafenCity University (HCU) in Hamburg. The graduate program intends to empower its students to encourage sustainable improvement on an architectural and urban level under various conditions, culturally and geographically.

As one module of the master's programme, the interdisciplinary project (Project III) in the third semester annually takes place in a different setting of real conditions abroad. Our semester, the 8th generation of REAP students, had the chance to work on and in a city of the Arabic Republic of Egypt. The satellite city of El Sheikh Zayed, located approximately 60km west of Cairo, was chosen as our focus area on which our projects were later developed. The primary emphasis of the so called Project III was to promote a sustainable approach within an urban development of this desert city and introducing climate responsive strategies for enhancing the living conditions in various ways and facets in Sheikh Zayed City. The project took place as a cooperation between the Architectural Department of Cairo University (CUFE) and HafenCity University Hamburg and was funded by the German Academic Exchange Service (DAAD) who generously provided support for this project.

This brochure highlights the outlook of six projects completed by the 8th generation of REAP students coming from different countries and backgrounds, such as architecture and landscape architecture, urban planning, civil engineering, environmental engineering, environmental science, economics and sociology. The projects presented in the following pages of this brochure are based on a comprehensive and thorough analysis of Cairo and the project site of Sheikh Zayed. Besides a functional theoretic approach, the consideration of real-life conditions and a feasible strategy were a key focus within the project development during this semester. Specifically, these urban interventions are related to the five REAP topics of *water*, *sustainable urbanism*, *energy* and *waste and material*.

As a preparation for a one-week site visit to Cairo, our REAP task forces, comprised of five to six students each, conducted a first analysis on Cairo and its desert cities. This in turn had to be successfully completed and complemented during the visit in Cairo. After gaining background knowledge on the present urban condition and issues, the project development continued in the course of theoretical research and practical analysis in Cairo, applying various methodologies. At this stage, local students of Cairo University were of great support in explaining the major differences in culture and politics and helping us to find the link between our preliminary analysis in Germany and the findings we could extract in Egypt.

Various presentations and lectures hosted by the CUFE were shaped to provided us with elaborate information on the aforementioned REAP topics in the case of Cairo. Besides the technical aspect, the existing framework of the city of Cairo, its inhabitants, services, government and authorities were addressed during these input sessions. Overall, these workshops with the attendance of students of CUFE and the communication with the locals widened our scope and supported us in terms of up-to-date information and local data.

Not only were the students of great support during research and investigation, our task forces from Hamburg

Figure 02: REAP students in Cairo (Donelson, 2017)

had the chance to receive temporary group members for their respective projects. Surely, this opportunity was an example of interdisciplinary and inter-cultural knowledge exchange and team work which provided valuable insights for students from both universities. After this short and intensive workshop in Cairo, the fields of research were shaped and the projects thoroughly elaborated in Hamburg.

Through the course of four months, we developed the following research projects:

- Wasteaid project. Case of Sheikh Zayed City.
- Green action plan. Micro-climate management with integration of grey-water irrigation.
- A [public] land scape. Solar souq in Sheikh Zayed City.
- Design of open spaces on block level. Integrative urban design and renewable energy.
- The oasis. A climate responsive architecture project.
- My neighbour, my hood. Community driven approach for sustainable urbanism in low-income neighbourhoods.

We would like to express our gratitude to the professors and staff from Cairo University, especially to Prof. Heba Khalil, Prof. Sahar Attia, Dr. Sherin Gammaz and our knowledgeable supervisors, Dipl.-Ing. Sonja Schlipf and M.Sc. Gionatan Vignola for their support, patience and command on the subject which helped us to successfully complete our projects.

Additionally we would like to thank our project tutor Ahmed Lotfy for his motivation and cooperativeness throughout the entire semester. We are also very glad to have experienced the continuous support of students of Cairo University during the Cairo visit and are thankful for their help.

Finally, we are grateful for all curious readers and hope that the following projects will leave them with interest and inspiration.

- 8th Generation of REAP students

Figure 05: Historical area of Cairo (Schlipf, 2017)

Figure 06: Nile view, Zamalek (Schnellberger, 2017)

Figure 03: Buildings, Sheikh Zayed (Vignola, 2017)

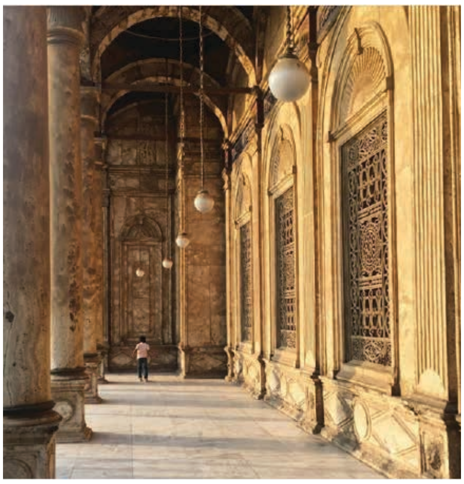


Figure 04: Citadel, Cairo (Schnellberger, 2017)

Figure 07: Pyramids of Giza (Köroglu, 2017)

BACKGROUND

Figure 08: Sheikh Zayed skyline (Zaluski, 2017)

GREATER CAIRO

In Egypt, 96% of the total population is concentrated in only 4% of the land in the entire country (Sims, 2015). The Nile Valley and Delta, are where the dense population is concentrated due to its oasis qualities compared to the surrounding desert that covers the rest of Egypt. Part of this densely populated area in the north-east of the country is known as the Greater Cairo Region (GCR) which, consists mainly of Cairo, Giza and Qalubiya cities. This region has a population that reaches approximately 18 million inhabitants. For this reason, not only it is a mega city but is also the largest one on the African continent. (Kraas et al, 2016)

Over the next ten years, this Mega City is expected to grow at an annual rate of 2.11%, which shows that the urbanization pressure on it is not decreasing (UN-Habitat, 2014).

The city of Cairo is the capital of the country as well as its cultural center. With the decay of this city and increasing socio-economic-cultural gap existent between classes in Egypt, the middle and upper classes as a result tend to search for new areas to expand. Due to this, it leaves the inner-city area with most of the lower class population that expands into informal settlements on agricultural land. In order to protect these lands on the periphery of Cairo city, beginning with the 70's the main expansion development concept was the implementation of satellite cities. These cities would accommodate the growing population of Cairo, however not disrupting the cultivated land around the Delta. (Kraas et al., 2016)

Therefore, GC can be divided into three urban area types. The "formal" urban area, which consists of the historical old city and its urban expansion area until the 50's. The "informal" urban area, which is the expansion of low-income population that create developments in the surroundings of the inner-city by construction on agricultural lands. Finally, the "Desert Cities", which are relatively new settlements located in the desert with the intention to reduce the high density of the "formal" inner city and represents a legal/formal option in comparison to the "informal" settlements.

In order to tackle the urban congestion issues, the Egyptian President Anwar Sadat in the 70's implemented a development to inhabit the desert away from the Nile River Valley by offering housing and jobs opportunities for a fast growing population as well as hundreds of new industrial districts, agricultural revitalization projects and tourist complexes (Bufeno, 2017).

New Urban Communities Authority (NUCA), established by law No 59 of November 1979 is the state body responsible for the establishment and development of new urban communities in Egypt. NUCA is commissioned to work in affiliation with the Ministry of Housing, Utilities and Urban Development and aimed to create new communities by redistributing citizens especially low-income households from the Nile Valley. These new community projects were initially financed by the state government but later on, the commission took the responsibility of financing all sovereign and sub-sector projects. From 1979 to date, the commission has developed approximately 30 new cities and covered a total land area of 1.1million acres. NUCA takes responsibility for managing these communities and involves civil society groups. (NUCA, 2018)

DESERT CITIES

The "New Town Programme" of 1977, planed the first satellite cities of the GC area, such as 6th of October, 10th of Ramadan, 15th of May, al-Ubur, al-Shuruy, New Cairo, al-Badr and finally the area of study, Sheikh Zayed. The rationale behind building this new city was questioned a lot, since it would compete with other new towns around Cairo "that were struggling to attract exactly the same kind of market demand" (Sims, 2015). Sheikh Zayed (Giza Governorate) has an area of 38 km^2 and was established in 1995. It is located about 25 km west of Cairo, bordered to the north by Cairo-Alexandria desert road and to the west by 6th of October city (Sims, 2012). NUCA set a target to attract 650,000 inhabitants to the city by 2020 (Sims, 2015). According to official data, current population of the city is 330,000 inhabitants (NUCA, 2018). The city is intended to accommodate people from all income groups, thus promoting social cohesion. According to the Master Plan of the city, no industrial areas are designed.

The planning norms and layouts of Egypt's new towns are very similar among themselves. Their common characteristics are: low densities, large distances between different elements and neighborhoods, wide streets, big areas reserved for green buffer zones and land uses that are strictly segregated (Sims, 2015). These characteristics are similar to western standards for residential development.

The intention of the new planned cities was to relocate 10% of the total population of GC by 2005. Despite the high investments of the implementation of such cities, they were only able to transfer 3.7% of the population by 2006 (Sims, 2012).

The reduced rate of success of the project, is due to the focus on social classes. Most of the projects in these new areas were directed to middle and upper classes and the

Figure 09: Sheikh Zayed area (Zaluski, 2017)

few existing ones for low-income, were almost entirely not approved by the users. The reduced accessibility due to not well-developed transport connections between satellite cities and Cairo, together with not sufficient job opportunities in the area, made this target group dependent on commuting back to the city for work related opportunities as well as social ones. On top of the poor transport and social infrastructure of the area, social housing prices were still too high for them to afford.

Regardless, the government continues to promote the expansion of the GCR into the desert area and prefers to invest in developing new satellite cities rather than investing in already existing informal settlements. As an example, the planned construction of "New Cairo" with new economic sectors and location of Egypt's government Centre (Kraas et al., 2016).

Despite the good intentions of the project, with forty years of extensive public and private financing, the desert cities development has not achieved the goals, with most of the population still settled inside the Nile River Valley as well as small percentage of jobs generated within the thirty desert cities. One of the main factors associated with the project failure was the poor quality of governance. The World Bank measured Egypt's government performance according to indicators such as voice and liability, government efficiency, regulatory quality, the rule of law, control of corruption, and political stability. For these reasons, the whole country has issues regarding the enforcement of laws and the supervision of public projects. Moreover, urban development projects are poorly implemented by the government resulting to inefficient urban revitalizations and waste of public funds, since the projects do not bring the quality expected. (Bufeno, 2017)

Another factor why desert cities in Egypt remain underpopulated is that Egyptian political elites and their international partners planned desert cities without including the inhabitants and final users into the planning of the projects. As a result, people lacking housing, continued to build informal communities on the Nile River Valley without proper infrastructure. (Bufeno, 2017)

Figure 10: Sheikh Zayed location in relation to Cairo (map from Google Earth, 2018)

Photo collage, Sheikh Zayed (Authors, 2017)

WATER

Figure 01: Nile river (Alhomsi, 2011)

Figure 02: Nile river (Alhomsi, 2011)

Figure 03: Nile river (Alhomsi, 2011)

INTRODUCTION

Water management process in Egypt is a sensitive topic that involves cooperation of different stakeholders to facilitate efficiency in water supply. However, the threat posed by pollution and abstraction to the Nile River,(the main water source in Egypt), is detrimental to the state of water supply in the country. The main challenge to water management is striking a balance between the sharp demand and limited supply of water. Cairo city is located about 250km from the Mediterranean Sea and a distance from the Nile Delta. The city extracts water from the Nile River for consumption, irrigation and industrial activities. As much as the Nile River is the source of freshwater to Cairo city, it is also the main recipient of the wastewater from varied activities. Consequently, Cairo City is served by six domestic water treatment plants whose effluents are deployed in agriculture during irrigation. On the other hand, Sheikh Zayed city in Egypt is served with canals diverted from Lake Nasser which provide water for irrigation as well as local use. Moving to the subject of water tariff and price in Egypt, the costs of water are expected to rise in the next coming years. So far, the costs of water increased by as much as 50%, when the Egypt Prime Minister Sherif Ismail signed off the act to increase sewage fees and costs of drinking water across all sectors and consumers.According to the official gazette notice, the new prices of residential water usage will range between LE 0.45 to LE 2.15 per cubic meter. The prices highly depend on the consumptions. In addition, Egypt's sewage fees are calculated as percentages of water price; the sewage prices increased from 57% to 63% (Egypt Independent, 2017). The increase of prices was expected to improve water management as the country tried to deal with looming shortage of the essential commodity.

AVERAGE WATER CONSUMPTION

According to the Central Agency for Public Mobilization and Statistics (CAPMAS), as in the year 2013-2014, the average water consumption per capita was 103.4 cubic meters. This was a decline compared to the previous year rates of 116.3 cubic meters. There was a significant decline despite the increasing population. In 2013-14, the total production of water in Egypt was 11.7 billion cubic meters, 75.6 % was pure water while 24.4 % was turbid (Al-Masry Al-Youm, 2015). Furthermore, 89.1% of the water produced in Egypt came from river Nile. with 10.8% of the water coming from the wells and the rest from desalinated sea water. Residential units consumed 68.9% of water, the rest 31.1% was consumed by non-residential units. The water wastage increased to 23.5% as result of broken distributed networks, water leakages and illegal connections (Al-Masry Al-Youm, 2015). The graphs below show the freshwater withdrawals per capita in Egypt.

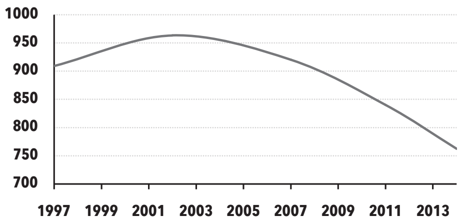


Figure 04: Freshwater withdrawals per capita (cubic m) (adapted from source: Ambartsumyan,2016)

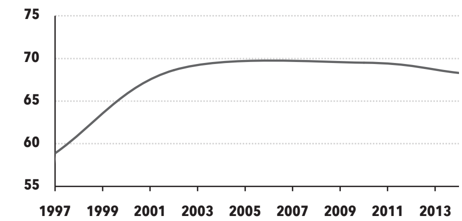


Figure 05: Freshwater withdrawals, total (bln. cubic m) (adapted from source: Ambartsumyan,2016)

WATER TREATMENT & MANAGEMENT

Wastewater treatment refers to the process of converting water that is no longer suitable for use into water that can be discharged back to the environment without causing any damage. They are two main methods of treating wastewater, the chemical method that includes a physical treatment plant and the biological method. The main difference between the two is the first method employs the use of chemicals while the second, the use of aerobic and anaerobic bacteria. The main reason for treatment of wastewater is to allow for disposition of environment-friendly water back to the environment.In addition to the Nile River surface water, ground water provides for the second source of water. Water management in Egypt is governed by the Ministry of Water Supplies and Sanitation Facilities. However, it works hand in hand with the Cairo and Alexandria portable Water Organization along with the National Organization for Portable Water and Sanitary Drainage. (Abdel-Dayem, 2011). Due to high demand of water and sensitivity of the water resources available, the government has introduced stricter controls and regulations over the use of water with the aim to provide constant and reliable supplies of water to its citizens. On the other hand, USAID has also had a positive impact on water management in the city by introducing water treatment and management strategies. These strategies led to the establishment of 8 directorates concerned with water resources and irrigation along with sub-divisions of 45 integrated water management districts (IWMD).They are also the main financial sponsors and advocate for these projects aimed at improving water supply to the Egyptians. Similar associations like the Water Users Association also operate on the ground by engaging the local farmers to make key water management decisions for the area (Batt & Merkley, 2010).

SUSTAINABLE URBANISM

Figure 06: Cairo (Vignola, 2017)

Figure 07: Cairo Outskirts (Vignola, 2017)

Figure 08: Cairo Desert Cities (Vignola, 2017)

INTRODUCTION

The term Sustainable Urbanism is defined as the application of sustainability and resilient principles to the design, planning, and administration/operation of cities (Sharifi, 2016). It is known that the long-term viability of any city, encompasses factors such as the social and economic wellbeing of people, responsible resource-consumption, livability of the place, and a thriving of natural environment. They are controlled by the systems, members, and forces, which constitute the society living in the city. While the scarcity of space in the desert is not a problem, space should be considered a valuable and limited resource that should be managed properly and used efficiently. At the heart of any city design is public space, that should be accessible and open to multiple users having various uses, connecting individuals and providing functional spaces.

It is clear that cities are the biggest consumers of natural resources. They are the nexus of power, influence, humans, natural resources, culture, ideas, and creativity. As such, cities play a key role in making and taking positive steps towards achieving sustainability and mitigating climate change. Therefore, we need to have sustainable city models to change the current situation in both Cairo and desert cities. Certainly, implementing such models on neighbourhoods is not an easy task. This is not because of the complexity of the model, but, its dependency on the responsible local government's determination in developing these desert cities. The trend of rapid social change is largely neglected behind a variety of urban crises that have unexpected local impacts (such as social housing, transportation, population growth, etc.). Accordingly, there is a growing demand for sustainable urbanism approach in urban planning to improve the adaptability of the social, economical & ecological system of a city.

URBAN FORM

Cairo for example represents the center of Egypt. It has experienced many transformations, and is the home to 20 million people with an increasing population growth trend (Sims, 2012). Its social and spatial structure was shaped during hundreds of years, and because of that a very complex urban structure currently exists, representing many different phases of development. Cairo is also the most densely populated area in Egypt and it houses almost a quarter of Egypt's inhabitants. In the 1970's, due to the large uneven population growth Cairo was facing, the government attempted to redistribute the population and put a limit to the creation of informal settlements, by creating desert cities. It was an attempt by the government to control population growth.

There are currently eight new desert cities, all of these cities are part of Egypt's new town's program which started in 1977 and was codified under law no 59 of 1979 (Sims, 2012). It is being implemented by the New Urban Communities Authority (NUCA) of the Ministry of Housing, Utilities and Urban Development. The layouts of all the new towns are quite similar both the original master plans and the extensions are all created over empty desert of state owned land with large distances between the different elements inside the neighbourhood. Residential areas are designed in a way that population density within these zones remains low. Furthermore, most of the neighbourhoods are designed to have as much as 60% of its land devoted to public services, open spaces, green spaces, playgrounds, wide streets and boulevards. Also, huge areas of lands are reserved for public services and green buffer zones. This layout while it sounds promising when is implemented numerous problems can be noticed in new cities which can be avoided with changes in the planning methods.

FACTS

The growth of the city was tackled with conventional planning methods, which failed to create a sustainable urban environment. Meanwhile, the developments only served the upper class, leaving the rest of the society with poor public spaces. Alternative planning approaches to revive the public spaces are needed, in order to accomplish a sustainable model. Those are the long-term goals that city planning departments should aim for, that run parallel process of analyzing and designing while engaging all stakeholders.

Figure 09: Egypt's alternative "sustainable urbanism" (Vignola, 2017)

As a closing remark, following a holistic approach which requires a combination of good planning, efficient design and the cooperation of both the urban population and government., with collaboration of all actors is the best option for a good sustainable urbanism approach.

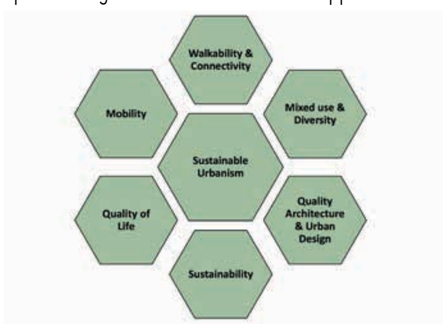


Figure 10:Some Principles of Sustainable Urbanism (Authors, 2018)

ENERGY

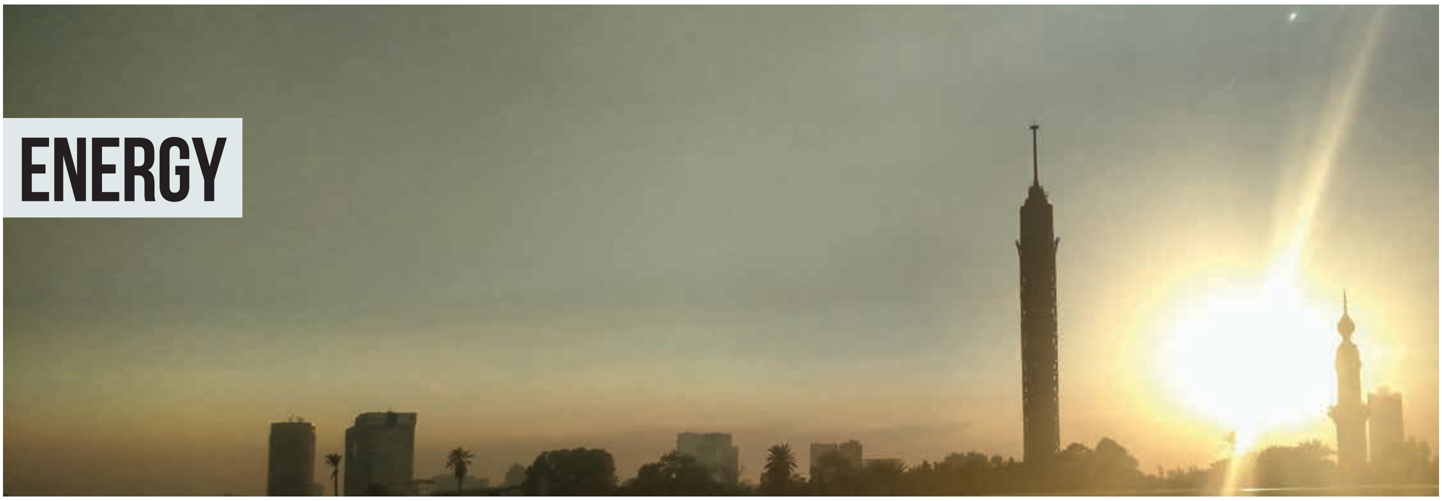


Figure 11: Cairo city scape. (Rayaprolu, 2017).

EGYPT AND ITS ENERGY SCENARIO

Egypt's energy sector is recognised as one of the most promising. Although, Egypt is not part of the Organisation of the Petroleum Exporting Countries (OPEC), it is the biggest oil producer in Africa and the second biggest gas producer on the mainland (Hegazy, 2015). Despite meeting almost 95% of the national demand (Al-Salaymeh,et. al., 2016), the Egyptian energy sector is right now facing tremendous difficulties. It is essential to note, energy generation in Egypt has been dominated by non-renewable energy sources (Hegazy, 2015). During the last decade, Egypt's energy policies and energy sector have seen key changes. Subsequently, a few attributes of the nation's energy sector could be recognized. Egypt's increasing population and financial (modern) improvement prompted a noteworthy ascent in the interest in energy commodities resulting in an energy demand in crease in all sectors (private, transportation and mechanical) (Hegazy, 2015).

Notwithstanding, from the year 2014, investment and economic growth began to fall into place. Fixed investment was set to be the essential driver of growth because of better economic strategies. Consequently, the administration is now inclining towards drawing in great foreign investments in the energy sector (Hegazy, 2015).

Until the year 2015, the share of non-renewables in producing electricity was 89% while renewable energy sources made only 11% of the total electricity generated including sources like hydropower. However, only 6-8% of the annual electrical needs of the nation are covered by hydropower. The best source of renewables for Egypt is wind, where the nation stands first in the whole Arab region having 750 MW of installed capacity at Zafrana and Gabel El-Zayt areas (Al-Salaymeh,et. al., 2016).

THE NATION'S ENERGY STRATEGY

The current energy strategy of the country has derived an ambitious plan to deliver 20% of the electricity generated through renewables by 2020, 12% of which is from wind energy. According to the sustainable development strategy, under Egypt's vision for 2030, the government of Egypt announced the feed-in tariffs programme. This also includes programs for increasing private investments in order to develop new renewable projects.

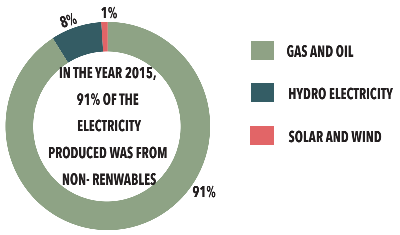


Figure 12: Percentage of fuel mix for electricity production in 2015 (Adapted from source: Egypt vision,2030, 2015)

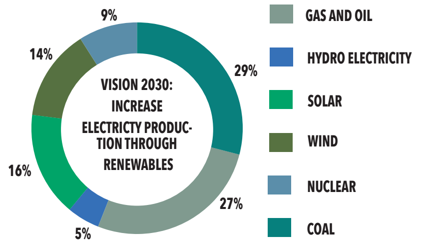


Figure 13: Vision 2030, percentage of fuel mix for electricity production (Adapted from source: Egypt vision,2030, 2015)

The government is now building up a coordinated energy strategy that incorporates new energy costs to decrease the energy subsidy bill. The plan aims to improve the demand side initiatives to reduce energy consumption and to approach the solution by implementing different initiatives. The strategy will also address the different difficulties faced with the utilization of coal by heavy industries (Egypt's vision - 2030, 2015).

ENERGY AT THE CONSUMER LEVEL

The energy consumption of a normal household is 5,811 kWh/yr (Author's survey results, 2017) in Sheikh Zayed satellite city, which is quite low when compared to a typical German household with 7000 kWh/yr (Braun, 2017). According to the survey done by the authors, the values of consumption might vary depending on the area and locality, number of users per household and type of appliances used.

The United Nations Development Programme with the help of a project (Improving Energy Efficiency of Lighting and Building Appliances Project) aims at supporting the government in strengthening the regulatory legal frameworks to improve energy efficiency of lighting and building appliances at the consumer level. The project is directed towards satellite cities like Sheikh Zayed to ensure reduction in energy consumption patterns. The target is to gradually phase out the inefficient lighting products by 2020 making energy efficient lighting an essential choice for the residential, commercial and administrative buildings as well as street lighting to reduce the energy demand (Ministry of Environment, 2018).

Figure 14: Energy consumption tracking meter at a resident's house in Sheikh Zayed, Cairo. (Rayaprolu, 2017).

WASTE & MATERIAL

Figure 15: Waste & Material in one frame (Haveriku, 2017)

BUILDING MATERIALS

Sheikh Zayed's neighbourhood consists of buildings that are used for residential, commercial, educational and religious purposes. The biggest share is that of residential area which covers 85% of the neighbourhood.

Figure 16: Neighbourhood of Sheikh Zayed (Haveriku, 2017)

The area is developed in two similar blocks, in which the centres are located in the middle and those are the economic and social heart of the block. The educational, commercial and religious services are placed in these centres. Therefore, the inner block roads are all meeting in the centre and connecting it with the main roads in the perimeter of the area.

Figure 17: Sheikh Zayed Building Façades (Macedo, 2017)

As the neighbourhood was established in 1996, the buildings were made of concrete and hence they aren't in line with the building materials used in downtown Cairo.

WASTE

A total of 75.9 tonnes of domestic waste is produced everyday in the Sheikh Zayed city. The city faces a numerous challenges pertaining to collection and separation of waste and the distribution of bins. Due to the lack of awareness or sometimes unwillingness, people tend to mix their wastes. Even after various initiatives taken by Egyptian Environmental Affairs Agency (EEAA) to bring in awareness by training programs, they proved futile bearing no positive results.

Figure 18: A Waste bin in Sheikh Zayed (Macedo, 2017)

According to the annual Report for Solid Waste Management in Egypt in 2013, Cairo was the biggest contributor with a generated amount of waste of 15,000 Tones/day and the second one was Giza Governorate with 4,500 tonnes/day. The accumulated waste is 3,000,000 m³ for the Giza Governorate and its waste collection coverage is 60% (Zaki et al., 2013). According to Hoornweg and Bhada Tata's analysis of the Municipal Solid Waste (MSW) composition for the year 2012, the biggest share of 56% was of organic waste followed by 13% of metal, 10% of paper and 15% of miscellaneous.

Only 60% of the MSW is collected in Greater Cairo, therefore, the remaining is not collected, which contributes to a polluted, unhealthy and non-aesthetic environment (Zaki et al., 2013). This 60 % of MSW is mostly collected by informal collectors such as Zabaleens (71%) and dump/street pickers (4%). Only 25 % of them are collected from small size manufacturing. The recycling process of the MSW is very low, only 20 % is recycled according to GOPP (2012).

Current waste collection by the 96,000-person strong Zabaleen community is well known for its role, providing much of the informal waste collection services in place around Egypt with major concentration in Cairo and Giza Governorates. One recent UNESCO study estimated that the Zaballeens collectively manage 10% of the country's waste (World Bank, 2015).

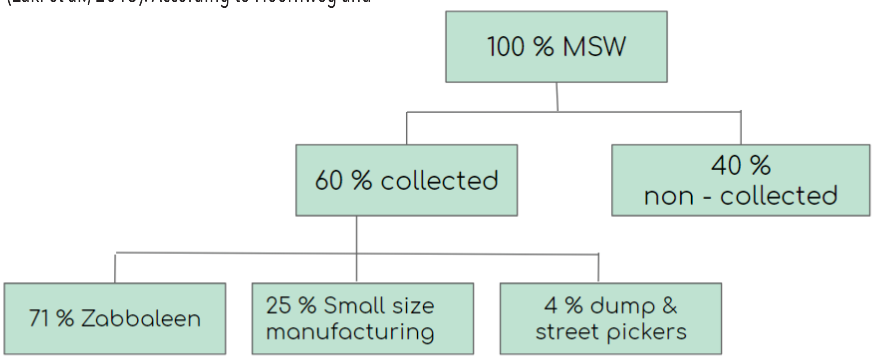


Figure 19: Local context for waste collection in Cairo. Graph (Authors, 2018); Data (Gunsilius et al., 2011) and (Zaki et al., 2013)

MAP *OF* PROJECTS

1 WASTEAID PROJECT
Case of Sheikh Zayed City

2 GREEN ACTION PLAN
Micro Climate Management with Integration of Grey Water Irrigation

3 A PUBLIC [LAND] SCAPE
Solar Souq in Sheikh Zayed City

4 DESIGN OF OPEN SPACES ON BLOCK LEVEL
Integrating Urban Design and Renewable Energy

5 THE OASIS
A Climate Responsive Architecture Project

6 MY NEIGHBOUR, MY HOOD
Community Driven Approach for Sustainable Urbanism in Low - Income Neighbourhoods

(map from Google Maps, 2018)

GROUP 1

WASTEAID PROJECT
CASE OF SHEIKH ZAYED CITY

Figure 01: Implementation of a WasteAid Collecting Station in a green courtyard of Sheikh Zayed (Authors, 2018)

INTRODUCTION

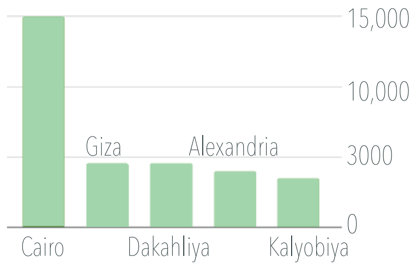


Figure 02: Waste Generated in tons per day 2012 (Authors, 2018. data from Zaki et al., 2013)

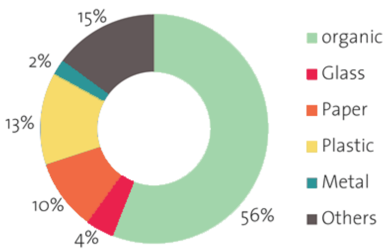


Figure 03: Composition of municipal solid waste in Egypt (Hoomweg & Bhada-Tala,2012)

Sheikh Zayed was established in 1995 and it is located thirty-five kilometer far from Cairo downtown. (NUCA, 2018). The total area of the city is 43,680 m² and its current population 293,000 inhabitants, although the target is 675,000 inhabitants. The selected neighborhoods consist of various uses such as residential, commercial, educational and religious, in which the residential area has the biggest share of 85.2 %. The area is considered green as per share of public green spaces of 23 %. Based on the surveys developed on-site, the educational area consists of one public and one private school, which are mostly not serving the neighborhood. There are other higher educational facilities nearby which use the area as well. The commercial areas are not attended by the residents themselves, rather than by the surrounding residential areas inhabitants (gated communities).

By studying status quo of Sheikh Zayed, we have noticed that waste management has significant problems mainly regarding the distribution of bins, collection and separation, and due to unwillingness and lack of awareness people, tend to dispose their waste as a mix. In fact, analyzing the Municipal Solid Waste (MSW) composition in Egypt in 2012, as per Hoornweg & Bhada-Tata, 2012 the biggest share of 56 % consists of organic waste, which is followed by 13 % of metal, 10 % of paper and 15 % others. Only 60 % of the MSW is collected in Greater Cairo, therefore 40 % remains uncollected and contributing to a polluted, unhealthy and non-aesthetic environment (Zaki et al., 2013). This 60 % of MSW is mostly collected by informal collectors such as Zabaleen (71%) and dump/street pickers (4%). Only 25 % of them are collected from small size manufacturing. The recycling process of the MSW is very low, only 20 % is recycled based on GOPP, 2012.

The current waste flow varies according to value and recyclability. The resident's waste in street bins can be collected by municipal waste collector truck and disposed directly in a landfill, hence shortening the service life of the product and inhibiting profit, instead losing money. A second root is when Zabaleen provides indoor collection service for a small fee or when they collect it in the street bins. For both ways there is income for the Zabaleen, daily LE 10 or US$ 1.90 (Fahmi and Sutton, 2010), to then after sorting the waste, they can earn a specific amount of money weight-based by selling it to informal recycling companies. However, organic waste creates no profit. After segregation, the waste might also end up in a landfill if some unit is unrecyclable. On the other hand, informal recyclers export the waste and, from it, new products are created, generating profit for the companies. Nevertheless, some products can also go to the landfill if it cannot contribute to a new product creation. Valuable waste such as electronic and furniture can be picked up from informal collectors called Rababekia at the door of the household that requested the service. The process is the same as the Zabaleens, but the profit is higher.

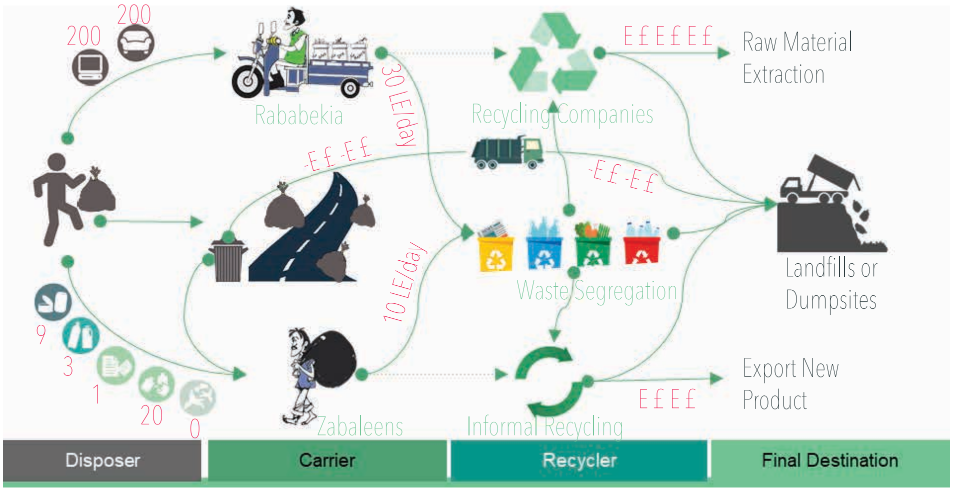


Figure 04: Scheme of current waste flow in Egypt. (Authors , 2018. Data from Zaki et al., 2013)

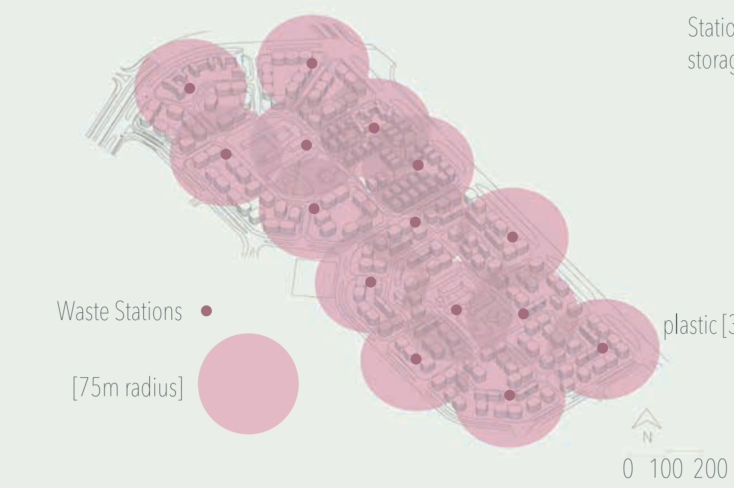


Figure 05: Station Distribution in Sheikh Zayed (Authors, 2017)

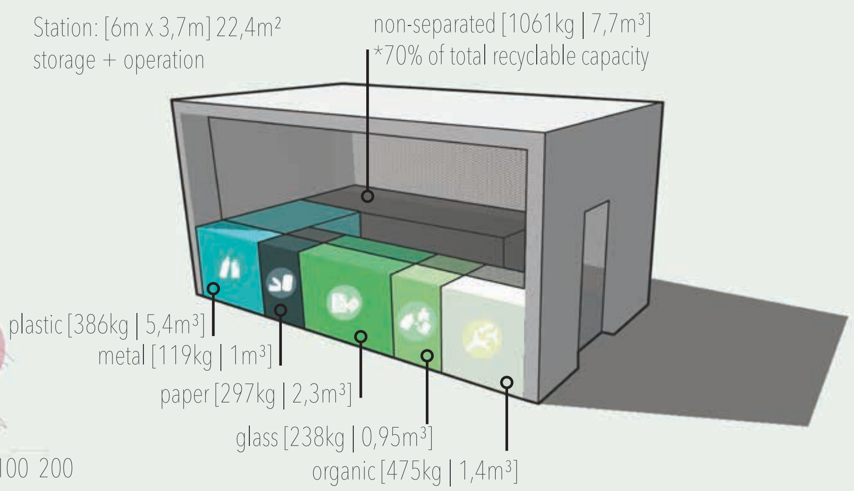


Figure 06: Modular Station and collecting capacity in kg and m^3 (Authors, 2018)

GOAL & STAKEHOLDERS

As a response to the status quo, the proposal intends to act in Sheikh Zayed into improving what our group identified as most important to the waste system towards a circular economy: the lack of proper collection and disposal of the waste, as well as the insufficient inclusion of the least valuable sorts of waste in to the system. It was done by studying more in detail, we chose waste management through a platform (WasteAid App Company) as our topic.

For the project, the households of the neighborhood are the target group. The direct stakeholders are private MSW operators, composting operators, recycle companies, biogas to energy companies, formal and informal recycles and international development organizations (of which many already exist in Greater Cairo: e.g.EMPOWER, ECARU, RecycloBekia, etc). Other important groups of stakeholders are the local authorities, the app company that we are creating and NGOs. The aim is to bring them all together to collaborate in the best way possible, according to their interest and power.

CONCEPT

The concept creates a system with users (producing waste) and customers (dealing with specific kinds of waste). The main task is to provide a better connection to those sides by improving the stream of wastes appropriately. For electronics and furniture, the provision of services for repairing can extend the life of the material until it is better suited to be disposed of. For the municipal waste, there is an incentive for users who segregate their waste and send them to one of our collecting stations. This can be done by the user, or to an indoor collection service, following the cultural background of households who hire informal collectors to pick their waste. Non-users waste can be collected, without any separation, into a station, and the segregation is made there, guaranteeing a correct division for the recycling company's collection. The user's waste bag is identified by the employee and the incentive is repassed to the user via the app. With it, users can request services and pursue new products. The recycling companies buy valuable waste, whereas the organic waste is directed to the biogas and fertilizer companies free of charge.

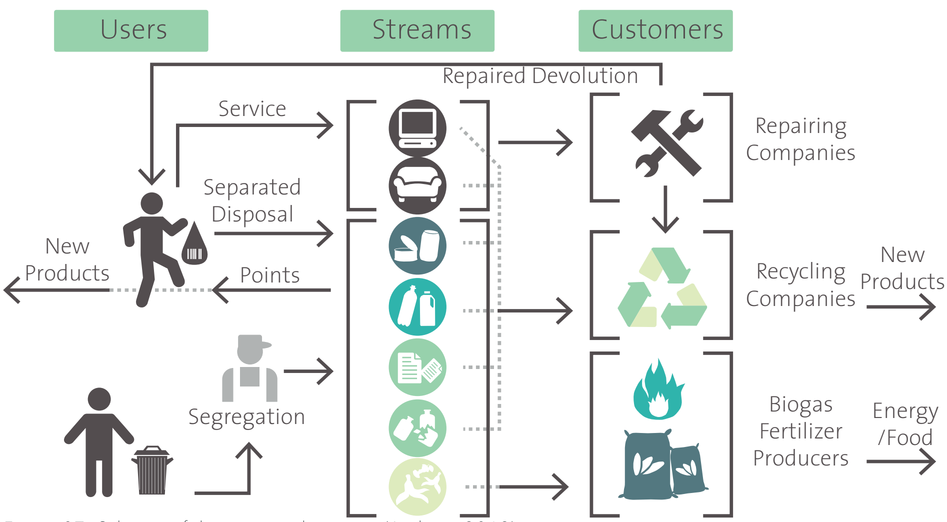


Figure 07: Scheme of the proposed concept (Authors, 2018)

TECHNOLOGY SELECTION

According to the necessity, our group decided to take high tech and low tech solutions. High tech solutions are related to the app itself (centralized system: algorithm, storage of information, internet connection and identification systems). Barcode technologies are cheap and easy to use. Therefore identification can be generated with their smartphones. The employees would require proper safe material to deal with the waste, the barcode readers, and the equipment placed at the storage facilities (collection stations).

The stations are the only infrastructure that the WasteAid Project really requires, a strategy that represents a reduction in cost. The stations are modular (according to the local demand) and equipped with weight scales, WiFi connection, storage containers and a computer. 15 modular stations are planned for the 2 compounds of Sheikh Zayed, reaching every household in a less than 80 meters radius, placed mainly in the courtyards where there is no obstruction from cars and trees. Each station has 22.4m² (6m to 3.7m) providing what was considered the optimized space for storage and operation, as well as security against robbery and vandalism. The storage was prepared from 5.4 m^3 of plastic (which represent 386 kg), 1m^3 of Metal (119 kg), 2.3 $m^3$of paper (297 kg), 0.95 m^3 of glass (238 kg), 1.4 m^3 of Organics (475 kg) as well as 7.7m^3 (1061 kg) of non-separated content. The estimation of storage volume was made for the entire community, understanding the scale and the number of stations required.

The criteria selected also included the operation: distance from the households, access from the street, retention time of each sort of waste, transportation parameter and waste internal operation.

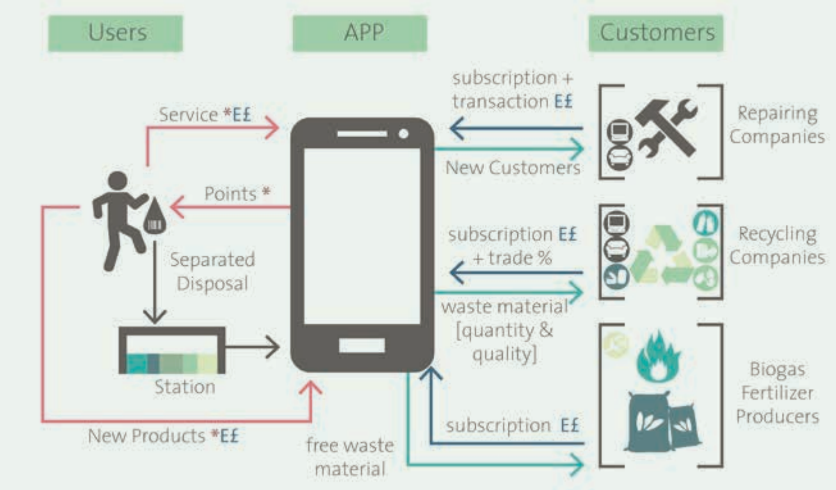


Figure 08: Transaction revenue model (Authors, 2018)

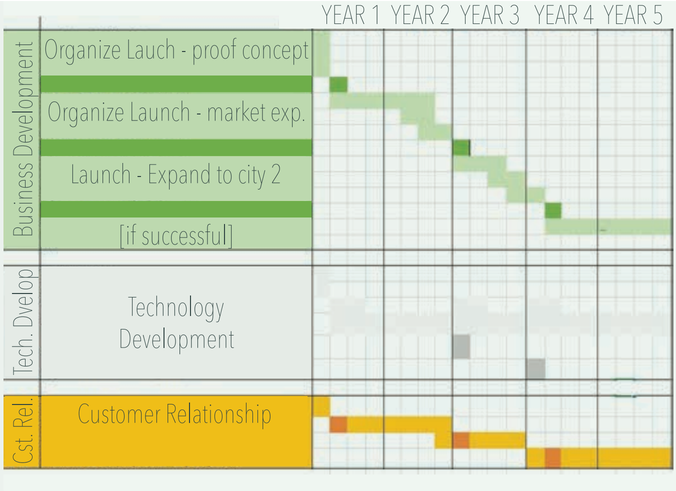


Figure 09: Implementation schedule [after App launch] (Authors, 2018)

BUSSINESS MODEL

In order to check the feasibility of our business plan, we inquired about the following:

1. Potential value of Household MSW: a typical household generates solid waste worth of 792 EGP per year (Hassan, 2017). By transferring the direct tangible benefit to the end user, they are induced to make an effort, for earning.

2. Income of informal collectors: In the past Zabaleen were promised a salary of 450 EGP/month to work for multinational waste management companies. In reality they were paid only 150EGP. Adding inflation component while respecting minimum wage requirement for Cairo, WasteAid Co. will offer them 1,200 EGP/month.

3. Interests of recyclers and waste processors: WasteAid needs to distribute its collected MSW judiciously among formal and informal recyclers, in order of their capacity.By formalizing informal recycling with clean resource, the efficiency of formal might increase of own business interest.

4. Possible Value Addition to existing waste eco-system: if our system can integrate higher value waste like electronics etc; integrate service and repair industry into it, in order to increase own-life of materials while creating a material cycle and find a systemic solution for organic waste it can create and holistic system along with managing MSW.

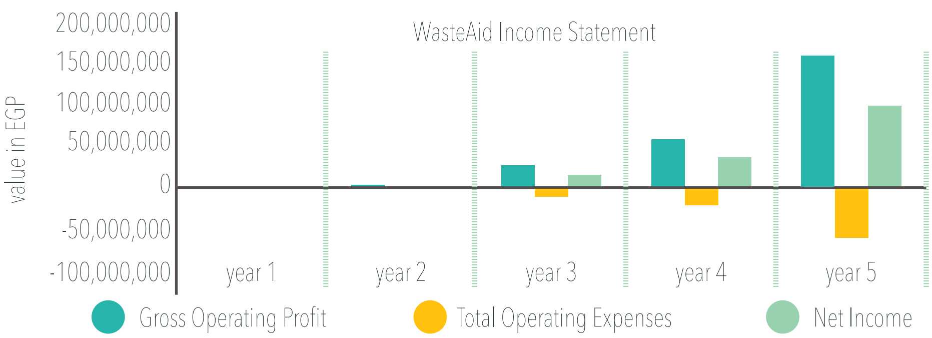


Figure 10: Income statement for the next 5 years (Authors, 2018)

TRANSACTION - REVENUE & EXPENDITURE

WasteAid app is made free for our users. Our revenue is therefore, directed to our customers. The strategies to obtain revenue from the customers come in 4 ways:

1. Subscription Fees - These apply to all types of recycling and repair/upcycle service customers. Nevertheless, a few particularities apply:

a) Recycler Subscription Fee - based on volume of waste recycled, waiving for small recycler in first year and then after first 100 clients, focus on adding big recycling companies.

b) Repairer Subscription Fee - which is standard and implemented since the first year of the project.

2. Waste trade or percentage of transaction fee: This revenue is directly proportional to the quantity of valuable of waste that is traded with recycling companies.

3. Percentage of service fee - this applies to all types of repair / upcycle or second hand selling, service customers available in the platform.

4. Advertising Fee - This applies to organic food shops & restaurants who would like to advertise in the App to attract new customers

PRODUCT & SERVICE

"WasteAid is an online platform that manage the MSW from its source to rightful processor for valorization, help our users to find repair and services for their household appliances, alongside with the creation of a market to organic compost for food cycle, in order to create a circular material flow in Cairo, leading towards circular economy".

There are three components in our service line up:

1. Managing municipal solid waste: People segregate their waste at home in categories of paper, plastic, metals, glass, pure bio and others (basically unsegregated) then taking it to stations. A quality control person is employed, (formalized Zabaleen) to check the quality if the segregation, weighs the respective pouches, scans the user's QRcode (on app or stickers in the pouches) and puts it in respective WasteAid bins. Finally, user receives respective points according to the weight and predetermined value.

2. Matchmaking for repair and service needs:User press for demand of service from her home (e.g., electronics repair, furniture or garment refurbishment or 2nd-hand selling). App's algorithm connects user to nearest service provider, or by choice. It could be a registered company or individual. Users get a home delivery or is required to reach the repairers destination. Transaction is made in cash; either user pays for the service or receives money for second hand goods. A percentage of transaction fee is deducted from customer's account. A percentage of our fee is paid back to the user as points, rewarding the user.

3. Fixing the cities organic cycle: organic waste problem is addressed by connecting them with compost creation, urban farming and organic food/ restaurants as an end product, where our strong 500,000 household (by end of 3rd year) user base drive consumption of organic food get a discount of 20% when they redeem them with points.

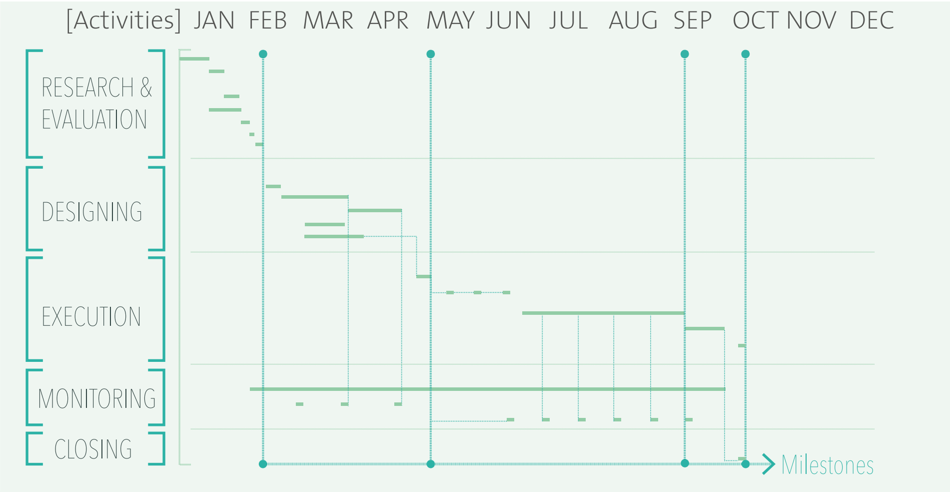


Figure 11: Implementation schedule of phase 1 [until App launch] (Authors, 2018)

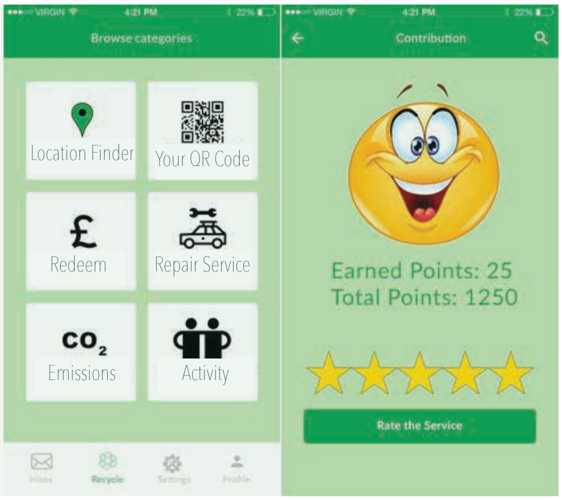


Figure 12: Look of the App [categories and contribution pages] (Authors, 2018)

PROFIT AND GROWTH & SCHEDULE

In terms of expenditure for launch, construction, running and maintenance of the app platform and company is based on various expenses. Namely: Initial capital investment, technical expenses, operational expenses, and business development

There are effectively 133 people employed per WasteAid center paying a salary of 1,600 EGP towards a center. Which account for 24,000 EGP in 1st year, expanding to employing almost 2,200 people by the 5th year. All in all the total salary to be paid by WasteAid is around 660,000 EGP from 1st year to 45,996,166 EGP by the 5th year.

Our net income (EBIDTA) will be in negative, -8% in 1st year, subsequently increasing to 36%, 54%, 60% and 59% in 2nd to 5th year respectively. Whereas the net income of -70,009 EGP in 1st year increasing to 1,048,195 EGP (12,000 household) in 2nd year to 14,116,337 EGP (with 100,000 users) and 92,654,913 EGP in 3rd (100,000 household) and 5th year (500,000 household) respectively.

The schedule of our entire project can be divided into 2 phases:

1. Implementation Schedule for Phase 1: until App launch is made, in which main components of development are Research and Evaluation, Design of the technical and physical entity, Execution, Monitoring, and Launch or closing of phase 1.

2. Realization Schedule for Phase 2: in a scenario of post App launch. there onwards, it is necessary the implementation of the business model and expansion according to the success of the enterprise and a further developed plan.

APP INTERFACE

App connects several components of the business model as well as customers, service facilities, recycling companies, electronic waste collectors and repair shops. The servers are from "Microsoft Azure" which is clouding computer service that we can test and deploy our enterprise apps, gain insights from our data, and above all this, we can easily upgrade our machine whenever it is required. Financially, it is helping us to start with a starter plan and pay no extra costs from the beginning and then when the business is getting bigger we can upgrade our servers in the most convenient and stable possible way.

In order to identify the contributors and apply the gained points, every household needs to create one user account on our platform. A user account could log-in to different devices that the app is installed and there is no necessity to create a new account for each family member or new devices. In this way, we are facilitating the household to use the app and every family member could participate in our program. The app contains four tabs: inbox (messages, notifications, events and facts about recycling), recycle (location finder for the next collecting point, user QR code identification, "redeem" for exchange of points in goods and services, repair service for furniture and appliances, "CO2 emission" and neighbor activity) , settings and profile. The "CO2 Emission" button gives statistics about the emission saved by the user and at the end "neighbor activity" button gives you a ranking comparing your neighbors, raising a sense of competitiveness in the area. The ranking system shows the top three households of each neighborhood for a certain period of time (weekly, monthly). Awarded with some redeems or extra points can encourage the people to participate in the program.

CONCLUSION

By creating a system with more financial and material benefit for all the stakeholders, it is possible to reduce resource wastage, while also creating a solution for the organic waste cycle by subsidizing and making organic food the primary consumption by our user base. Indirectly eliminating emissions with organic-waste mixed landfills, while establishing a nutrient cycle in the city. Therefore, We bring measurable cost reductions and environmental benefit to the city's waste management system, improve compliance with the Government's sustainable city initiative, as well public perception for improving cleanliness. Hence, we would like to receive an official endorsement as the city's 'Circular SMART Economy App'.

Figure 13: Look of the App (Authors, 2018)

GROUP 2

GREEN ACTION PLAN

MICROCLIMATE MANAGEMENT WITH INTEGRATION OF GREYWATER IRRIGATION

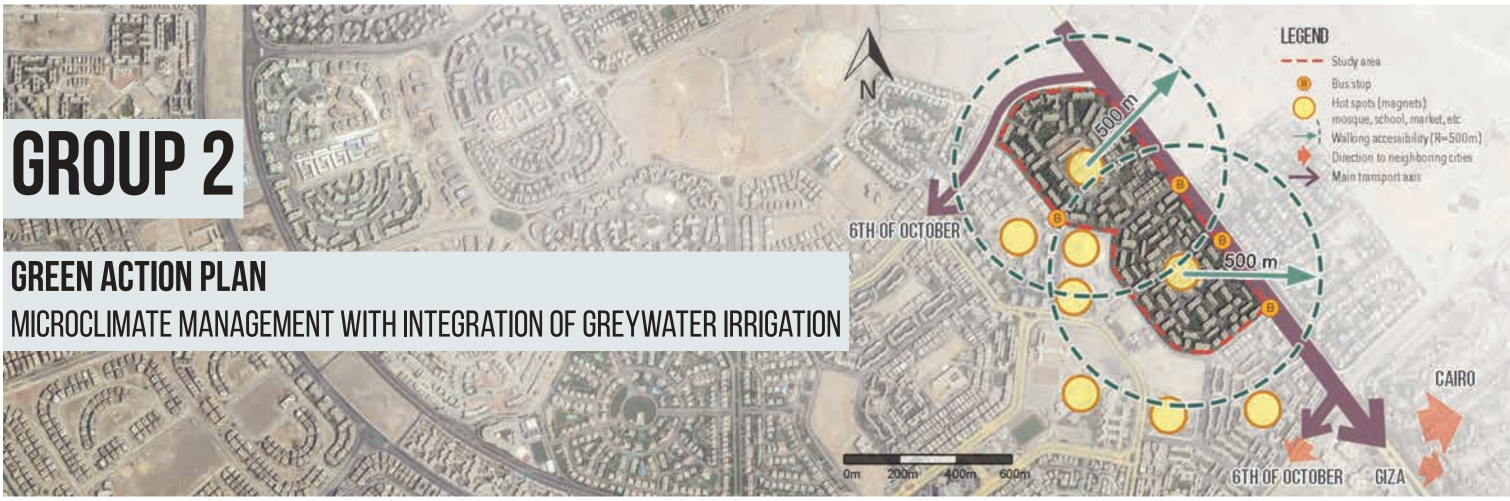


Figure 01: Urban analysis of the study area, Sheikh Zayed (Authors, 2018; Yandex map, 2018)

ANALYSIS

Increasing temperatures due to climate change along with potential urban heat island effect, resulting from booming construction in the area; water shortages, raising utility prices and population increase are all among the challenges that Greater Cairo Region (GCR) is likely to face in the near future (MENA, 2017; NUCA, 2018; Osman, et. al., 2016; Sušnik, et. al., 2014; Tahrin News, 2017).

Our analysis concluded that Sheikh Zayed (SZ) is not ready to meet those challenges. Water leakages, wasteful water use and inefficient irrigation with tap water are common practice in the study area. The green system of the neighbourhood is currently improperly allocated, failing to provide the necessary shading for the sidewalks and is often struggling for survival. Despite the presence of green spaces around almost every building, these are often not maintained, littered and with broken furniture.

In interviews with local residents we found out that the value of water is not properly recognised by the locals and the SZ authorities are disinterested in investing resources into the green system. The site analysis raised the question:

How can we minimize the impact of climate change and water scarcity on a neighborhood while enhancing the livability?

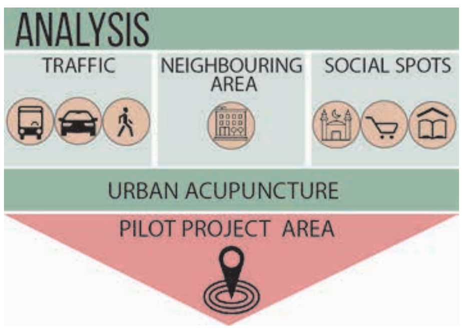


Figure 02: Urban fabric analysis (Authors, 2018)

CONCEPT

Our intervention proposal addresses the effects of climate change and the increasing water stress, while also raising the awareness of conscious water consumption. It reintroduces the water resource into the environment and utilises open public space in a functional manner, both facilitating and contributing to the microclimate management and the recycling process. The visibility of the project allows the target group, locals and visitors of SZ, to recognise the benefits of climate change mitigation and adaptation, get involved and advocate for it.

The Green Action Plan is a strategic plan for the introduction of decentralised greywater treatment systems in Sheikh Zayed, Egypt and utilisation of the treated water for irrigation of the vegetation in courtyards and surrounding streets (green web). Substituting inefficient tap water irrigation with treated effluent allows the redesign of open spaces and planting of new vegetation, while cutting on fresh water consumption and reducing wastewater treatment stress. Newly enhanced and greener open spaces are inviting with their shade and walkability and benefit the microclimate.

THE GREEN ACTION PLAN

The plan is targeted to the SZ residents and is to be implemented by a team of experts working under the supervision of NUCA.

The Green Action Plan starts with a pilot project. Looking for the optimal place to implement it, we analyzed the urban fabrics in wider city context in terms of traffic and identified the social hot-spots within the radius of walking accessibility. Urban acupuncture refers to a series of small-scaled, strategically focused interventions that aid the sustainable regeneration of a city (Lerner, 2016). The pilot project targets as acupuncture spots:

- The area around the mosque because of its central position and vibrant atmosphere. We recognised a potential to reach maximum people, make the benefits of the project visible and thus increase awareness, support and the sense of community.
- The area in the courtyard because of its immediate vicinity to the neighbourhood center and spaciousness, thus, potential to treat significant volumes of wastewater. Additionally, we identified existing interest in developing the courtyard among the residents.

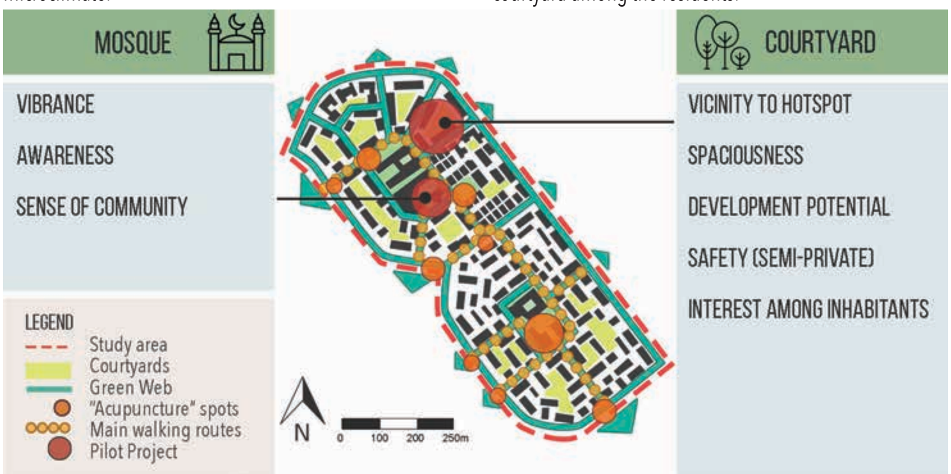


Figure 03: Pilot project areas, Sheikh Zayed (Authors, 2018)

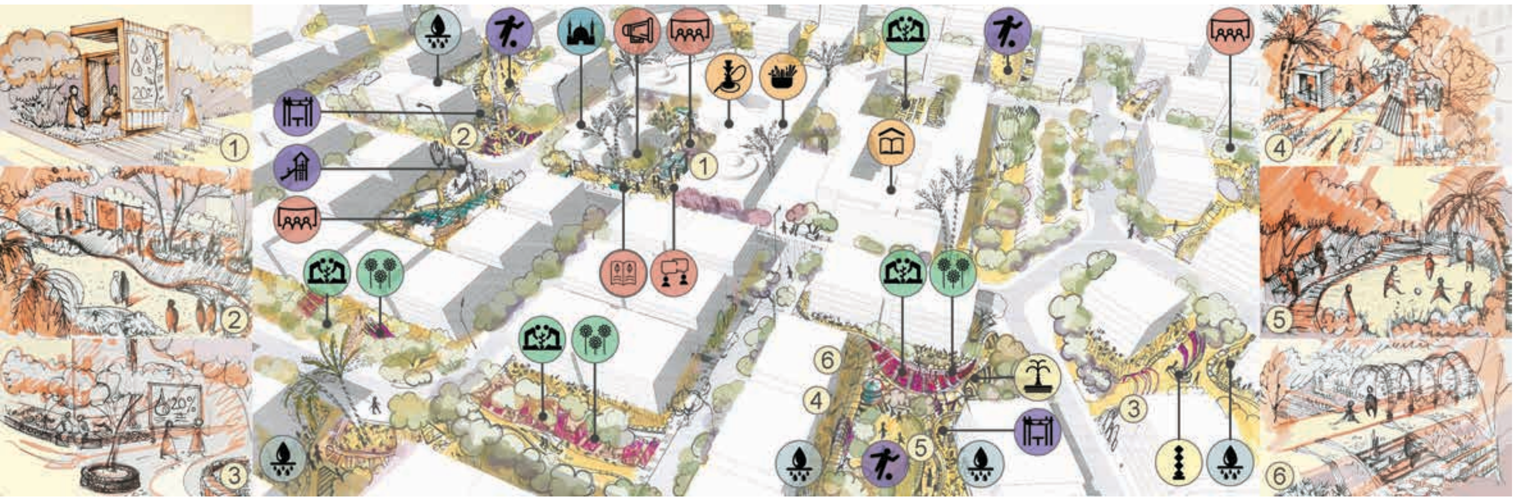


Figure 04: Mental map, Sheikh Zayed (Authors, 2018)

GREYWATER TREATMENT SYSTEM

The system recycles the greywater generated from the showers, faucets and laundry machines in the building. It is installed in all 11 buildings surrounding the courtyard and constitutes 54% of the water consumed by the households (Soliman, 2017). The vertical flow bed (VFB) was chosen because it is low-tech, cost effective solution with high treatment potential, covering the WHO requirements. It is a subsurface constructed wetland with minimum health hazard or facilitation of mosquito breeding. The greywater is collected in two-stage pretreatment containers where coarse screening and oil removal is executed. The resulted influent is intermittently dosed with the help of a pump into the VFB (4 to 10 times a day) (Tilley, 2014). The soil bed consists of gravel, rock, and organic materials such as compost, soil, and sand. Kenaf plants are planted to stabilise the surface of the bed, facilitate of the physical filtration of the influent, prevent clogging and aid the microbial growth for the organic, nutrient and microbiological digestion (Abou-Elela, 2017). The treated water is then pumped and stored in a collection tank.

GREYWATER TREATMENT RESULTS

As a result, we release 27% of the primary water consumption into the atmosphere through evapotranspiration and collect another 27% in effluent container for irrigation of existing and newly planted greenery. By positioning the system next to the building, we create a natural green fence, and a cooler climate for the building base. With 11% of the plot area as vertical flow bed, we manage to treat all the greywater generated by the 11 buildings. In our pilot project, this area amounts to 1,450m^2 and is sufficient to irrigate the green web in the immediate surrounding of the courtyard, and the entire courtyard, leaving sufficient space for paths, urban furniture and a playground. We utilise nearly 99m^3 a day and create nearly 50 m^3 of water a day for the irrigation of existing and newly planted greenery.

With 1% of the area of the mosque plot as a soil filter (30m^2), we manage to irrigate 12% (360m^2) of the total area - sufficient for the needs of present and potential vegetation. With the positioning of information points, we clarify the process, raise awareness and enhance the sense of community.

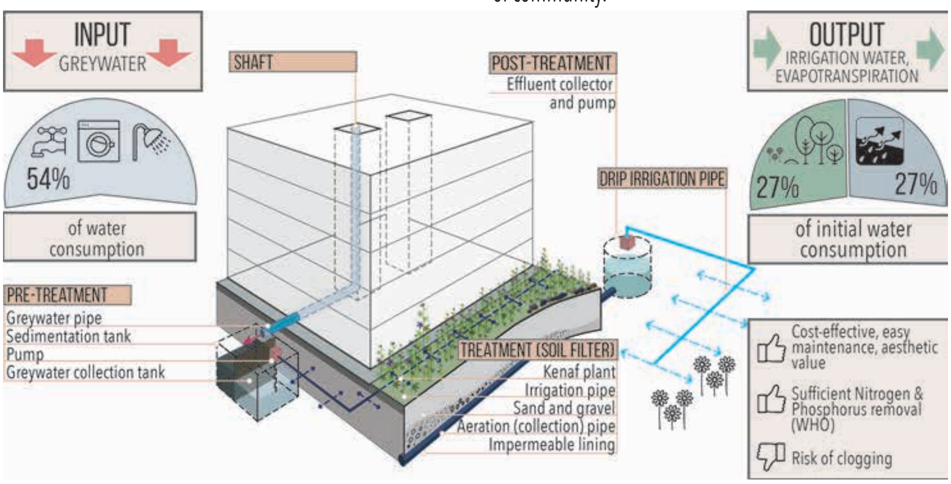


Figure 05: Greywater treatment (Authors, 2018)

PROJECT REPLICATION

Important for the replication is that the system elements are not hidden attracting attention. Vegetation should be positioned with consideration to its functionality, making the area pleasant and inviting with its microclimate.

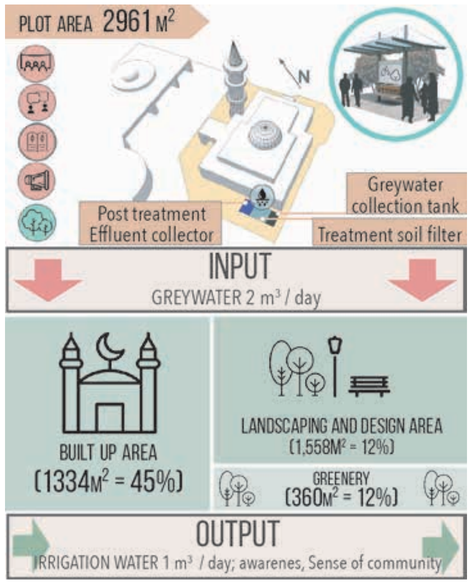


Figure 06: Zoning, Mosque (Authors, 2018)

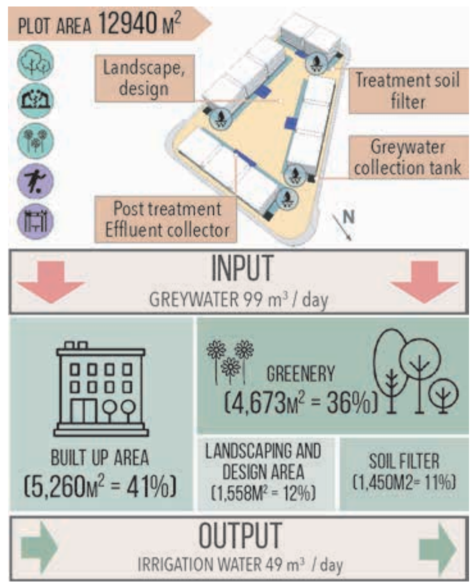


Figure 07: Zoning, Courtyard (Authors, 2018)

Figure 08: Courtyard vision (Authors, 2018)

TREE SELECTION

Analysis was made on local tree species according to a research on urban tree selection criteria. Different literatures put tree selection criteria into three main categories: the first is on the basis of a tree's functional requirements such as its thermal performance, which in turn depends on foliage characteristics, as well as the tree's mature shape; i.e. total height and canopy geometry. The second is the environment tolerance, which mainly covers the botanic aspect; i.e. type of soil to be planted in, tree deciduousness, depth and radius of roots, capability of bearing site hazards and harsh climates. The third is aesthetics and design requirements, which mainly focuses on aggressiveness towards the surrounding structures (root damage potential) and tree's growth rates. This is an important factor for ease of maintenance.

COMPARISON OF LOCAL TREE SPECIES

Figure 10 illustrates the result of our analysis for the range of local tree species in Egypt. Since it's difficult to find tree species which fully satisfy all the criteria stated in the analysis, we were able to look at the best compromise for the different landscapes of SZ. For example, looking at species A and B, they have the lowest root damage potential. This is of course an important characteristic to avoid the risk of damage to pavement and utilities (most appropriate for road side trees). In the case of species C, it has significant mature height beyond the human scale, hence could be considered for street island locations. And due to a requirement of wet soil for species D and E, they are more suitable for use in wet-courtyards as compared to species F. These results were applied in the development of the tree allocation scheme.

TREE ALLOCATION

There are three groups of trees for the project: Inner courtyard, Outer courtyard and Roadside species. We based the allocation on the specific tree characteristics. For instance the tree type on the roadside landscape has the lower root damage potential as compared to the inner courtyard due to the proximity to the pavements and utilities, while outer courtyard has moderate potential. At the same time, the tree type selected for the Roadside landscape has a characteristic of lower water requirement; attributed to a hotter microclimate in the street as compared to the inner courtyard. On the other hand, tree species in the inner courtyard have wider canopies for the abundance of area inside the courtyard as compared to the other landscapes. It is also important that the selected trees have the highest growth rate potential.

FUNCTIONAL REQUIREMENT	ENVIRONMENTAL TOLERANCE	DESIGN REQUIREMENTS
LEAF DENSITY MATURE TREE HEIGHT CANOPY WIDTH	WATER REQUIREMENT	ROOT DAMAGE POTENTIAL GROWTH RATE

Figure 09: Species indicators (Authors, 2018)

Indicators Vs Species		Dodonaea viscosa [A]	Nerium oleander [B]	Phoenix dactylifera [C]	Delonix regia [D]	Ficus elastica [E]	Ficus microcarpa [F]
1		High	High	Low	Low	Moderate	Moderate
2	Height	Short	Short	Very Tall	Medium	Medium	Medium
	Width	Small	Small	Medium	Large	Medium	Medium
3		Moist - Dry soil	Moist - Dry soil	Moist - Dry soil	Wet soil	Wet soil	Wet soil
4		Low	Low	Moderate	High	High	Moderate
5		Moderate - Fast	Moderate - Fast	Slow - Moderate	Moderate - Fast	Moderate - Fast	Moderate
Landscape allocation		Road side	Road side	Street Island	Wet Courtyards	Wet Courtyards	Dry Courtyards

1 Leaf density; 2 Mature tree height and canopy width; 3 Water requirement; 4 Root damage potential; 5 Growth rate

Figure 10: Species indicators (Authors, 2018)

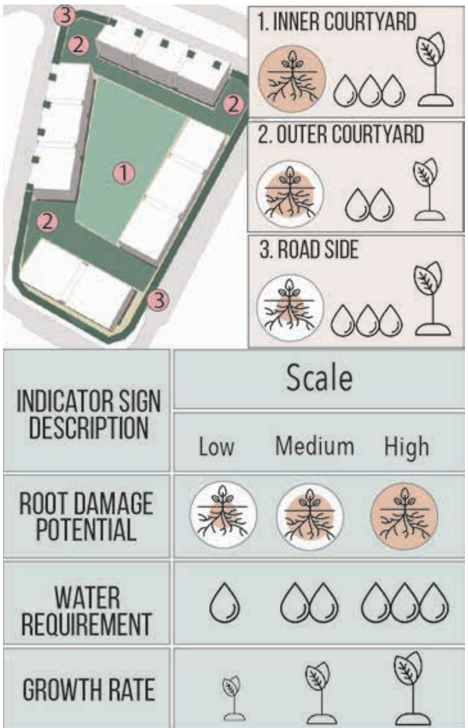


Figure 11: Species indicators (Authors, 2018)

Figure 12: Courtyard vision (Authors, 2018)

IRRIGATION WATER REQUIREMENT

We calculated the total water requirement for irrigation for the different landscapes using the following four factors: Reference Evapotranspiration in SZ, which is the same value for the all landscapes; Species factor, which depends on the characteristic of particular tree species inside the landscape; Microclimate factor, which depends on the landscape type; and Irrigation application efficiency, which depends on the type of irrigation system. For a higher efficiency in the desert climate of the pilot project area, we selected drip irrigation. Based on the results of our calculations, the inner courtyard takes the highest share of the treated grey water from the neighbourhood (with 41%) followed by roadside (33.1%) and outer courtyard (26.8%). The Figure 11 shows how the treated water is distributed to the different landscapes.

Figure 13: Mosque square vision (Authors, 2018)

Figure 14: Courtyard vision (Authors, 2018)

Figure 15: Courtyard vision (Authors, 2018)

RESULTS, MONITORING & EVALUATION

The success factors for the pilot project are: 27% reduction in tap water; 101m^3 per day reduction in wastewater; more shade in streets by healthy growing trees; increased awareness of sustainable resource management among residents; and increased replicated projects in GCR. The possible risks are the irregular extreme climate conditions, and small participation of residents for workshops and related events.

The existing situation shows that there is high quantity of water supplied to our neighbourhood and 100% of grey water disposed to the sewers. At the same time there is also an increased temperature of the surrounding environment. After implementation of our project, it is possible to reduce the water supply for irrigation by 18,000m^3/year and the grey water disposal by 17,000m^3/year, while promoting a circular use of water inside the neighbourhood. In the long term, the total water supply to the neighbourhood could be reduced by 29.4%, the load of the waste-water treatment plant in the region by 1.4%, and cooler microclimate can be achieved.

STAKEHOLDERS, FINANCE & TIMELINE

This project will be led by NUCA and targeted mainly on the SZ residents. NUCA heads 3 project teams: advisory, management and construction. Each team consists of local and national level stakeholders as well as the UN, since we utilize their Green Climate Fund as a source for the initial investment.

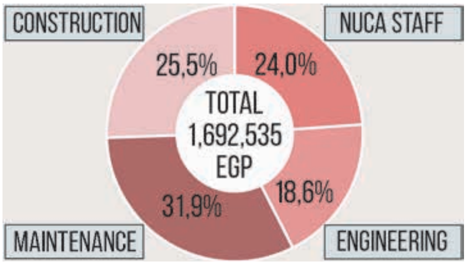


Figure 16: Financial chart (Authors, 2018)

The pilot project will be fully financed by the Green Climate Fund. It is estimated to complete its construction in 1.5 years, after which the replication to neighbouring blocks can follow. The operation and maintenance thereafter will be financed by NUCA, the budget of which is generated by the saving from tap water usage and reduced stress on existing wastewater treatment plants.

OBJECTIVE	INDICATORS	MEANS OF VERIFICATION	ASSUMPTION
REDUCE TAP WATER DEMAND	REDUCTION IN WATER CONSUMPTION PER BUILDING BY 27% UPON COMPLETION	MONTHLY & YEARLY WATER BILL FOR BUILDING (NUCA)	1. SUFFICIENT AMOUNT OF GREYWATER PRODUCTION FOR IRRIGATION 2. NO IRREGULAR CLIMATE CONDITION
REDUCE WASTEWATER	101 M³/DAY WASTEWATER REDUCTION	REPORT FROM WASTEWATER	NO DRAMATIC INCREASE IN CONSUMPTION
MORE SHADE IN STREETS	0.6M HEIGHT GROWTH IN IMMATURE TREES BY 1 YEAR AFTER COMPLETION	PHYSICAL MEASUREMENT OF TREES	NO IRREGULAR CLIMATE CONDITION
COOLER MICROCLIMATE	REDUCTION IN ENERGY CONSUMPTION FOR AIR CONDITIONING (SUMMER MONTHS) BY 5% BY 1 YEAR AFTER COMPLETION	MONTHLY ENERGY BILL OF RESIDENTSCOMPLETION	NO IRREGULAR CLIMATE CONDITION
AWARENESS AMONG RESIDENTS	75% OF RESIDENTS IN THE AREA ARE INFORMED ABOUT THE PROJECT BY 1 YEAR AFTER COMPLETION	PUBLIC SURVEY	1. ALL INFORMATION SIGNS NOT VANDALIZED 2. PARTICIPATION OF RESIDENTS IN WORKSHOPS AND OPENING EVENT
INCREASE REPLICATED PROJECTS	5 SIMILAR PROJECTS IN GCR WITHIN 5 YEARS	NUCA PROJECT REPORT	NUCA CONTINUES DEVELOPING OF GCR

Figure 17: Monitoring & Evaluation (Authors, 2018)

GROUP 3

A PUBLIC [LAND] SCAPE
SOLAR SOUQ IN SHEIKH ZAYED CITY

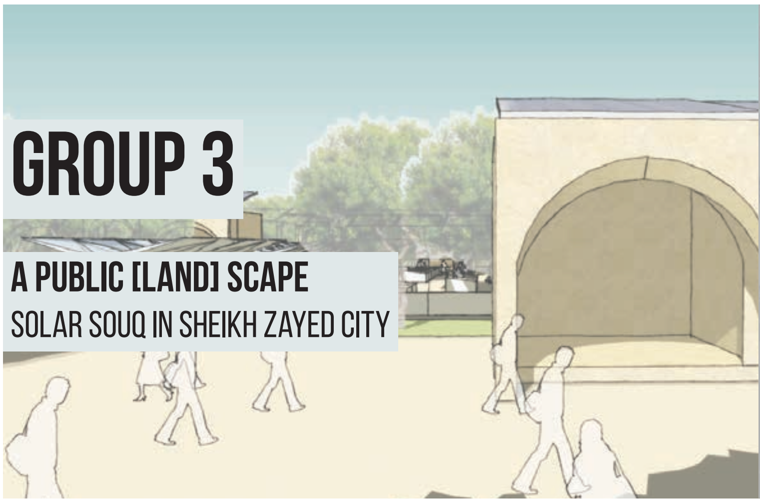


Figure 01: Eye level view of the Solar Souq (Authors, 2018)

Figure 02 : Eye level view inside the Solar Souq (Authors, 2018)

MOTIVATION / SCOPE

Sheikh Zayed City, as a new settlement on the western outskirts of Cairo, Egypt, experiences the same issue as many new settlements, that it cannot rely on local history to have a sense of belonging. Our project targets to improve social connectivity to residents of Sheikh Zaid through a local solar souq. The project takes place in a dedicated commercial area as per the land use plan which is accessible for residents from nearby neighbourhoods. The underlying baseline of the research project was a realistic approach, which serves the existing conditions, with the aim of developing a dedicated commercial area in a socially viable manner, referring to traditions and the local identity. In accordance with our research question "How can we develop urban space(s) to promote social inclusion, cohesion and living opportunities based on environmental and social sustainable principles?", we focused on three main aspects:

-Spatial design of an existing open space which would increase cultural vitality, social equity and stability, social integration and civic pride and a higher quality of life;

-Proposing required and demanded activities and services which would increase economic vitality and attract human capital

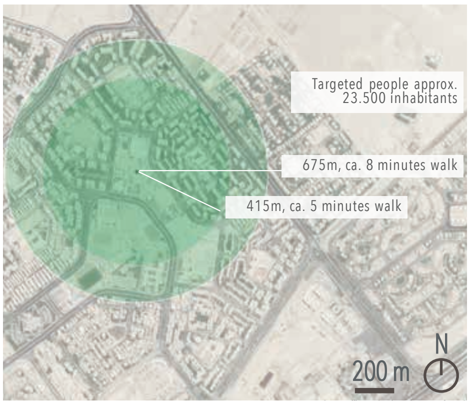


Figure 03: Project location and distances of covered area (Author illustration based on map from Google Maps, 2018)

-Inclusion of renewable energy through/ for monetary surplus and local job opportunities.

The investigation area at the eastern border of Sheikh Zayed was extended in order to gain a better understanding of the local situation and potentially achieve a bigger impact on the neighbourhood level. This area includes 12 neighbourhoods which surround a central piece of vacant land, dedicated as a future service area.

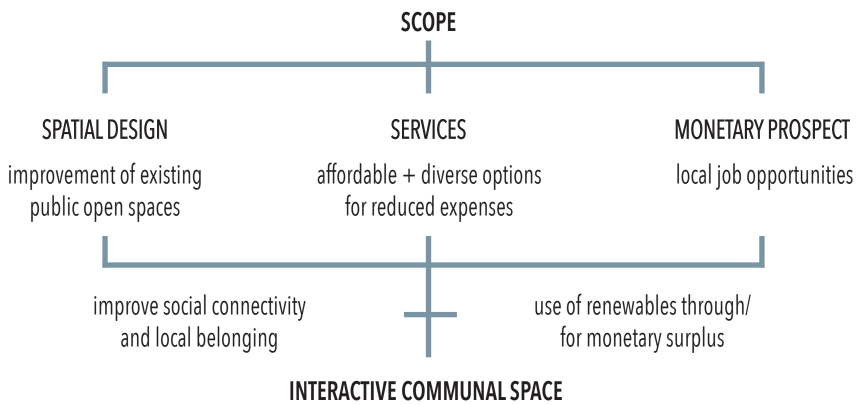


Figure 04: Project Scope division into three main topics (Authors, 2018)

METHODS / ANALYSIS

We used the background data which originates from the Central Agency for Mobilization and Statistics (CAPMAS, 2017); however, official governmental statistics could not provide all needed information. Therefore, site analysis and local interviews offered an insight into the societal and physical situation in the area of Sheikh Zayed. We refrained ourselves from applying a copy-paste western approach. Instead, we tried to sink into the on-site situation and used a thorough analysis of social structure, behaviour, everyday life, spatial analysis, financial aspect, authority regulations and practices, as a starting point for strategy development and further investigation. In our investigation area, luxurious and high income housing; middle-income (the majority, approximately 63% of the total inhabitants) and; low-income housing are available (Figure 07). Residents are able to find their basic needs inside of the neighbourhood; however, they still prefer to commute for several services. The behaviour analysis suggested that lower social classes might prefer quantity shopping in local markets whereas higher classes prefer exclusive quality shopping in malls. The behaviour of the society in Egypt is strongly shaped by social statuses, which the citizens are usually born into. The daily habits depend on these classes which translates into different consumer behaviour patterns, different daily routes and different points of interaction amongst the population (Commisceo Global, 2017). This aspect is important for the design proposal of the derived concept. With regard to public spaces, a "Souq" or "Suk" represents a local economic centre in a neighbourhood, village or city and is the equivalent to the Persian Bazaar. The local souq usually trades handmade goods and crafts, whereas industrialised, highly processed products can be found in modernised shopping centres (Gharipour, 2012).

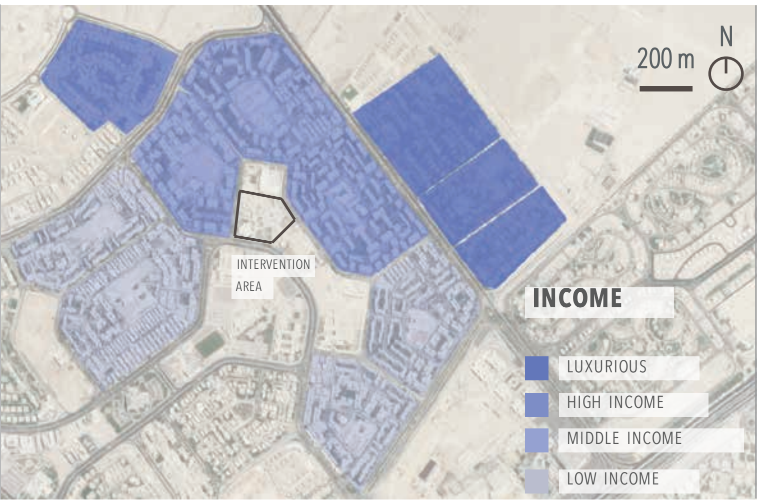


Figure 05: Income levels in the intervention area (Authors, 2018)

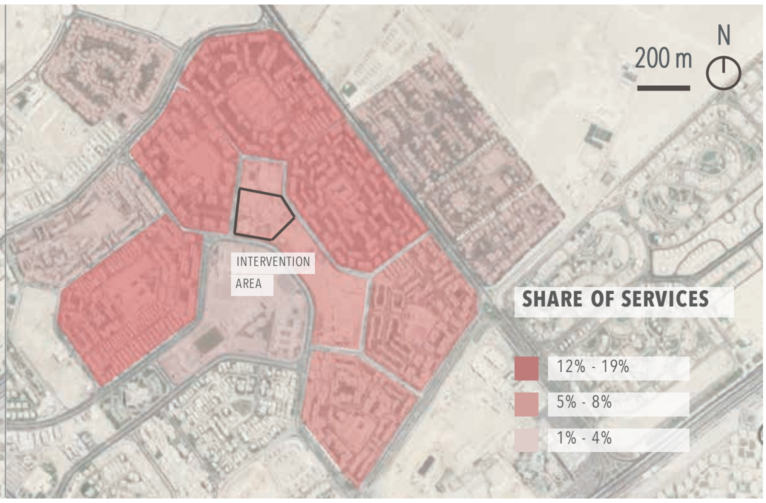


Figure 06: Share of services around intervention area (Authors, 2018)

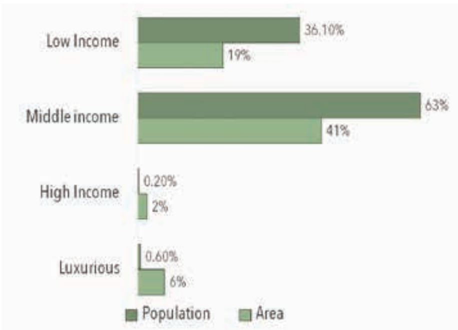


Figure 07: Population income and land occupancy (Authors, 2018)

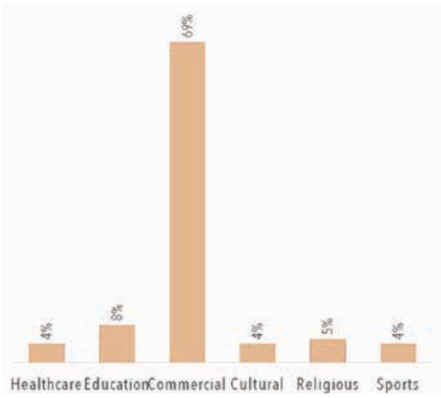


Figure 08: Shares of existing local services (Authors, 2018)

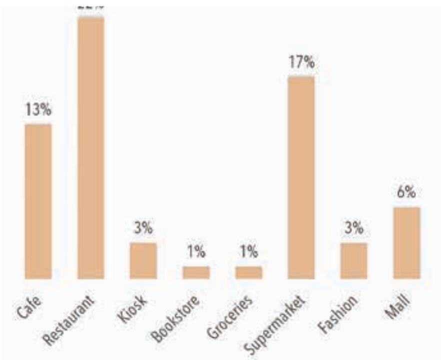


Figure 09: Shares of existing commercial services (Authors, 2018)

FINDINGS

Based on our survey with the participation of local citizens of the intervention area in Sheikh Zayed, we identified three target groups: A – lower income, underage, existing social contacts, need for more public spaces; B – low income to middle income adults, stable social contacts; C – middle income adults, local services in the price range needed, not many social contacts available. In general we concluded that there is an imbalance of services with a dominance of commerce which lacks affordable services, green public spaces, or just adequate spaces for social interaction. The key aspects we want to provide for a positive outcome need to address their current issues, give locals the opportunity for social interaction besides solving the shortage of some services, offering affordable services and meeting points for different groups. In the general strategy, underlying the physical design process, we focus on the analysed elements, such as site conditions, social behaviour, service use and needs, the role of public urban spaces and the function of souqs as a connecting fabric within a society. Therefore by overlapping aspects of these various elements, we shape a comprehensive strategy in order to reach the overall project scope in the form of a solar souq.

APPROACH

Our intervention area is a central, available site dedicated to commerce whcih has not been developed yet. It is accessible to residents in walking distance, also by the use of public transportation. In addition, the SWOT analysis pointed out on opportunities such as existing vacant spaces which can be turned into green spaces that would provide diverse activities in the neighbourhood. This would promote social inclusion and create opportunities for culture, leisure and recreation for all. The harvest of solar energy by using photovoltaic panels will help creating a self-sufficient neighbourhood and increase public awareness regarding clean energy. For the sustainable transformation of Sheikh Zayed, we considered a merger of two basic approaches (top-down & bottom-up). This resulted in forming an association (*Sheikh Zayed Association*) that will be responsible for gathering the needed initial support for the Solar Souq, organize its space and set the running fees, as well as management of the project. As seen on Figure 10, representatives from the different neighbourhoods (*muhtasibs*) will influence decision making based on community interests and governmental and/or non-governmental authorities will provide for commercial and organizational support, which are both part of the association.

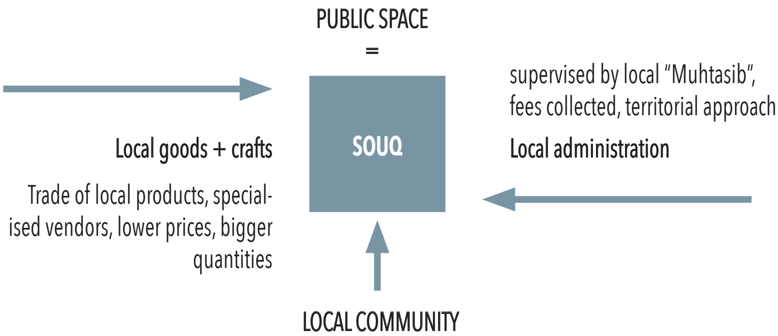


Figure 10: Solar Souq scheme (Authors, 2018)

Figure 11: Bird's eye view of the Solar Souq (Authors, 2018)

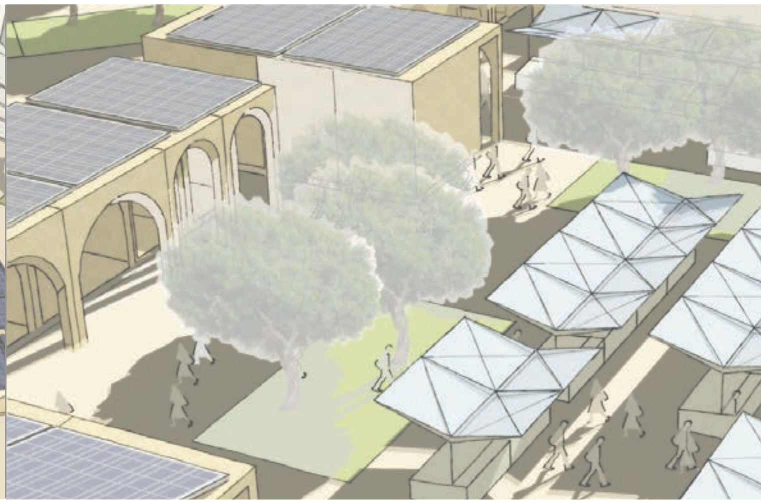


Figure 12: "S" modules arrangement inside the Solar Souq (Authors, 2018)

APPROACH

In addition to the Sheikh Zayed Association, the implementation of the Solar Souq is highly dependent on the involvement of eight major stakeholder groups (Figure 13). The elements that we saw as necessary for the development of this projects were the business plan which outlines the most realistic approach and the design guidelines that should be executed with supervision on site in order to meet the local building habits and mentality. Considering the local authorities in Egypt, financial support can only be given to self-sufficient projects which, as a result, leads to a larger number of commercial developments over social or public ones. It is considered, that a functioning financial plan is the basis for any successful intervention in the area which will then lead to the prospected outcome of social approximation and additional opportunities for the local communities.

The basic guidelines, allow various physical outcomes of the strategy, fulfilling the set requirements and thereby increasing the chances for a successful and accepted result.

As Design Guidelines, the following targets describe the necessary elements for a functioning outcome. However, the arrangement is flexible:

- Place for Foul + Falafel take-away, is timesaving;
- Café for the men while women are shopping;
- Transportation for the goods is necessary as usually huge quantities are bought (ca. 20kg)
- Provided services must differ from existing ones;
- Smart Pavilion as a technological/educational element;
- Ventilation + shading to allow shopping in summer;
- Storage for the vendors;
- Inclusion of energy efficient technology + solar panels;
- Security in and around the Souq;
- Easy access to public transportation routes

POSSIBLE OUTCOME

With the onsite interventions we strive for a framework which will allow usual habits and create a comfortable environment, but the target is to arrange these habits in a sequence that it will allow additional elements to perforate the current attitude. Figure 16 shows a layout that provides the services for the souq market according to the analysis. Narrow streets provide shading and allow ventilation by openings towards the predominant wind directions (North and West). Another building was added for higher processed food, that will be bought in lower quantities. The necessity for two markets is given due to the fact that the social classes in Egypt do not mingle on the same plane and tend to use different services. A way to connect the society and create a point of interaction is given by the placement of gastronomic services, such as falafel and foul shops or cafés.

Towards the south of the given plot, public open spaces for children (playing, soccer, dancing), flexible space for events, seating for all generations and an educational pavilion are suggested. There are four types of modules that we proposed as one possible outcome of our strategy. Overall, the various sizes of the modules allow different solar gains and thereby electricity generation and revenue. This aspect can be used to encourage vendors of different scales to rent these spaces as the costs depend on the size, operating costs and solar gains. Besides the area for PV panels, further cost factors for the development of a solar souq were considered and calculated. These factors include land price, construction price, electricity generation and energy consumption. Ideally, the generated energy covers the whole electricity demand for the solar souq creating a high level of self-sufficiency.

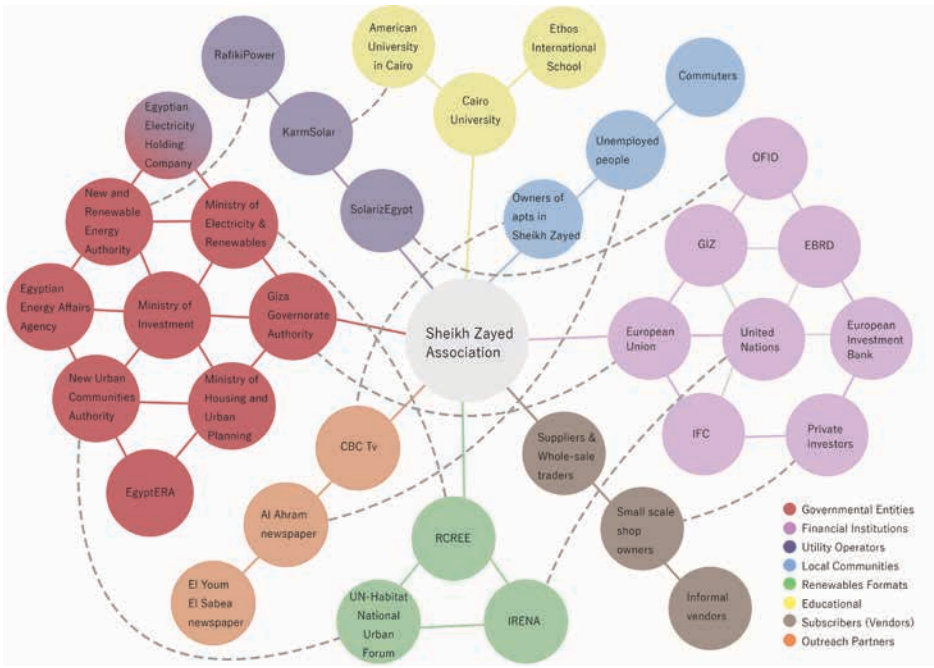
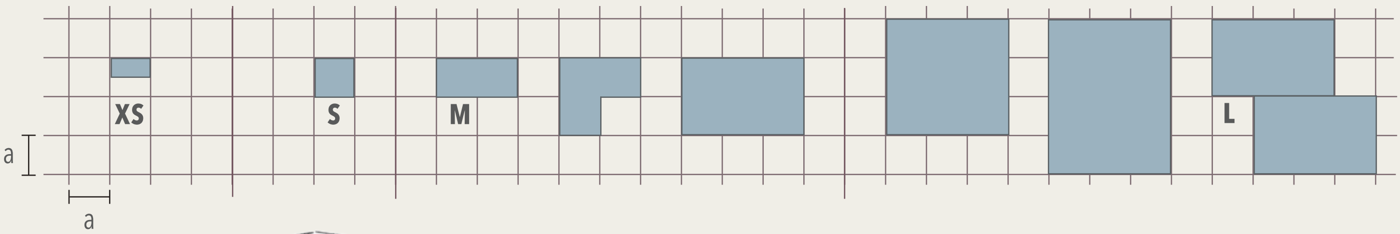


Figure 13: Stakeholder involvement (Authors, 2018)



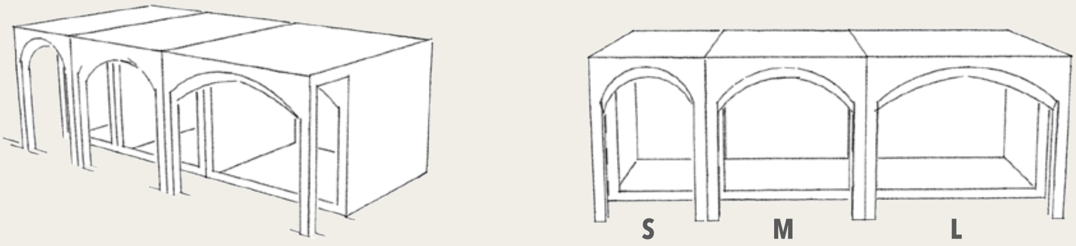


Figure 14: Possible layout of the four module sizes (above) (Authors, 2018)

Figure 15: Illustration of the three permanently installed module sizes (below) (Authors, 2018)

EVALUATION

The previously described design guidelines allow for various physical outcomes of the strategy, fulfilling the set requirements and increasing the chances of successful results. Furthermore, we developed design evaluation criteria, to objectively compare possible design versions for the location by taking into account four major factors: Location, society, economy and environment. Location sub-factors include accessibility from all directions and allowance of North to South cross ventilation. Sub-factors under Society evaluate wether the design addresses all user profiles, represents their interests and creates social meeting points. In regard to economy, the applicability of the following requirements is evaluated: financial self-sufficiency, options for various vendors, services for different budgets, rentable area for exhibitions, elaborated management and maintenance plan. Lastly, the environmental factors taken into account are the implementation of renewables, climate adaptive design, shading, public green areas, percentage of electricity consumption covered by renewables and site occupancy area.

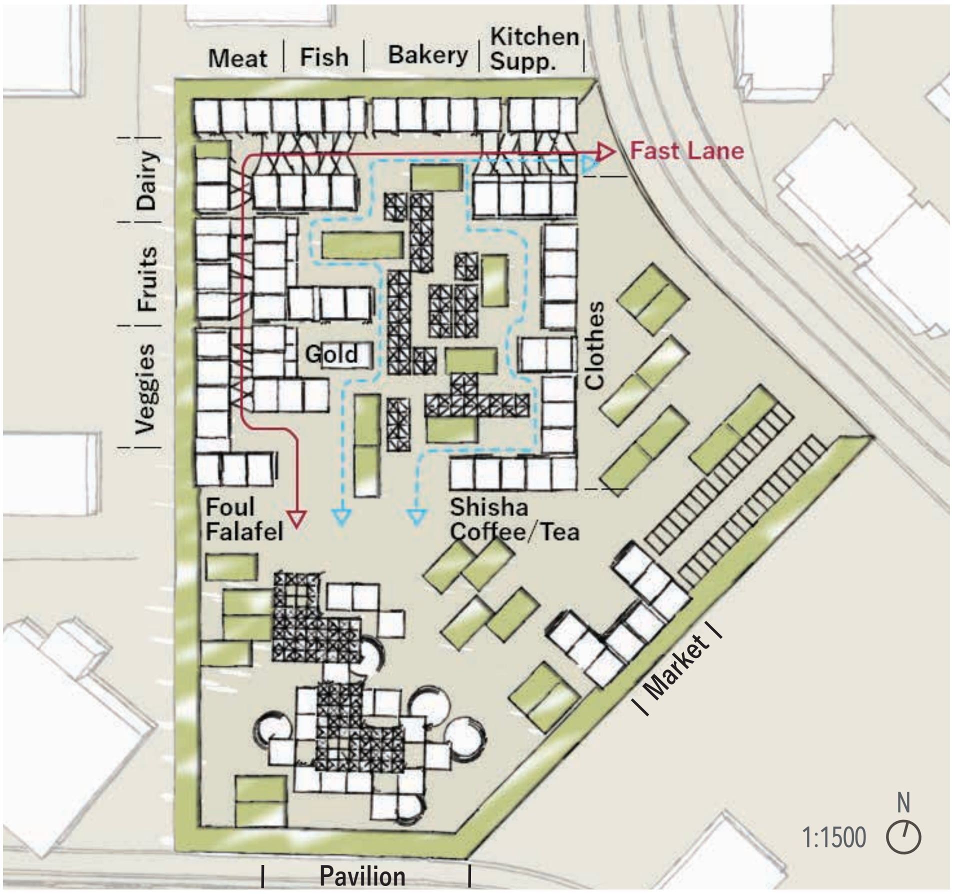


Figure 16: Potential design layout (Authors, 2018)

CONCLUSIONS

The question of "how to develop urban space(s) to promote social inclusion, cohesion and living opportunities based on environmental and social sustainable principles" lead us to the targeted outcome of this project. Our conclusions were that, firstly, a local analysis is the basis for a context related approach which should consider from physical site characteristics to lifestyle and traditions. Wherever a social meeting point is aimed, the spatial and educational dimensions of it are to be carefully and thoroughly considered, in order to give the necessary liveable conditions. The educational dimension, in this case, was achieved through showcasing of renewable energy. Our own calculations for different design versions show, that the generated electricity on site allows the self-sufficiency of the Solar Souq and eases the inclusion of local and small-scale vendors by offering lower rents. By that measure, we conducted that the inclusion of solar energy can act as the binding link between social inclusion, education and an affordable lifestyle in El Sheikh Zayed City.

Practical risks, such as limited basic official information and necessary further on-site investigation, are worth mentioning. For an improved and achievable, solid outcome, a coopertation with local authorities or governmental entitites would be necessary to ensure data availability and consider legislative boundaries in more depth.

GROUP 4

DESIGN OF OPEN SPACES ON BLOCK LEVEL
INTEGRATING URBAN DESIGN AND RENEWABLE ENERGY

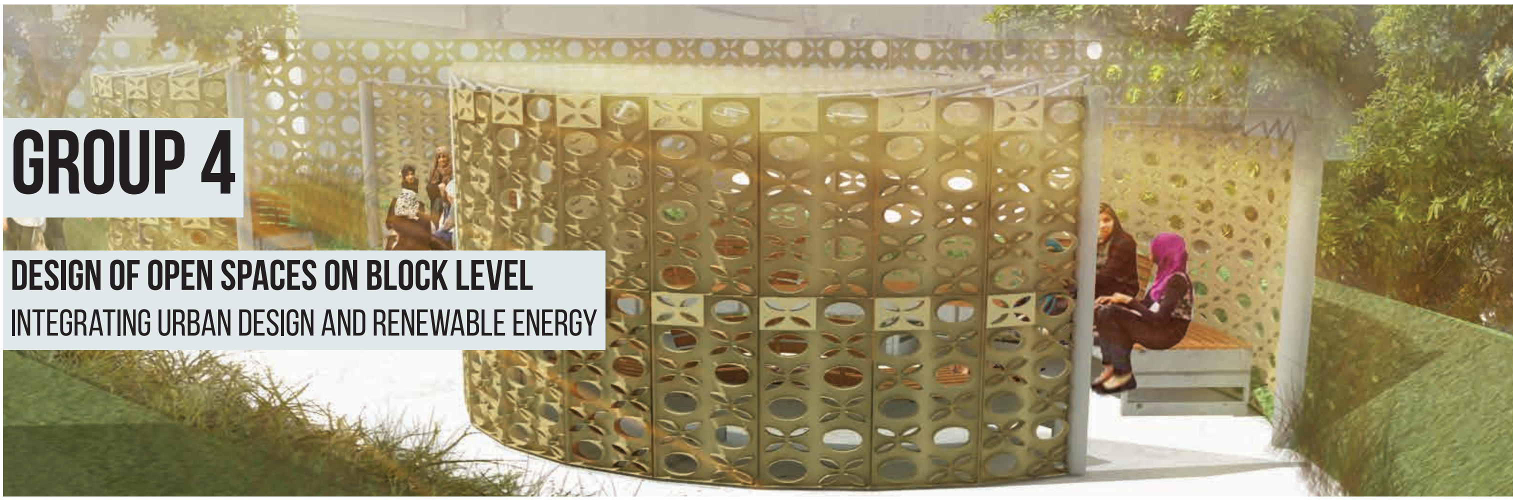


Figure 01: Women's area visualisation (Authors, 2018)

INTRODUCTION

From the beginning, our aim was to create a feasible project that would serve the needs and requirements of the inhabitants of the study area, ensuring that all proposed solutions would be linked with in-force policies, regulations and initiatives in support of sustainable solutions.

We approached the area to find out issues concerning inhabitants' life quality, air pollution, urban heat island, opportunities to implement climate responsive architecture, sustainable energy supply strategies, water management strategies, waste and material cycle management. Further, we seek to find solutions to improve accessibility, livability, identity and people's involvement in major decision making processes.

Figure 02: Linked solution concept (Authors, 2018)

URBAN ANALYSIS

The study area comprises of two neighbourhoods in Sheikh Zayed city, intended for the middle-income population. Total land area of the neighbourhoods is 0.496 km^2, with a district coverage ratio of 22.7%. Residential units account for 83% of the built up area and each neighbourhood has a school, a mosque and a commercial zone. All these utilities are concentrated in the central part of the neighbourhoods, within walking distance for inhabitants of the area. Residential housing is represented by few similar types of five-storey buildings. Individual plot area varies from 300 to 500 m^2 and large land is allocated for open spaces and public services (Hegazy & Moustafa, 2013). 30% of the total area is covered by green spaces.

One of the main characteristics of the area is that residents own the buildings, while local authorities retain ownership of the adjoining open spaces. This measure as well as a number of restrictions on land uses imposed on private developers (such as prohibition to open retail shops, services and offices, urban gardening, etc.), were implemented due to the risk of informal development and densily built up areas. NUCA is responsible for maintenance of the open spaces within the courtyards of the blocks, but often this is not done appropriately (most of the street and courtyard lights do not work, existence of litter, lack of urban furniture and sprinkler system with leakages). Since residents do not own the open space, they do not engage in its maintenance. This was one of the major problems identified by our group.

An urban area consists not only of built environment, but also people inhabiting it. A good understanding of the needs of the local community is a key factor for a sustainable urban design. Citizen involvement in the design and decision making process can lead to creative ideas and increase public support for proposed interventions (Ahmed, 2017). Interviews with the inhabitants of the study area were conducted to get an understanding of their behaviour, needs and expectations. Our main findings were inhabitant's concern with safety issues, related to cases of robberies, especially at the ground floor as well as complaints about high electricity bills.

The livability of a neighbourhood, particularly regarding open spaces, is basically defined by the activities that people carry out there. The cultural background has a big influence on people's behaviour. Related literature suggests that in the Middle East, people would mostly use open spaces for the following purposes: going out with children and family, meet friends or relatives, enjoy the beauty of the place, play sports or games (Aljabri, 2014). The design of public space should be carried with the consideration of privacy aspect for women, and personal distance between genders. Special attention should be paid to thermal comfort and aesthetic preferences, such as diversity of colors, materials and forms, as well as complexity of the structure.

For the proposed interventions, which will be described further, it was decided to focus on block scale. Due to the similarities of features between the neighbourhoood blocks, we chose one that would work as a pilot project and after could be replicated throughout Sheikh Zayed.

The specific selected block (see Figure 02) has an area of 10,765 m^2, with 67% covered with greenery. This block was chosen due to its location in close proximity to the service area in the center of the neighborhood, with a high pedestrian traffic load. The "perimeter block" building typology, with six flat-roofed separate buildings and an opening in the perimeter to the west, allows visual permeability and access to the courtyard zone.

Figure 03: Playgroup area visualisation (Authors, 2018)

CONCEPT

With the information collected from our site visit and the initial interviews with some of the inhabitants of the area, we concluded that safety is one of the issues for the open spaces in Sheikh Zayeed, more specifically lack of lighting and not well developed urban open space structures to address security concerns of the residents. Further, the inhabitants complained about high electricity bills. The large area between buildings, with no use, absence of urban furniture, and lack of maintenance turned this open area into a desolate, lifeless place. The shutters at the ground floor level are kept close since there is no limit between what is private and what is public in relation to the big open space between buildings.

After identifying the issues, we developed a concept that could link the solutions between buildings, especially ground floor issues and open spaces. First, we would develop boundaries to limit what was public from semi-public on the courtyard. Secondly, the concept would consist of a conjoined urban design and energy project.

Energy comes together with urban design to provide enough electricity for better lighting of the open space. PV modules would be installed on the rooftops of the buildings providing enough electricity. Monetary incentives would be communicated to the inhabitants in order to raise their awareness. The increase in sense of community and belonging would show them the importance of maintenance of the developed project of sustainable urban design and solar energy for the block.

Our Sustainable Urbanism concept consists of enhancing the existing quality of these blocks, which is the pedestrian permeability by creating pathways to better connect the surrounding blocks. Enclosure elements would provide boundaries between public and semi-public as well as determine the areas of different uses, while also contributing to the sense of privacy. In order to raise people's involvement with the Energy concept we would develop urban furniture that can showcase the technology as part of the urbanism and illustrate to the inhabitants the benefits of solar energy for this area. The integration of solar PV panels into our project is a step towards self-sustenance, lower electricity bills and a well lit courtyard.

ENERGY

The circumstances for implementation of PV projects are attractive with lots of opportunities in Egypt. The Government has predicted that by 2030 Egypt will be net importer of oil (Egyptian Electric Utility for Consumer Protection and Regulatory Agency, 2016). Due to this fact, high feed-in tariff (FiT) rates for renewable energy were introduced. The Central Bank of Egypt guarantees FiTs for a long term power purchase agreement (PPA) of 25 years (IEA/IRENA Joint Policies and Measures database, 2016).

For our project investment, we first identified areas on the flatroofs of the block buildings that could be used for solar PV panels. A private investor would be invited to our project. The investor would gain acess to the roof for the PV panels installation and benefit from FiT rates. In return contributing a major portion of the funds needed for the courtyard intervention as well supplying electricity for lighting of the project's open space.

For this project, we planned to install a total of 540 units of 280 W PV panels with a total capacity of 151.2 kW of power. The sample block demands around 829 MWh of energy per year while the PV plant will produce 662 MWh, which

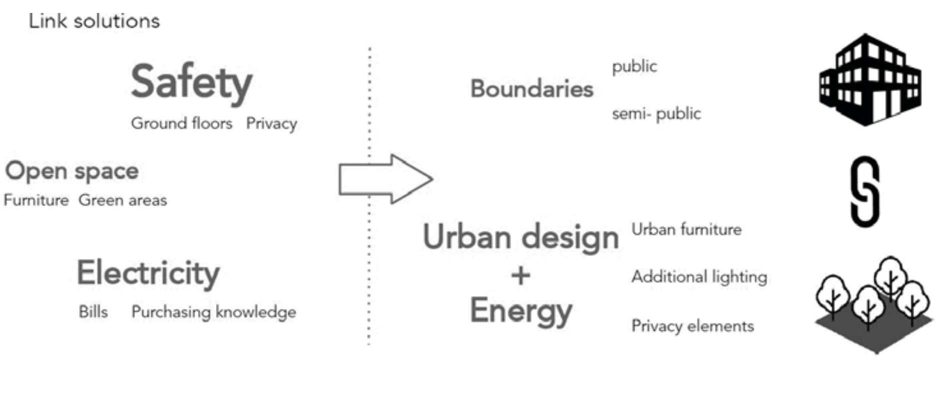


Figure 04: Linked solution concept (Authors, 2018)

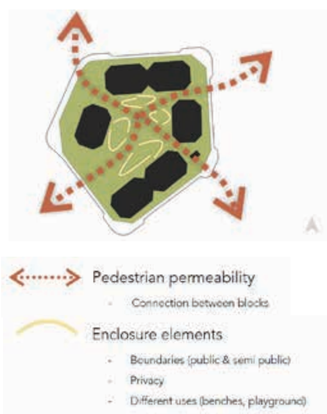


Figure 05: Sustainable urbanism concept (Authors, 2018)

Figure 06: Plaza area visualisation (Authors, 2018)

means approximately 80% of electricity demand would be covered. The PV project will also provide lighting of 75 lumen/m^2 for the entire open space area of the selected block for 10 hours during the night.

We considered, as an option, to involve into the operation of the project the doorkeepers, who are individuals employed by residents of each block for minor maintenance work and surveillance. They would benefit from 50 USD increase in salary (paid by the private investor). They would act as a force factor to continuously inform people about their involvement and their responsibility to mantain the courtyard. The total project cost of 25 years life cycle would be 295,000 USD, which includes: PV cost, work and installation costs, operation and maintenance costs, area lighting costs. Investiment recovery period would be 9.5 years. Another option is to not involve the doorkeepers . In this case, the total project cost would be 205,000 USD, with a recovery period of 6.6 years.

Most of the stakeholders involved in this project shall be managed closely, they have a high interest and high power to influence the project. Main involved stakeholders are: residents, NUCA, Egyptian Electricity Transmission Company and the private investor.

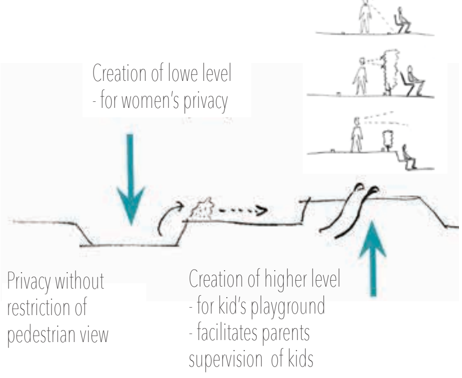


Figure 07: Courtyard study of levels (Authors, 2018)

SUSTAINABLE URBANISM

Participatory design process

In order to involve all stakeholders in the design process, we implemented the participatory design as a method. This approach can differ from a passive informed project development to a more active one, when the stakeholders can contribute at higher levels, increasing their influence on the decision-making process. The process can also increase the realistic expectations, which reduces the risks of failure and in turn, the costs of the project.

In our project, we divided the process into five phases. The stakeholders involved in the process are the specialists (our team), inhabitants, investors and NUCA. The initial analysis is the first contact with the real urban context and the inhabitants of the area. In order to create a project focused on the users and their needs, we classified the public into five different profile groups (kids, teenagers, men, women and the elderly). In the second phase, we implemented specific interviews to the five profiles and defined kids, women and elderly as target user groups for the project. In this phase, we focused on identifying the urban furniture needed and creating the catalog with different criteria.

The workshop place-making phase is the most interactive one, where the inhabitants contribute at higher levels on the decision-making process. The aim of this phase is to share project ideas and get feedback, opinions and preferences from the inhabitants.

In the fourth phase, we took into consideration the outcome of the previous ones to create the design proposal and at the end present to all stakeholders with a possible revision step, if necessary.

In the final phase of the project, the designed interventions are implemented. Interactive workshops with the residents are organized, where they can personalise some designated parts of the urban furniture. These participatory activities will contribute to increase the sense of belonging, generate identity to the area and build social network among neighbours. A continuous and constant phase is the monitoring and evaluation, where indicators are verified in order to prove if the goals were reached as assumed, as further explained.

Block Design

To develop the design of our block, we first determined the main pedestrian axes, which connect residential blocks with the commercial area of the neighbourhood and a transversal axis that would originate from the perimeter opening. This opening acts as a strong pole to display the project of this block as an example for the surrounding blocks and as a pilot project. This area would be an open plaza inviting for public use. We then divided the courtyard in levels of privacy: public – semi-public – a more private area. Finally, we separate these privacy levels into different uses for each target group.

The most public zone is intended for all residents of the block as well as neighbours. In this open plaza, we aim to attract people, make them understand the benefits of conjoining energy and sustainable urbanism with the tree energy totem and information plaque. The center of the courtyard is intend to be used by the inhabitants of the 6 surrounding buildings, as our intention is for this to be replicated in other blocks. In the semi-public zones, there would be an area for all target groups with shaded benches and game tables. Beside it, an area focused for the elderly group, with outdoor fitness equipment for seniors and game tables for chess and backgammon as a way to introduce more activities for them to enjoy. In the more pri-

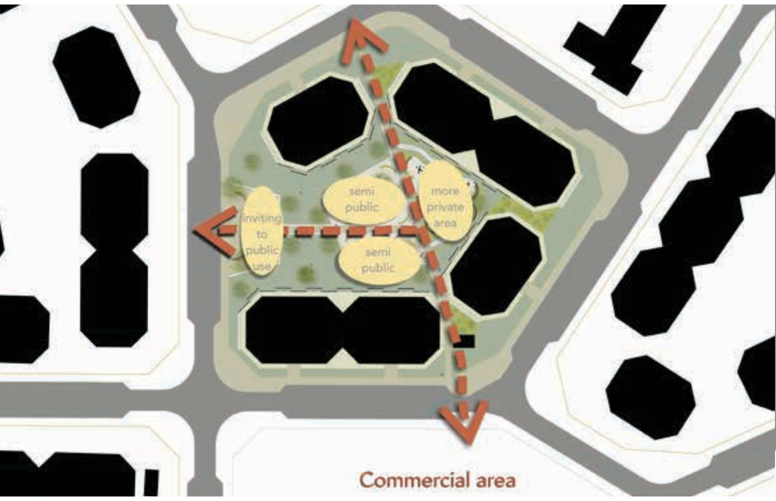


Figure 08: Permeability and privacy levels (Authors, 2018)

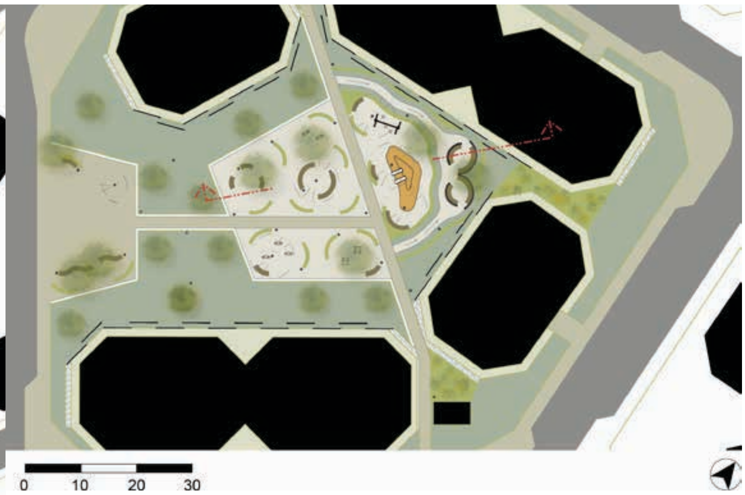


Figure 09: Courtyard plan (Authors, 2018)

vate area, since there is a certain enclosure of the building and no pathway leading across it, there is the playground for the kids and space for parents to supervise them. Behind it, the most private place is designated for women, always taking privacy into consideration.

In order to maintain the inhabitant's privacy inside the building especially on the ground floor, we allocated metal perforated panels with 1.80m high and 5m length that work as boundaries in relation to the buildings. For shading, we designed an element with similar metal base as the tree energy totem, with a membrane in a dome shape. In the women's area beside the benches arranged in C-shape, that create a more reserved space, a metal panel is placed. This panel has small perforations and shading that provides privacy for women, which allows them to feel more comfortable in the outside space. After studying some design strategies in relation to privacy in Muslim homes (Othman et al., 2015), we adapted the different levels strategy to an outside scenario. By creating a lower level of -0.70m, we would obtain a more private zone without interfering with the visual permeability of other users. The excavated earth is relocated to the playground, to create a small hill of +0.90m. This becomes a feature in the playground where kids can climb to the top and go down the slides.

MONITORING AND EVALUATION

To demonstrate the effectiveness of this project, satisfying the investors and the local community, we created a monitoring and evaluation (M&E) plan. This plan is a regular collection and gathering of information about the project activities, which will aid its performance in actualizing our desired outcomes.

We integrated the M&E plan throughout the project cycle i.e. from the need of assessment till its final implementation. We also designed a logical framework matrix as a guide to reach our main goal of improving the quality of life through urban design and the use of renewable energy.

Furthermore, to measure the progress of this project, we developed three main indicators. These are: 90% reduction in the rate of robbery in the project area, 80% of electricity produced with solar PV and 90% of residents participation in maintenance of the courtyard. We defined a deadline for each indicator.

For proper monitoring, specific roles and responsibilities were assigned to different individuals. They would carry out these activities through questionnaires, interviews and field surveys, which would be done daily, weekly, and monthly. The data collected would be both numerical and non-numerical. This data would later be analyzed and necessary recommendations for improvement will be made.

CONCLUSION

As a result of this study, we were able to identify and address two main issues for the inhabitants of the selected block and propose an intervention project potentially applicable in the study area in Sheikh Zayed.

Despite the drawbacks of doing a project in an area we visited only for a short period and with limited accessibility to precise figures, we strongly believe the project developed for the site is feasible. This pilot project for the block scale can be easily replicated in other blocks of the neighbourhood with a similar structure, providing benefits for the inhabitants that goes beyond creating a pleasant outside safe space to use together with integrated renewable energy production. The project also provides the government with an important tool for revitalization of satellite cities, and raising their attractiveness for future residents. This project would not be a single solution but should be used as part of a more holistic urban development program.

Figure 10: Courtyard section (Authors, 2018)

GROUP 5

THE OASIS
A CLIMATE RESPONSIVE ARCHITECTURE PROJECT

Figure 01: Distrct view (Santos, 2017).

INTRODUCTION

The Oasis project is a climate responsive architecture project on residential buildings in the district of Sheikh Zayed city. It has a goal of reducing both energy demand and electricity reliance on the grid. The district consists of 218 buildings as a result of a duplication of one building in different orientations. By studying a single building as a pilot project, we can determine strategies which can be applied to the entire neighborhood (Figure 02).

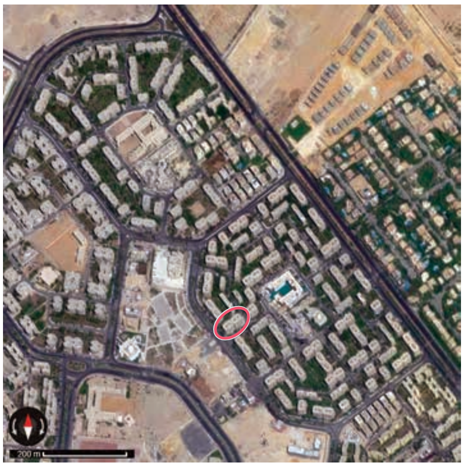


Figure 02. Project site plan in Sheikh Zayed and the selected building circled (Google Maps, 2018)

The study was focused towards two main aspects of energy efficiency. One aspect dealt with building energy and the other aimed at consumer behavior. The study process was carried out in sequential steps starting from data collection at the site, building energy simulation and final analysis of the results.

BUILDING ENERGY SIMULATION

The building's simulation was carried out within the following parameters that form the basis of the building study. Firstly, the building is solely residential, consisting of five stories with each story having four apartments, which has a total floor area of 2,226 square meters (Figure 08). The simulation of the building energy contains various standards due to the country's building codes, regulations, geographical situations and climate information. The project design level with its main indicators is bound by the 2030 challenge target (Architecture 2030, 2015) and ASHRAE 90.1 (ASHRAE, 1997). The energy segments for this building have been divided into several categories, with the main categories with higher energy consumption segments being cooling, lighting, equipment, and fans (Figure 03).

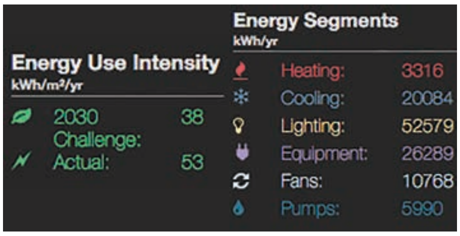


Figure 03: Energy simulation result from (Authors with data extracted from Sterner, 2014)

An important indicator, Energy Use Intensity (EUI) is a building's annual energy use per unit area which is calculated by Sefaira Plugin. It is typically measured in thousands of kWh/m2/yr. EUI measures "site" energy use (what the building consumes) or "source" energy use (the amount of fuel the power plant burns to produce that much energy) (Sterner, 2014).

In this project EUI refers to the site energy use with the standard Egypt 2030 challenge target at 38 kWh/m^2/yr. In our project, the current EUI level of the building is 19 kwh/m^2/yr more compared to the standard target.

To effectively reduce the EUI, several strategies have been considered in this project to scale down the energy consumption level. These are bound by the construction regulations and their alteration limitations. With the above considerations, the project has been structured into three phases of passive, one phase for active and consumer behavior strategies. The following passive and active strategies considered within this project are:

- Material-insulation (passive),
- Windows size, shading and blind (passive),
- Natural ventilation (passive), and
- Solar PV panels (active).

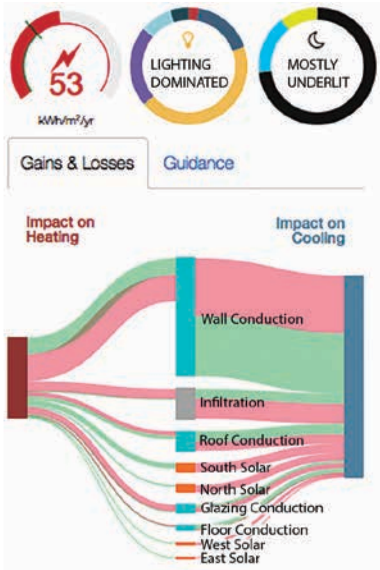


Figure 04: Impacts of building elements on the cooling and heating load (Authors with data extracted from Sterner, 2014)

With regards to material-insulation, the restrictions on change of building elements made it only possible to insulate the building by applying plaster and heat insulation

Figure 05. From left a) Elevation details, and b) Project logo (Authors, 2018).

paints on the external facade. However, insulation materials will reduce wall conduction losses and help to reduce energy demand for heating load. As a result, the building will need more energy for cooling due to the promotion of wall conduction. The insulation is considerably useful for energy reduction during the winter or in any other cold climate areas, but this does not have sufficient influence during the summer, especially within Sheikh Zayed (Figure 04). Accordingly, the simulation results concluded only a reduction in EUI of 1 kWh/m^2/year less energy intensity compared to the existing conditions.

The following passive strategy window size, shading and blinds, were analyzed by changing the size of the windows from 130x130 cm to 130x200 cm, adding a 39 cm horizontal shading and automated blinds. However, these simulated options neither showed significantly low improvements to the natural ventilation levels within the building nor any increase to natural lighting. The preferred strategy was then discarded due to the subsequently low impact simulation results.

As the last passive strategy, Natural ventilation can reduce the EUI level to 35 kWh/m^2/yr and achieve the desired 2030 challenge standard level. Unfortunately, due to the climatic conditions of Sheikh Zayed, natural ventilation will lead to a deficit in thermal comfort. With the intention to retain the building's thermal comfort for the residents, an HVAC system needs to be provided and this requires the use of renewable energy to keep the building within the Egypt standard EUI level.

To provide an additional source of energy, renewable energy via solar PV panels was introduced as an active strategy. The solar PV panels cover 50 percent of the roof area. This resulted in a considerable reduction in EUI to 21 kWh/m^2/yr due to the energy source now being catered with 31 percent from renewable energy. Concluding that the intended target was fulfilled, however, via adjusting energy source, the energy requirements remained within 1 percent reduction, which has a low impact.

Occasionally, the simulation of a small scaled project cannot provide acceptable results to make the stakeholders satisfied in implementing the project. For example in our building, the passive strategy design has only a 1 percent impact, which is not a sufficient reason to bring stakeholders to implement the project. However, considering the final result of the project for the entire district, stakeholders can be easily convinced also through encouragement by the government to realize the project's passive strategies.

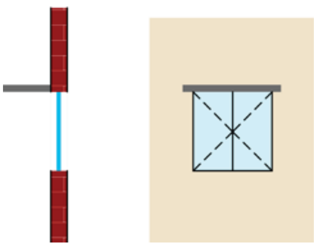
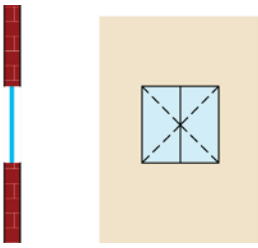
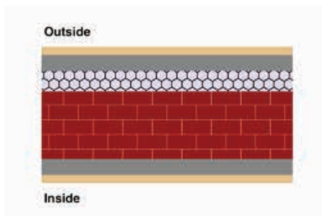
		
North - South Facade, (Window + shading)	East - West Facade, (Window + no shading)	External Wall, (Adding thermal insulation)
Wall - Window Ratio: 20-30% Size: 130 cm x 130 cm Type: Casement window Shading: Yes - 84 cm depth Glass: Clear glass 3.2 mm Details: Transparent- (6.0 mm air) - Double glazing Investment: 86,533.2 EGP (3,927.21 €)	Wall - Window Ratio: 10-20% Size: 130 cm x 130 cm Type: Casement window Shading: No Glass: Clear glass 6.4 mm Details: Reflective-(6.4 mm air) - Single glazing Investment: 70,618 EGP (3,204.92 €)	Wall Type: 25 ++ upgrade from just plain 12cm brick wall with plaster & paint Thickness: 27 cm U - Value: 0.897 W/m2K Build up: Full red brick wall + 2 cm external expanded polystyrene thermal insulation layer + plaster + paint Investment: 9,406 EGP (426.88 €)

Table 1:Project passive strategies (Author, 2018; Investment costs based on data from Mahdy&Barakat, 2017; Mahdy&Nikolopoulou, 2013a; 2013b)

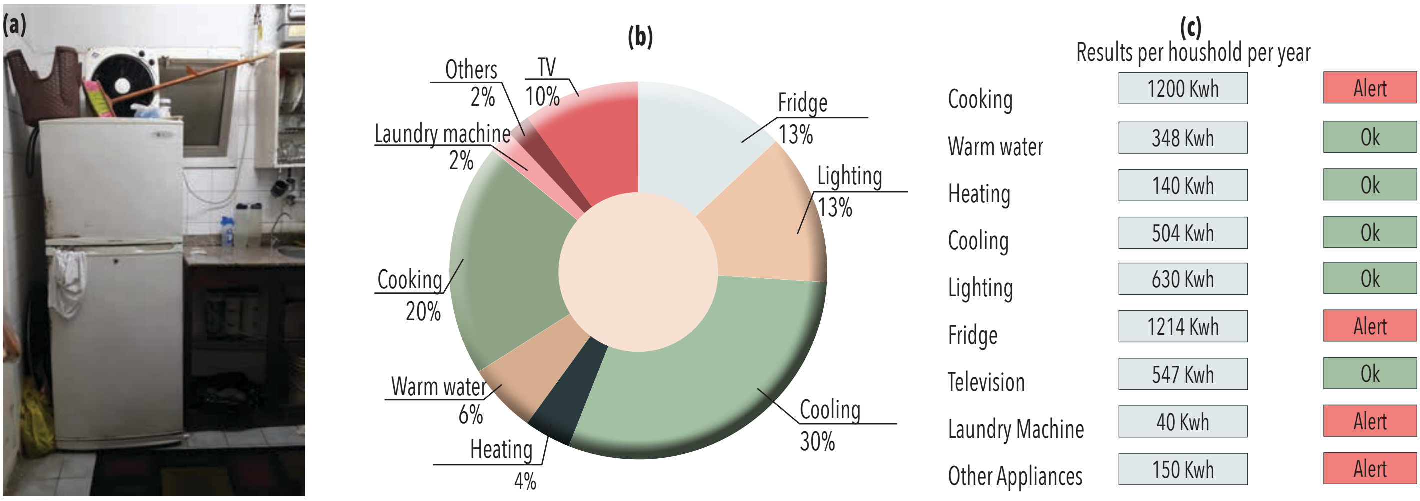


Figure 06. From left a) Current appliance (Mosha, 2017), b) Energy demand based on appliances and services, and c) Meter tracker per household (Authors, 2018).

CONSUMER BEHAVIOR

This is focused on the living habits of residents and types of appliances in the building that directly influence the amount of energy (electricity) consumption. Thus, we needed to find precise information about the consumer behavior in the selected building. To do so, a survey was conducted based on the type of appliances used and the energy demand for the same. Therefore, the energy consumption demand for each activity was noted and the analysis based on the acquired survey data per activity was performed. After interviewing 5 residents of the Sheikh Zayed neighborhood and surveying their apartments, we figured out that the larger amount of energy being consumed is for cooling and cooking (Figure 06). In addition, the appliances are very old and the residents use electric fans for cooling due to the hot climate.

Figure 07: A resident being interviewedfor the survey (Authors, 2017).

THE PILOT PROJECT

According to the analysis result for both strategies; building energy and consumer behavior, it was clear that the scope of the project is to reach better energy efficiency standards. To fulfill this, a combination of passive strategies, changing daily consumer behaviors, and implementing the active strategy is the solution. This leads us to the pilot project achievable scope as stated below:

1. Passive Strategies: These include the change of window type, adding shading devices and applying external wall material-insulation. This strategy has a one percent effectiveness in reducing energy demand.

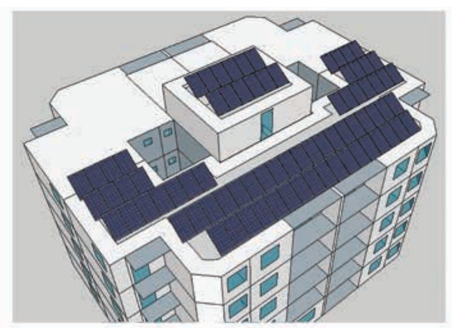


Figure 08: Chosen PV system installation option with 50% roof coverage. 78 PV panels, with capacity of 20 kw each, are installed in this option. Energy for heating, warm water, lighting and washing machine will be covered. The required investment is 20,000 €. (Authors, based on data from Sunprism, 2017; Faraj, 2016; Brown, 2016; mg solar shop, 2017; USGoBuy, 2017; Cairo Solar, 2017; TPS, 2017).

2. Consumer Behavior strategy: focuses on triggering a change in habits and behavior of the user by raising awareness about the appliances energy consumption. An information booklet and a mobile application guides residents on how to use their appliances and how to change them if necessary. Two phases are suggested for implementation, phase one is equipping one household with efficient energy appliances, a meter tracker, and an energy tips catalogs. For phase two, the project is scaled to a neighborhood level to bring awareness to other households about the results of the pilot project. This strategy has an 8% effectiveness in reducing energy demand (Figure 06).

3. Active Strategy: Use of renewable energy as a source for the dominant energy segment (lighting and cooling). The PV model chosen for this strategy has the capacity of 260 WP (watt power) and the dimensions are 1623 x 997 x 40mm (Sunprism, 2017). Three options are possible for installing PV panels. First is to cover the 100% of the roof area by PVs. In this case, a structure is needed to hold the panels off the roof surface. By doing so maximum power production will be possible, however, it would be too expensive. The second option is to install PV panels on the whole roof without any structure. This would occupy spaces which residents use for some routine activities. We chose the third option (Figure 08), which is more economical and covers only half of the roof area with PVs leaving the other half for residents to use. Generated power in this option can cover 31% of building energy demand.

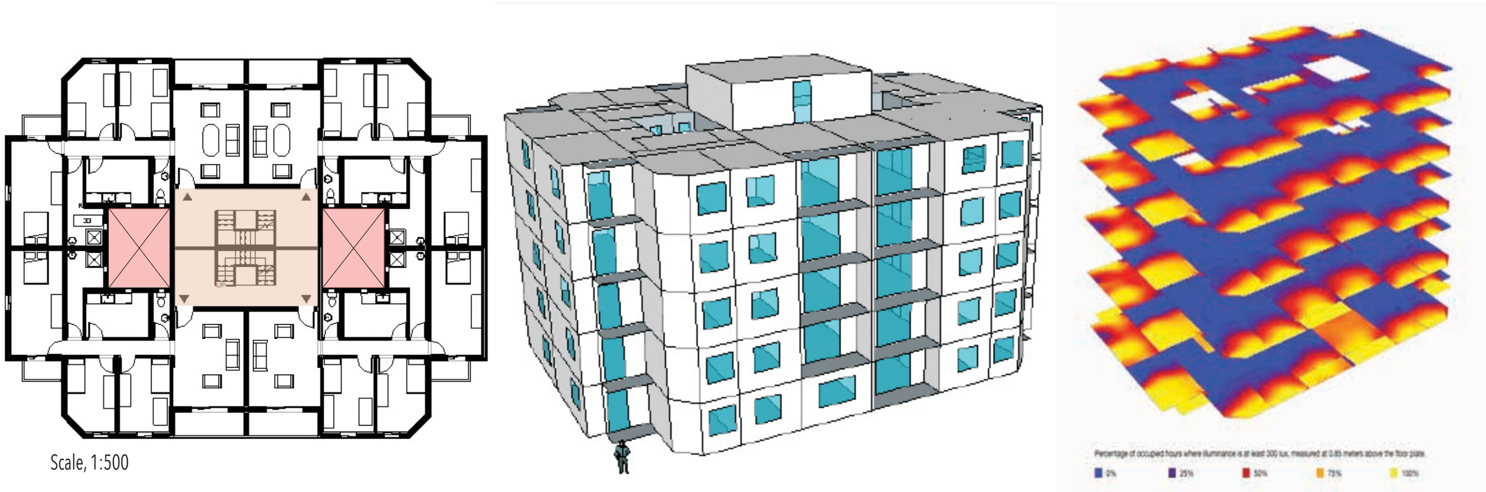


Figure 09:From left a) Building plan, b) Building 3D model , and c) Energy simulation result by Safaira showing under lit spaces in blue (Authors, 2018)

PROJECT IMPLEMENTATION

To further determine the effectiveness of our proposed strategies, we calculated the amount of energy being covered by installing PV panels and the energy being saved by reducing the demand. According to our analysis, current building energy demand is 116,220 kwh/y per building. After implementing the passive strategy and the consumer behavior strategy, we reduce the energy demand by 9%. Furthermore, the chosen option of active strategy, installing 78 PV panels on 50% of the roof area, covers 31 percent of the energy demand per building. This means that in total the building would consume 40% less power from the grid. In terms of the district scale, the strategies implemented would lead to an expected saving of 214,730 Euros within these stated percentages (Figure 10).

The implementation period for the whole project is estimated to take a maximum of one year. There are four main implementation phases: two for passive strategies, one for active strategies and one for consumer behavior. Each phase of passive strategies will require at least six months and the second phase can only begin after the first phase is completed. Meanwhile, the phases of active strategies and consumer behavior can be started simultaneously and will require two to three months. It should be noted that the estimated duration of the project implementation was calculated with regard to any possible occurring and unforeseeable risks.

These unforeseen risks should be assessed by the project participants, especially the project manager. From the beginning every project participant should assure that every contract has been settled between the stakeholders to ensure that all required aspects match and to avoid the cancellation of the contracts by project stakeholders and participants. The project manager has the duty to keep them informed, satisfied and on schedule. During the entire project duration, the stakeholders need to know about the ongoing progress of every participant in terms of their scope of work. To avoid unforeseen problems with any of the stakeholders, the provision of proper codes and regulations is crucial. All sponsors should be informed about the total costs including profits and savings. A higher economical security during the implementation of the project can be reached by guaranteed bank loans. Participants such as the government or other authorities could provide amongst others financial support and fiscal benefits, media advertisements about the project, improved education, insurance, expert workforce, the amendment of building codes and regulations, alarms and emergency response with scientific simulations and analysis. All these mitigations can lead to an increased security of the project.

The financial aspect of the pilot project is vital, therefore we separately calculated the implementation cost of a building by each proposed strategy. By doing so, we determined that the passive strategies, would cost 7,559 Euros, implementing consumer behavior strategy would cost 2,500 Euros, and 20,088 Euros would be required for installing the active strategy. Thus, the total implementation cost of all three strategies summed up to be 30,147 Euros. On the other hand, the total estimated savings per building per year would be 985 Euros. The majority of the savings are due to the active strategy (installing PV panels). With regards to the investment payback, a period of 30 years is calculated for this project.

We conclude by stating that a combination of strategies is essential to achieve an effective project with regards to building resource efficiency. As a final remark on this project; to bring an Oasis to the desert city of Sheikh Zayed City - Residential, an investment of 30,147 Euros per building is required. This will cover 31% of the energy demand through PV panels and have the demand reduced by 9%, resulting in an improved resource efficiency outcome. Therefore it is possible to reach efficiency in existing building performance by minimising the energy use and encouraging renewable energy generation through simple interventions.

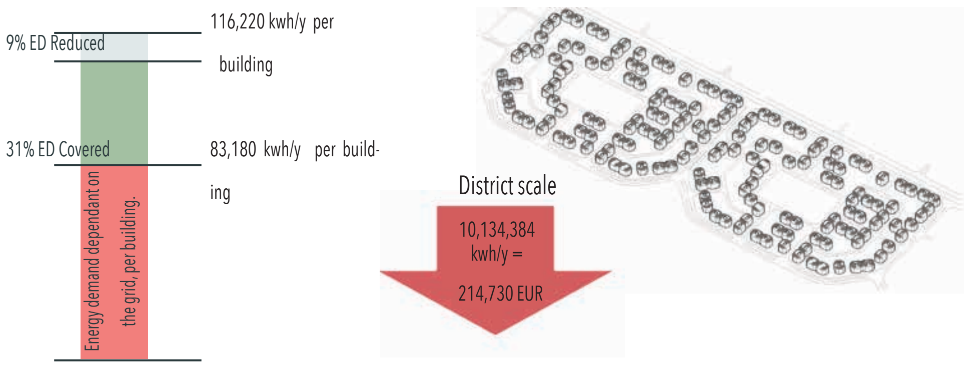


Figure 10: Project expected results per building and in district scale (Authors, 2018).

GROUP 6

MY NEIGHBOUR, MY HOOD

COMMUNITY DRIVEN APPROACH FOR SUSTAINABLE URBANISM IN LOW-INCOME NEIGHBOURHOODS

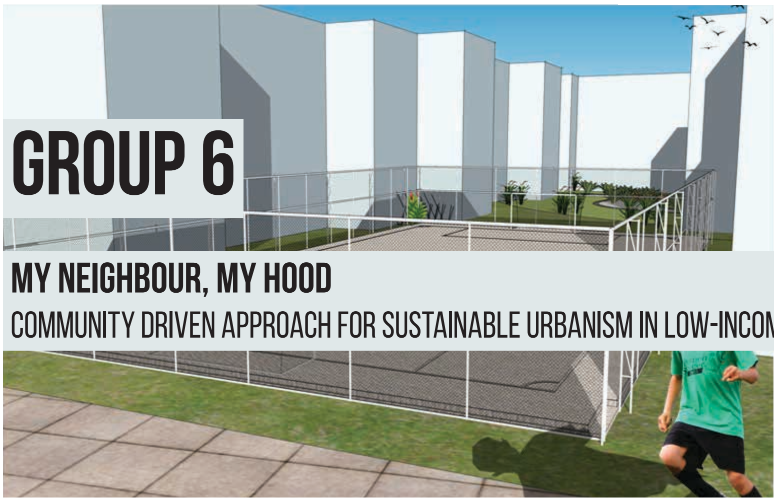


Figure 01: Sand Fooball Pitch (Authors, 2018)

Figure 02: Grey Water System (Authors, 2018)

INTRODUCTION

This project deals with a low-income neighbourhood in the city Sheikh Zayed. During the preliminary analysis it was found that 60% of Egypt belong to the low-income class, of which 80% live in inadequate housing conditions. (Kipper et al., 2009) As inadequate housing is often found on agricultural land without planned infrastructure this may lead to environmental problems. On the other hand, government projects are often unsuccessful, which is reflected in reverse migration from New Cities back to informal settlements. (Essam Al-Din, 2003)

These facts were the starting point for our group to work on a social housing neighbourhood and lead to three initial slogans:

#make social housing social
#utilize informalities
#activate the economy

During our ongoing project work we specified our focus according to,

1. the needs of the target groups we have identified in our neighborhood
2. the scope of the project related to "resource efficiency".

The needs of the target groups in our neighbourhood are crucial to their existence and basic human needs, whereas "resource efficiency" can be seen as luxury item. Our project group has accepted the challenge to merge both the target groups' needs and "resource effciency". Our final concept satisfies the needs of our target groups by utilizing the public open spaces on one hand and "resource efficiency" by implementing a grey water system on the other hand. The project group is convinced, that the measures on public open space will improve the identity of the neighbourhood. The newly created spaces shall bring the opportunity to build community amongst neighbours. Affordable activities support the process of socializing. A greywater system can be implemented at relatively low cost due to the existing stream separation with a two-pipe system on building scale. Additionally, low cost treatment is possible by using a constructed wetland system that produces water for the irrigation of public open spaces. Thereby, our concept becomes comprehensive and interlocked in itself. As we identified a main threat of improper operation and maintenance, we try to avoid this by introducing an institution that manages the whole process by engaging qualified and interested inhabitants of our neighbourhood on a honorary basis. Also, our concept aims to create job opportunities for the low income and unemployed inhabitants.

Figure 03: Target groups needs (Authors, 2018)

Figure 04: School connection to CBO (Authors, 2018)

URBAN ANALYSIS

Given the tremendous scale of Egypt's low income population, currently around 60% of the country's population are of low income and around 80% of those are living in inadequate housing, so it was clear that despite the continuous efforts of the government and the various subsidized housing programs, which were created to attract a big portion of those who are of limited income, that the low income part of sheikh Zayed must be tackled to find how can limited income inhabitants be attracted to such developments. The low-income neighborhood consists mainly of subsidized social housing built by the government, the neighborhood consists of the following a center where a mosque, a public school along with market place is located, subsidized social housing in 11 blocks, individual subdivisions of land that is privately owned and built, wide streets on the perimeter and small connecting streets on the interiors of the neighborhood. It was clear for us that despite the tremendous scale of both public and private investments and the strategic location of the project are in the heart of sheikh Zayed, it failed to attract inhabitants, as it does not offer the kind of housing, choice and livelihood that would entice the people to move and stay. Accordingly, we found that the spatial layout does not favor sociability, but when there are people interested in creating it, it is possible to do so by getting people organized. The big distances between one place to another is staggering along of lack of amenities that encourage people to walk such distances under the harsh sun of the desert. A second factor that discouraged the livability of the neighborhood is the availability of space but it is inefficient space which discourage the development of public activities and disconnect the people which as we learnt from informal areas in Cairo is important between the people of low income.

Figure 05: Workshops Area (Authors, 2018)

Figure 06: Oven Area (Authors, 2018)

MASTER PLAN

Perhaps the most serious problem facing this low-income neighborhood in sheikh zayed is the restricted and the high standard uses imposed by NUCA authorities, Therefore, we believed that the establishing of small community projects which is run and controlled by the community of the neighborhood will help rejuvenate it.

Such flaws can be seen as an opportunity that must be seized and directed to the better of the neighborhood, a major aspect discovered from our analysis is the real wasteful use of the land and the un-needed allocation of it, along with the absence of a real community organization to maintain and develop the neighborhood, the success of such organizations can be easily seen in many small scale projects in Cairo's old and informal areas, we found:

1- Low social dynamics, 2- Poor condition and low use rate of public space, 3- Missing community capital

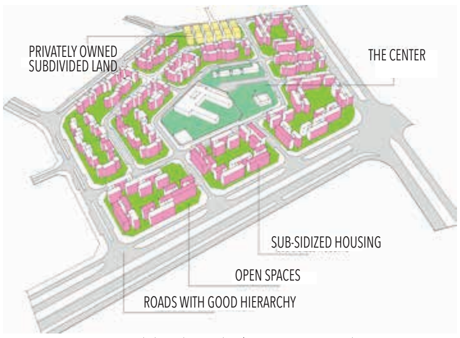


Figure 07: Neighborhood Elements (Authors, 2018)

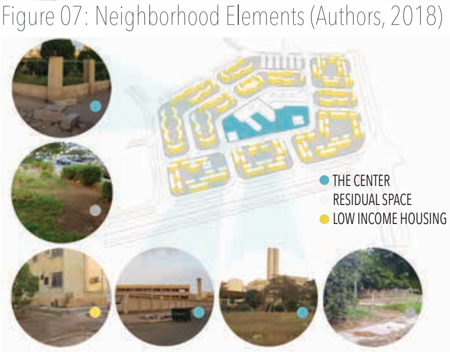


Figure 08: SITE ANALYSIS (Authors, 2018)

The detailed analysis and understanding of site context highlighted a primary motive for the master planning process. Through integrating solutions via utilizing space, bringing function and life to its surroundings and considering the target groups needs with regards to cultural feasibility. A masterplan that foresees the process of building blocks by laying base towards a self-evolving long-term initiative. Schematic development was formed by looking at the existing space availability and grading the spaces with potential of interaction based on daily user movements, distance, enclosure and how much a proposed intervention in that area would contribute to the larger picture.

It leads to a better usage of space with in the courtyards specially corners and the centre by integrating them. This would lead to establish an entity binding the premises and the entire neighbourhood.

Figure 09: Target groups interventions (Authors, 2018)

Figure 10: School Playground (Authors, 2018)

To allocate a structure for the community-based organization (CBO), the school and the enclosed space with a mosque adjacent to the small commercial area located in the centre are planned to be combined by removing the fence and connecting them through a passage. The intention is to allow the utilization of open public space for leisure activities and the open school area for community gatherings and a safe play area for underage kids. The main purpose of these interventions at the centre is to rejuvenate the space as an actual neighbourhood centre.

Figure 11: Central Space Intervention (Authors, 2018)

Radiating from the centre towards the outer proximity specific interventions are proposed as per the main objective. Firstly, calculated wet lands are allocated adjacently in the corners to add water element in the outer periphery and to irrigate the green spaces of the neighbourhood via connecting short pipes (Figure 02). Secondly, remaining courtyard spaces are assigned with target group's needs, relatable to cultural acceptance, such as a shared oven and workshop space for the ladies, cemented football field for the sports enthusiasts (Figure 01, 05, 06). Integrating a specific use will not only help in fulfilling the needs of the community but will also develop a sense of ownership and a reason to maintain it. In (Figure 09) all the interventions reflected on the master plan were shown, which were choosen based on the needs of the target groups.

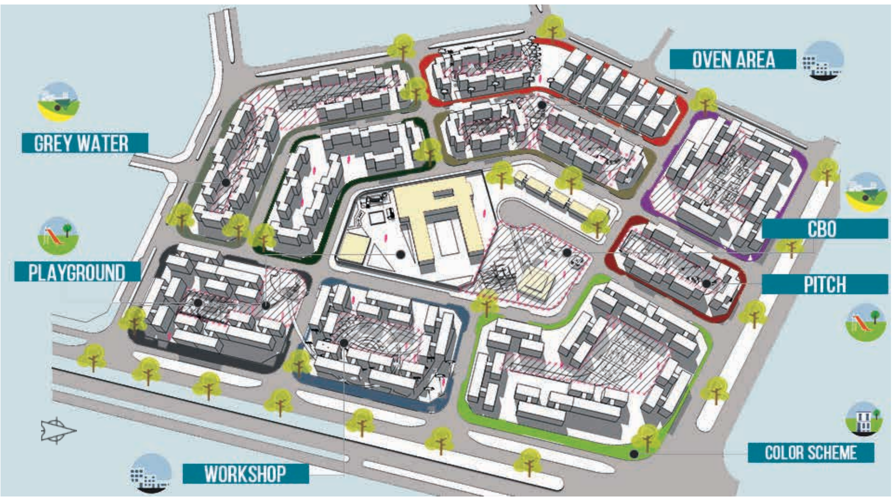


Figure 12: Schematic Master Plan (Authors, 2018)


Figure 13: CBO Area (Authors, 2018)

OPEN SPACES

We decided that providing a well assigned network of walkable, engaging public open spaces and greenery within the neighbourhood answers a variety of recreational, sporting, play and social needs of the community.

The greenery, public oven and other areas of public open space (workshops, playgrounds and football pitch) represent a local destination for people to walk and socialize to and be active in. It provides exposure to space, which can be restorative and have positive mental health benefits; and places for social interaction which are critical for creating and maintaining community cohesion and building social capital. For children and young families, green spaces provide a place to meet and to participate in physical and social play. The provision of public open spaces in our intervention is thus a key factor in promoting active living and providing important physical, psychological and social health benefits for individuals and the community.

The master plan includes a set of open spaces which are:

1- The CBO. (Weekley Market and temporary events zone)

2- The Oven.

3- The Workshop.

4- The Playground.

5- School Space.

Having such spaces, we believe, will be a step to have an organized and structured communal effort.


Figure 14: School Space (Authors, 2018)

GREY WATER

We estimate the current irrigated area at 77,000m^2, which is being watered with potable water. The importance of conserving the water resources especially in a desert climate cannot be neglected. Hence, we decided to save potable water resource and use treated greywater for the watering. We also estimated the amount of greywater generated by the residents of the focus area to be 1,157m^3/day. It is a huge amount of water that can be easily reused with a basic treatment system. The Egyptian code of standards for wastewater reuse (no. 501 /2015) does not distinguish between black & grey water, as it is all considered wastewater. As a low income neighbourhood, we had to develop a solution that is acceptable by the community and has a low maintenance cost, as the CBO will be taking care of it. The Biological Oxygen Demand (BOD5) concentration was the limiting factor from the standards. The water to irrigate the greenery has to be of grade "A" with 5mg/L BOD5 concentration. Afterwards, we evaluated the possible solutions and decided to create three vertical flow constructed wetlands (VFCW). The buildings already have a two piped system, one for the grey and another for black water. Our solution would divert the greywater pipe before it mixes with the black water and get it to one of the treatment systems based on the location. Each system capable of providing 82m^3/day of irrigation water consists of an underground 15m^3 settling tank for the primary treatment process, then the water flows into the wetland that has a surface area of 910m^2 (based on Kickuth's equation). At last, the water is distributed through the irrigation network based on the location relative to the systems. The wetland has a height of 70cm filled with sand and gravel layers. The 3 systems would irrigate an area of 49,000m^2 with 5 L/m^2/day at a cost of 42,000 Egyptian Pounds per system.

MONITORING & EVALUATION

While documentation is taking part in the CBO as an ongoing process to monitor the project, we needed the evaluation to measure the project success. We used a Log Frame Matrix, we set the overall objective, the purpose of the project and the results we would like to get. The indicators used are specific, measurable, available, relevant and time bound (SMART). The monitoring and evaluation process would continue even after all the interventions are implemented. We assume that through the monitoring process further development of the interventions can be implemented. The main verification process is documentation and surveys before and after the project implementation. The success in attaining the overall objective of making the social housing neighbourhoods better, while using sustainable urbanism and planning principles needs to be measured. To do so a documentation of the results from the CBO is required and a survey has to be done in order to know the resident's views. If there is an increase of 25% in the acceptance when compared to the time before the implementation and completion, then the overall objective of the project is achieved and thus such interventions can be implemented in similar neighborhoods. The results from the greywater system is to save potable water. We would measure the success of the system by comparing the actual amount of water saved to our indicator which is 14,760 m^3 of potable water to irrigate the area of the wetland in 6 months after the first system is implemented. To verify the results, we need to have monthly water metering of the irrigation system before and after the implementation as well as water tests. It should be noted that all the above is controlled and implemented by the community based organization, changes and developments in the interventions will be based on the results.

Figure 15: Master Plan (Authors, 2018)

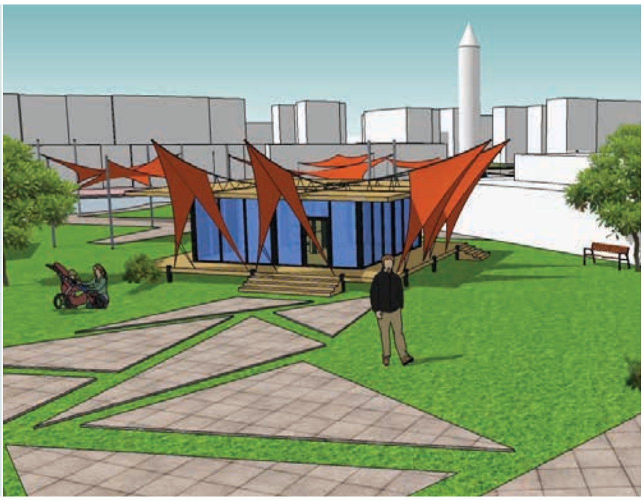


Figure 16: CBO (Authors, 2018)

COMMUNITY-BASED ORGANIZATION

The CBO acts as the umbrella, which supervises all the different tasks connected to the implementation of the master plan. However, it is supposed to organize the whole neighborhood in an organization and community, where the individual supports and is supported by the community. This is especially important in a low-income neighbourhood, in which many residents only have just about enough financial means to cover basic needs like food and clothes. Paid free time activities are a luxury many low-income citizens can't afford, which creates the need of a neighborhood that offers spaces usable for different activities and community purposes. The CBO offers the opportunity to provide these needs, organized by the citizens themselves. Furthermore, the CBO is not only supposed to organize the neighborhood in a structured form, but to create the advantages of communicating and addressing its needs to external stakeholders.

The CBO Structure starts with organizing community representatives that form the foundation of the organization. The representatives are elected by the local residents from each of the different target groups to ensure that the interests of each group are represented in the CBO. The representatives elect the board of the CBO, which is mainly responsible for the administrative tasks and organization of the CBO. As the executive branch, the board hires and manages the operational staff and the finances. The board also needs to consist of residents of each of the target groups and their decisions are always monitored and supervised by the community representatives. The board is also responsible for guiding the honorary committee. Its task is to execute the actual projects and steps in working groups, that are connected to the realization of the master plan and the improvement and maintenance. The execution is by the honorary committee is dependent on volunteers.

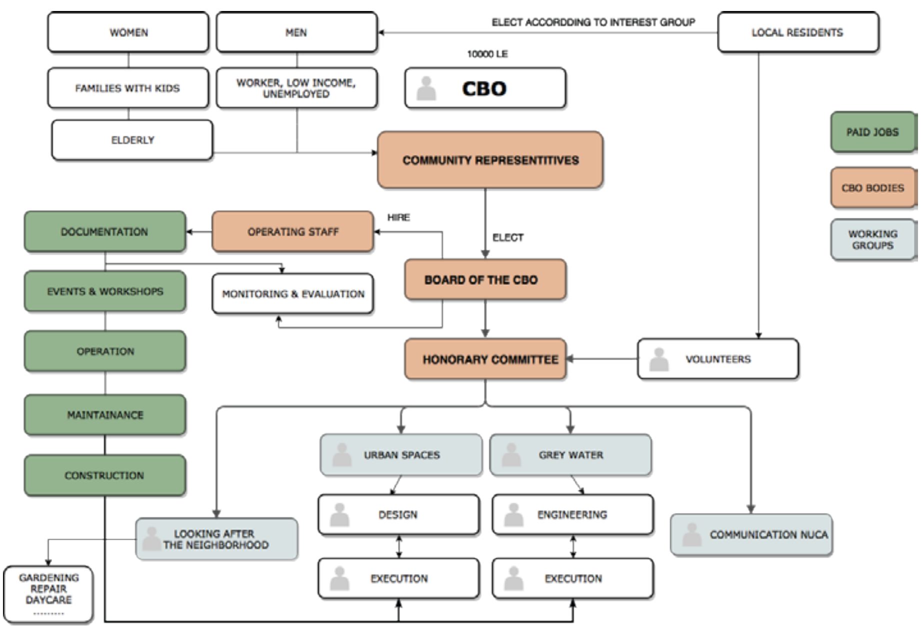


Figure 17: CBO Structure (Authors, 2018)

TIMELINE

For the execution of the project, we developed a timeline to illustrate roughly what milestones and goals there are and the time frame they are intended to be achieved, considering the initial challenge of starting and financing the CBO and the interventions. Each major goal is displayed as a headline with specific indicators and tasks to accomplish it beneath it. The major goals for the project are divided into three categories.

The category of CBO management consists of every task and goal connected to initiating, operating and growing the CBO. The initial goal in short term, is to create the CBO with the objective of growing the organization and gaining an increased influence on external stakeholders and local politics with the purpose to initiate larger projects and cover the needs of the residents with possible governmental funding. The second category of projects includes the specific interventions and projects, which are implemented and operated by the CBO and the volunteers. On a short-term basis, the goal is to initiate first smaller public space projects to achieve immediate results and thus increasing the engagement of the residents. The Mid and long-term objectives of the project are to utilize the potential of the public areas in the quarter with the intention of providing valuable spaces for the inhabitants to improve the livelihood, engage in community and free time activities.

The third category of monitoring contains every goal and task connected to detecting and measuring the success of the CBO and the specific interventions. In short term, the goal is to achieve acceptance of the CBO by the majority of the residents to create the fundament on which the body can grow and initiate the interventions. The ultimate objective is to create an exemplary model with the CBO and the improvements for the quarter.

CONCLUDING REMARKS

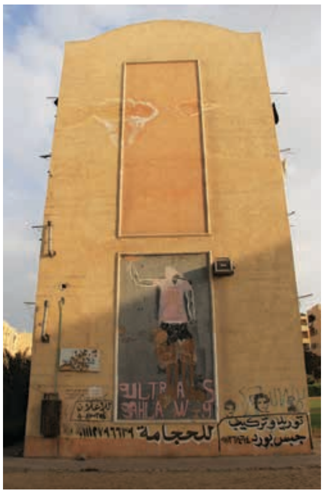


Photo collage, Sheikh Zayed (Authors, 2017)

SUMMARY

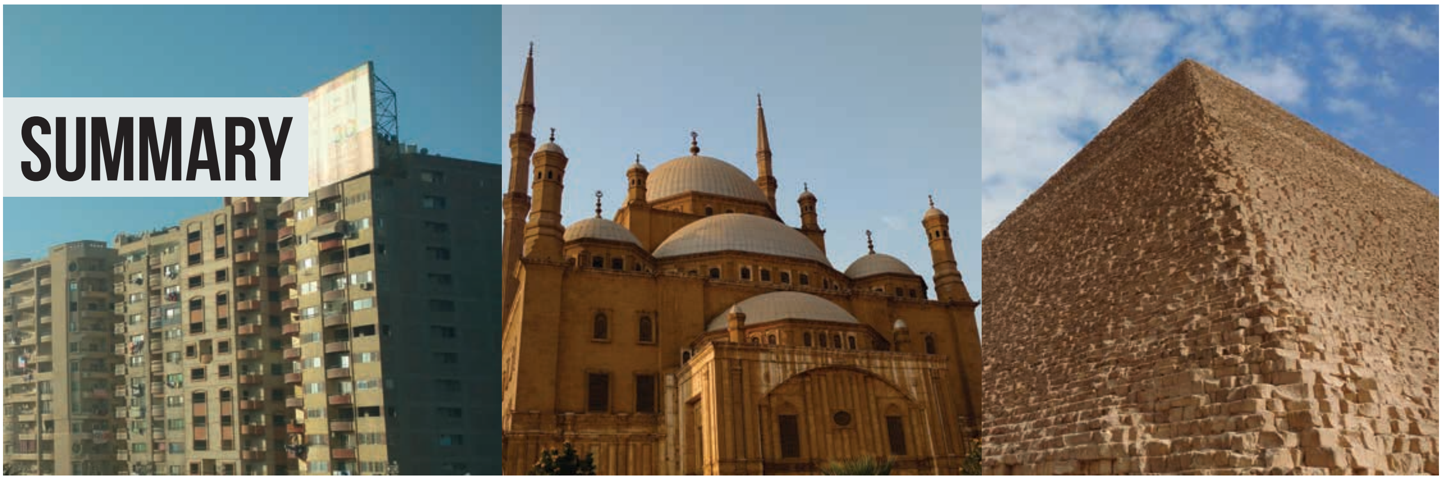


Figure 01: (a) Urban scene, Cairo, (b) The Citadel, (c) The Great Pyramid of Giza (Rayaprolu, 2017).

We the 8th generation of REAP, designed 6 projects concerning urban solutions in block, neighborhood and city scale for Sheikh Zayed city, Cairo, Egypt. These projects are intended to address the urban related issues in short, mid and long terms.

There is an increasing need for adaptation of cities to climate changes to put resource efficient designs and sustainable solutions more in practice. As a result of funding by DAAD and the cooperation between HafenCity University and the Cairo University, Sheikh Zayed a satellite city located in west of Cairo was selected to perform our investigations, discover the issues and come up with sustainable solutions. Not only to address city scale issues but also to contribute for our long term common goal of adaptation to climate change.

Initially, the approach was to find out issues concerning life quality of the inhabitants, air pollution, urban heat island effect, climate responsive architecture design, sustainable energy solutions, water and wastewater management strategies, and material cycle management. Further we sought to find solutions for improving accessibility, livability, making identity, enhancing infrastructures and improving people's involvement in major decision making processes.

We have put forward solutions to provide safety for the residents, linked it with solar PV project to provide lighting for the open spaces, which also supports the efforts of the government towards switching to more renewable energy resources and self-sustenance. Similarly, we addressed the energy issues that the locality faced at the building scale and found solutions to tackle them. Both the demand and the supply perspectives had been approached, keeping in mind the user behavior and the energy consumption of households.

Distribution of bins,collection and separation of municipal solid waste were the main problems identified in regards to waste management which were due to the unwillingness of people for cooperation and also due to the lack of awareness. For this purpose we introduced management system with a mobile app, and its financial benefits for waste producers and customers of specific kinds of waste.

Our teams addressed the temperature increase due to climate change, along with potential urban heat island effects on Sheikh Zayed resulting from intense urban development activities. To tackle the issue we designed a green action plan with a focus on efficient water consumption for green areas by grey water irrigation. We found different plant species which can be used in the locality, based on their water requirement.

We proposed to improve the existing scenario of the commercial areas, with refinement of the spatial design to increase the ambiance not just culturally but also coupling it with the feel of social inclusiveness and wellbeing. Similarly, we approached the challenges of the public spaces by designing and utilizing the help of a community based organization. The organization intends to make social housing for the low income households, utilize informalities and activate the economy.

It has to be acknowledged that there are limitations that challenge these solutions in Sheikh Zayed, which we believe are generally true for any intervention project presenting a new idea. Participation of the people in these projects, support of the local government authorities, political status and political will to realize these ideas, transparency of the local government authorities, and more importantly people's acceptance and endorsement of these projects with their cultural, and religious values are some set of limitations that each of these projects face. We also realize that these projects are holistic approaches, based on the information gathered during surveys and interviews, linked with statistics, facts and figures from challenging data resources which were hardly accessible and some of them not being available in English. However, these ideas are backed with strong and reliable academia and literature review. Despite all above mentioned difficulties and restraints, we think that these projects are promising, suitable, feasible, and viable in Sheikh Zayed. We strongly believe that by realization of these projects in Sheikh Zayed, we would be able to achieve more steps forward in dealing with the global challenge of climate change and our race towards more sustainable and resilient cities of the future.

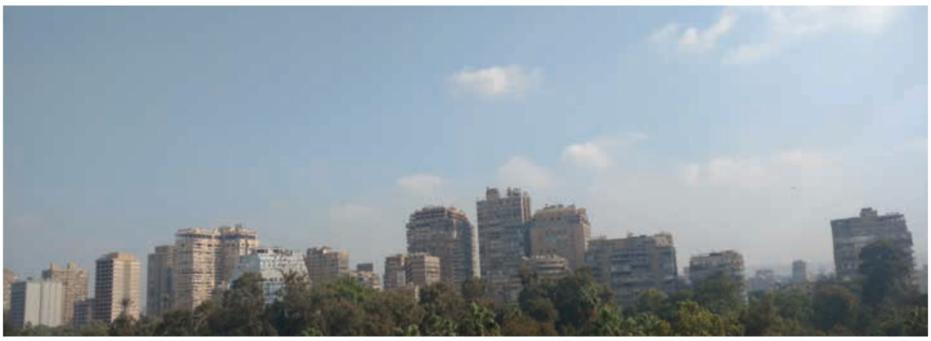


Figure 02: City scape, a view from the Cairo University, (Rayaprolu, 2017)

REFERENCES

Abdel-Dayem, S. (2011). Water quality management in Egypt. International journal of water resources development, 27(1), 181-202

Abou-Elela S.I. (2017). Constructed Wetlands: The Green Technology for Municipal Wastewater Treatment and Reuse in Agriculture. In: The Handbook of Environmental Chemistry. Springer, Berlin, Heidelberg

Ahmed, K. G. (2017). Designing Sustainable Urban Social Housing in the United Arab Emirates. Sustainability, 9(8), 1413. Chicago

Aljabri, H. (2014). The Planning and Urban Design of Liveable Public Open Spaces in Oman: Case Study of Muscat. Edinburgh. Retrieved from http://www.ros.hw.ac.uk/handle/10399/2761

Al-Masry Al-Youm. (2015). CAPMAS: 11.1% decline in average fresh water per capita consumption. Retrieved from http://www.egyptindependent.com/capmas-111-decline-average-fresh-water-capita-consumption/

Al-Salaymeh, A., Abu-Jeries, A., Spetan, K., & ElKhayat, M. (2016). A Guide to Renewable Energy in Egypt and Jordan: Current Situation and Future Potentials (p. 16). Jordan and Iraq: Friedrich Ebert Stiftung Jordan & Iraq. Retrieved from http://www.fes-egypt.org/fileadmin/user_upload/documents/publication/Energy_Guide_ENGLISHcompressed.pdf

Ambartsumyan, I. (2016). Water Consumption in Egypt. Retrieved from https://knoema.com/zuliuvf/water-consumption-in-egypt?origin=tunisia.opendataforafrica.org

Architecture 2030 (2017). Architecture2030.org. Retrieved from http://architecture2030.org/

ASHRAE. (1997). Shaping Tomorrow's Built Environment Today. Retrieved from https://www.ashrae.org/technical-resources/bookstore/standard-90-1

Batt, H. A., & Merkley, G. P. (2010). Water management and user association analysis for irrigation improvement in Egypt. Irrigation and drainage, 59(2), 150-160

Brown, C. (2016). How to size a PV system from an electricity bill [Aurora blog]. Retrieved from http://blog.aurorasolar.com/how-to-size-a-pv-system-from-an-electricity-bill/

Braun, A. (2017). Stromspiegel für Deutschland, 2017. Berlin: co2online gemeinnützige GmbH. Retrieved from https://www.die-stromsparinitiative.de/fileadmin/bilder/Stromspiegel/broschuere/Stromspiegel_2017_web.pdf

Bufeno, M. (2017). The Mirage: Dreams of utopia in the deserts of Egypt and greater Cairo's chaotic reality. Retreived from http://dar.aucegypt.edu/handle/10526/5004

Cairo Solar (2017). Home/Commercial Packages - On grid systems for all loads. Retrieved from http://www.cairo-solar.com/home-commercial-packages/

CAPMAS. (2013). Average per capita of consumed pure water. Retrieved from http://www.capmas.gov.eg/Pages/IndicatorsPage.aspx?page_id=6151&ind_id=2361

CAPMAS (2017). Egypt Statistics. Retrieved from http://www.capmas.gov.eg/

Egypt - Language, Culture, Customs and Etiquette. (n.d.). Commisceo-global.com. Retrieved from https://www.commisceo-global.com/country-guides/egypt-guide

Egypt Independent. (2017). Egypt increases cost of water by up to 50%. Retrieved from http://www.egyptindependent.com/water-prices-increased/

Egypt Vision 2030. (2015). Arabdevelopmentportal.com. Retrieved from http://arabdevelopmentportal.com/sites/default/files/publication/sds_egypt_vision_2030.pdf

Egyptian Electric Utility for Consumer Protection and Regulatory Agency. (2016). Feed-in tariff for wind and solar PV projects (Egypt). Retrieved from http://egyptera.org/Downloads/taka%20gdida/Download%20Renewable%20Energy%20Feed-in%20Tariff%20Regulations.pdf

Essam Al-Din, M. A. (2003). Evaluation of the Egyptian Experiment in Establishing the New Towns in the Desert Areas." Journal of Engineering Sciences (JES) 31 (1). Assiut University.

Fahmi, W., & Sutton, K. (2010). Cairo's Contested Garbage: Sustainable Solid Waste Management and the Zabaleen's Right to the City. Sustainability, 2(12), 1765-1783. Retreived from http://www.mdpi.com/2071-1050/2/6/1765

Faraj, M. (2016). Arab Industrialization: 1690 pounds price of solar panels including taxes [Al Borsa News] (in Arabic). Retrieved from https://alborsanews.com/2016/10/26/917197

Gharipour, M. (2012). "The Culture and Politics of Commerce," in The Bazaar in the Islamic City: Design, Culture, and History, Mohammad Gharipour (ed.), New York, The American University in Cairo Press

Google Earth. (2018). Cairo 30°02'39.91"N and 31°14'08.56"E. [Software]. Retrieved from https://www.google.com/earth/

Google Maps. (2018). Sheikh Zayed City. Google Maps, Google ORION-ME. Retrieved from https://www.google.com.sa/maps/place/Sheikh+Zayed+City,+Giza+Governorate,+Egypt/@30.0411676,31.0070694,1298m/data=!3m1!1e3!4m5!3m4!1s0x14585a29f1b324d9:0xc5c5525706430b8d!8m2!3d30.0491629!4d30.9761599?hl=en&authuser=0

GOPP (2012). Greater Cairo Urban Development Strategy. Retrieved from http://gopp.gov.eg/wp-content/uploads/2015/07/1CFV-EN.pdf

Gunsilius, E., Spies, S., & García-Cortes, S. (2011). Recovering resources, creating opportunities. Integrating the informal sector into solid waste management. The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.giz.de/en/downloads/giz2011-en-recycling-partnerships-informal-sector-final-report.pdf

Hassan Y. (2017). From trash to treasure: Egypt's new recycling initiative triggers dispute with millions of garbage collectors. Egyptian Today article. Retrieved from https://www.egypttoday.com/Article/1/4027/From-trash-to-treasure-Egypt%E2%80%99s-new-recycling-initiative-triggers-dispute

Hegazy, I. R., & Moustafa, W. S. (2013). Toward revitalization of new towns in Egypt case study: Sixth of October. International Journal of Sustainable Built Environment, 2(1), 10-18

Hegazy, K. (2015). Egypt's Energy Sector: Regional Cooperation Outlook and Prospects of Furthering Engagement with the Energy Charter (pp. 2-3). Brussels, Belgium: Energy Charter Secretariat, Knowledge Center. Retrieved from https://energycharter.org/fileadmin/DocumentsMedia/Occasional/Egypt_and_the_Charter.pdf

Hoornweg, D. and Bhada-Tata, P. (March 2012). "What a Waste - A Global Review of Solid Waste Management", Urban Development Series. Knowledge Papers, No. 15. The World Bank. Retrieved from https://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/

What_a_Waste2012_Final.pdf

IEA/IRENA Joint Policies and Measures database. (2016, 9 1). New National Renewable Energy Strategy. Iea.org. Retrieved from http://www.iea.org/policiesandmeasures/pams/egypt/name-24583-en.php?s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-SG9tZTwvYT4gJnJhcXVvOyA8YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy8iPlBvbGljaWVzIGFuZCBNZWFzdXJlczwvYT4gJnJhcXVvO

Kipper, R., Fischer, M. (2009). Cairo's Informal Areas Between Urban Challenges and Hidden Potentials. - Facts. Voices. Visions. GTZ Egypt

Kraas, F., Leggewie, C., Lemke, P., Matthies, E. (2016). Humanity on the move: Unlocking the transformative power of cities Flagship report. Berlin: Wissenschaftlicher Beirat d. Bundesregierung Globale Umweltveränderungen

Lerner, J. (2016). Urban Acupuncture. Island Press

Mahdy, M., Barakat, M. (2017). Thermal Behaviour Assessment for The Different Building Envelope Parts In Egypt Under Climate Change Scenarios [Journal of Engineering Science and Military technologies] Volume (1), Issue (2). ISSN: 2357 - 0954. doi: 10.21608/ejmtc.2017.396.1003. Retrieved from http://ejmtc.journals.ekb.eg/article_4152_de78a4f44f71e81d0ebb094afefe32da.pdf

Mahdy, M., Nikolopoulou, M. (2013a). The cost of Achieving Thermal Comfort via Altering External Walls Specifications in Egypt; From Construction to Operation Through Different Climate Change Scenarios. [Proceedings of BS2013: 13th Conference of International Building Performance Simulation Association, Chambéry, France, August 26-28.] Retrieved from http://www.ibpsa.org/proceedings/BS2013/p_1343.pdf

Mahdy, M., Nikolopoulou, M. (2013b). Evaluation of Fenestration specification in Egypt in terms of Energy Consumption and long term cost effectiveness. [Sciencedirect - Energy and Buildings 69 (2014) 329 -343]. Retreived from https://www.academia.edu/28213531/Evaluation_of_fenestration_specifications_in_Egypt_in_terms_of_energy_consumption_and_long_term_cost-effectiveness

MENA. (2017). Water Crisis in Egypt. Retrieved from https://www.ecomena.org/egypt-water/

Mg solar shop (2017). SMA solar inverter. Retrieved from https://www.mg-solar-shop.de/solar-inverter/sma-solar-inverter/

Ministry of Environment (2018). Ministry of Environment - EEAA. Urban Communities. Eeaa.gov.eg. Retrieved from http://www.eeaa.gov.eg/en-us/topics/management/development/urbancommunities.aspx

Morel A., Diener S. (2006). Greywater Management in Low and Middle-Income Countries, Review of different treatment systems for households or neighborhoods. Swiss Federal Institute of Aquatic Science and Technology (Eawag). Dübendorf, Switzerland

NUCA (2018). Sheikh Zayed City. New Urban Communities Authority. Newcities.gov.eg. Retrieved from http://www.newcities.gov.eg/english/New_Communities/Zayed/default.aspx

Osman, R., Ferrari, E. and McDonald, S. (2016). Water Scarcity and Irrigation Efficiency in Egypt. Water Economics and Policy, Vol.2, No.3

Othman, Z., Aird, R. and Buys, L. (2015). Privacy, modesty, hospitality, and the design of Muslim homes: A literature review. Retrieved from https://www.sciencedirect.com/science/article/pii/S2095263514000740

Sharifi, A. (2016). "From Garden City to Eco-urbanism: The quest for sustainable neighborhood development". Sustainable Cities and Society. 20: 1–16. doi:10.1016/j.scs.2015.09.002.

Sims, D. (2012). Understanding Cairo. London: I.B. Tauris

Sims, D. (2015). Egypt's Desert Dreams: Development Or Disaster? Oxford University Press

Soliman, M. (2017). Reuse of greywater in Egypt; Reality and hope. Civil Engineering Department, Aswan University, Egypt, p.2. Retrieved from https://www.ierek.com/wp-content/uploads/2017/07/Reuse-of-greywater-in-Egypt-submitted.pdf

Sterner, C. (2014, July 03). Six Metrics Every Architect Should Know (And How to Use Them). Retrieved from http://sefaira.com/resources/six-metrics-every-architect-should-know-and-how-to-use-them/

Sunprism (2017). PX Series 260-270 Wp. Retrieved from http://sunprism.solar/en/wp-content/uploads/2018/01/Polycrystalline-60-Cells-Series-260-270.pdf

Sušnik, J., Vamvakeridou-Lyroudia, L.S., Gebert, N., Kloos, J., Renaud, F. La Jeunesse, I., Mabrouk, B., D.A. Savić, Kapelan, Z. Ludwig, R., Fischer, G., Roson, R., and Zografos, C. (2014). Interdisciplinary assessment of sealevel rise and climate change impacts on the lower Nile delta, Egypt, Science of the Total Environment, Vo. 503, pp. 279-288

Tahrin News. (2017). Water Supply Bills in Egypt. Retrieved from http://www.tahrirnews.com/posts/815342/%D9%81%D8%A7%D8%AA%D9%88%D8%B1%D8%A9+%D8%A7%D9%84%D9%85%D9%8A%D8%A7%D9%87+%D8%A7%D9%84%D8%B4%D8%B1%D9%83%D8%A9+%D8%A7%D9%84%D9%82%D8%A7%D8%A8%D8%B6%D8%A9+%D9%84%D9%85%D9%8A%D8%A7%D9%87+%D8%A7%D9%84%D8%B4%D8%B1%D8%A8+%D8%A7%D9%84%D8%B5%D8%B1%D9%81+%D8%A7%D9%84%D8%B5%D8%AD%D9%8A++%D9%85%D8%AC%D9%84%D8%B3+%D8%A7%D9%84%D9%88%D8%B2%D8%B1%D8%A7%D8%A1+

Tilley, E. (2014). Compendium of sanitation systems and technologies. Dübendorf: Swiss Federal Institute of Aquatic Science and Technology (Eawag)

TPS (2017). SMA Solar - Sunny Tripower 30000TL, 30kW Three Phase Solar Inverter - 2 MPPT - AFCI, Optitrack with Monitoring - 480VAC [The Power Shop]. Retrieved from https://www.thepowerstore.com/sma-sunny-tripower-30000tl-30kw-three-phase-solar-inverter-2-mppt-afci-optitrack-with-monitoring-480vac

UN-Habitat – United Nations Human Settlements Programme (2014). The State of African Cities. Re-Imagining Sustainable Urban Transitions. Nairobi: UN-Habitat

USGoBuy (2017). US to Egypt via DHL. Retrieved from http://www.usgobuy.com/en/dhl/shipping-us-to-egypt.html

World Bank (2015) Report No.: PIDC18002. Retrieved from http://documents.worldbank.org/curated/en/245761468024247659/pdf/PID-Print-P152961-01-05-2015-1420469398757.pdf

Zaki, T., Kafafi, A. G., Mina, M. B., Abd El-Halim, A. El-H. M. and Saber, M. (2013). Annual Report for Solid Waste Management in Egypt. New center for Integrated studies of Land & Environment (NILE). Retrieved from http://cairoclimatetalks.net/sites/default/files/EN%20Annual%20Report%20on%20Waste%20in%20Egypt_2013.pdf

Photo collage, Cairo (Authors, 2017)

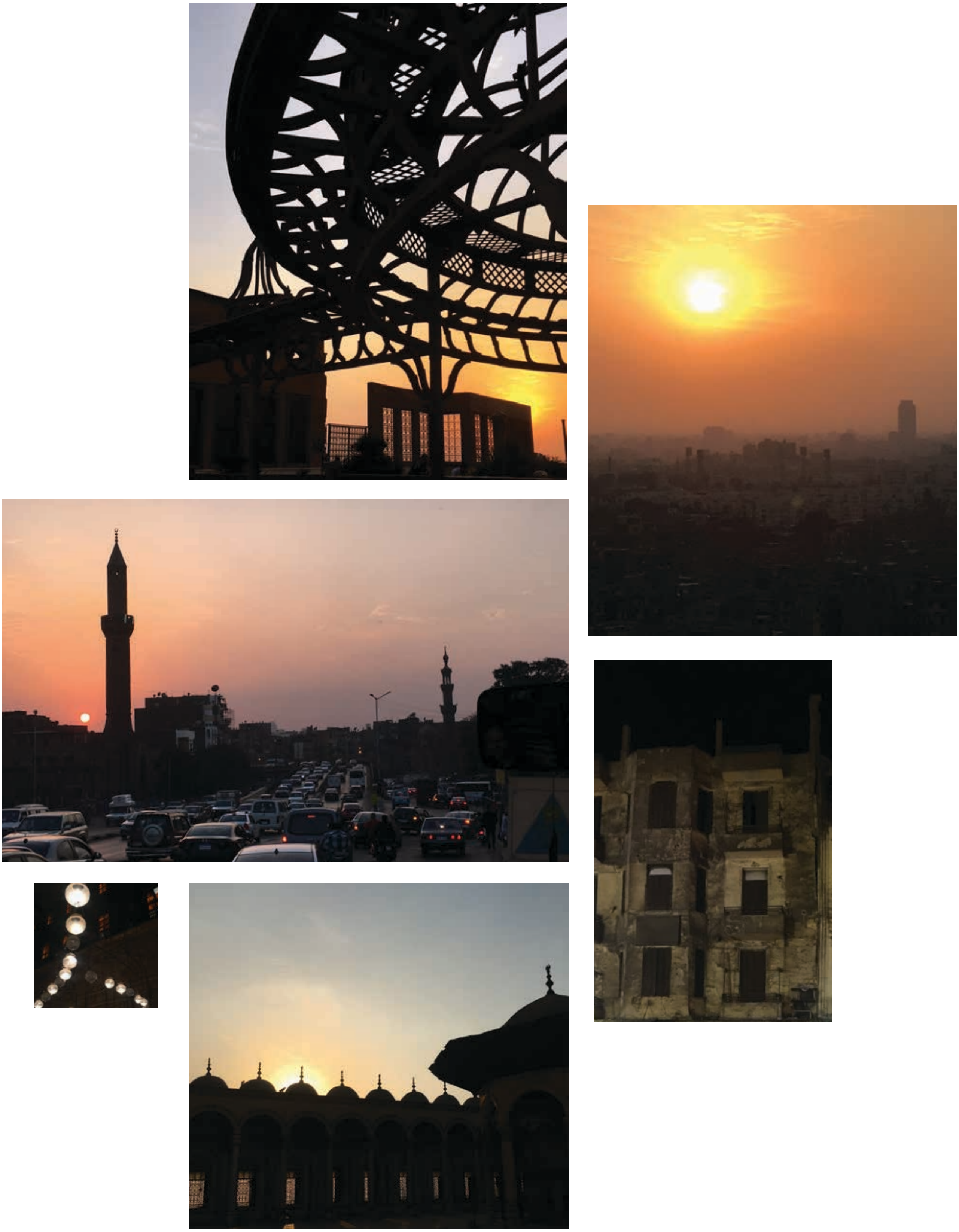


Photo collage, Cairo (Authors, 2017)

Greater Cairo is facing the challenges of urban growth and physical expansion on desert land. This brochure focuses on sustainable interventions for the satellite city of Sheikh Zayed, elaborated by the 8th generation of REAP students in collaboration with the Cairo University Faculty of Architecture.

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