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# Integration the Solar Energy with Residential Buildings within Smart Cities - Gulf Countries

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**Abstract**

Solar energy has proven that new technologies in the field of renewable energy are prosperous and advanced. The home's prosperity and solar systems don't contradict with idea of a perfect ecosystem. Knowing the potential of solar energy is prompt to discovering new services. The utilization of solar energy in housing for cooling, heating, lighting, and water heating increases efficiency and saves power. The high consumption rates per capita in the Gulf countries support dealing with solar energy and employing it in the future vision. Referring to Masdar city in the case study illustrates the integration of solar energy into the gulf country's housing. Al Falah Complex Housing is another case study of a sustainable, scalable project. Solar systems in smart cities are a series of steps represented in the infrastructure, materials, networks, sensor systems, security, and consumption.

**Keywords**: Residential Buildings, Solar Energy, Technology

## Güneş Enerjisinin Akıllı Şehirlerdeki Konut Binalarına Entegrasyonu - Körfez Ülkeleri

**Özet**

Güneş enerjisi, yenilenebilir enerji alanındaki yeni teknolojilerin müreffeh ve gelişmiş olduğunu kanıtlamıştır. Evin refahı ve güneş sistemleri, mükemmel bir ekosistem fikriyle çelişmez. Güneş enerjisinin potansiyelini bilmek, yeni hizmetleri keşfetmeye teşvik eder. Güneş enerjisinin konutlarda soğutma, ısıtma, aydınlatma ve su ısıtma için kullanılması verimliliği artırır ve enerji tasarrufu sağlar. Körfez ülkelerinde kişi başına düşen yüksek tüketim oranları, güneş enerjisinin ele alınmasını ve gelecek vizyonunda kullanılmasını desteklemektedir. Vaka çalışmasında Masdar şehrine atıfta bulunulması, güneş enerjisinin körfez ülkesinin konutlarına entegrasyonunu göstermektedir. Al Falah Kompleks Konutları, sürdürülebilir, ölçeklenebilir bir projenin başka bir vaka çalışmasıdır. Akıllı şehirlerdeki güneş sistemleri, altyapı, malzemeler, ağlar, sensör sistemleri, güvenlik ve tüketimde temsil edilen bir dizi adımdır.

**Anahtar Kelimeler**: Konut Binaları, Güneş Enerjisi, Teknoloji

## 1. Introduction

In the fourth revolution, the technology and development of housing have increased. The annual energy consumption rate by buildings is 55%, which exceeds the consumption of all other sectors. Buildings aspire to have adequate power, unlimited and environmentally friendly. Solar energy has occupied a high position with satisfying basic and luxury needs. The consortium of architecture and technology supports the concept of buildings that use efficient solar energy in house services. The presence of water heating, cooling and heating systems powered by solar energy is a healthy investment for all living creatures. The amount of consumption determines the options and ways to supply solar energy to residential buildings. Smart cities support renewable energy through vital infrastructure Internet networks and develop ideas that raise solar power to a level of modernity. Development and future vision are code of intelligent cities that depends on solar energy to a large extent, especially in the Gulf countries. Smart

cities have laws in reducing gas Emissions, so they reinforce existing houses within healthy and developed environment systems. The paper aims to clarify the strategies and systems working by solar energy in houses that line with futuristic and intelligent city planning. The common issue is lack of problems awareness of the arising out of residential buildings advancement by using harmful energy. Burning raw materials is caused to environmental pollution and affects the life system. The paper is essential to explain the relationship of solar system technology in dwellings with a surrounding residential spot. Illustrate the abilities of solar power in residential buildings and meet the Gulf countries' population's needs. This paper balances the developed city used high technology and the population's needs by analyzing sun power generating systems. Furthermore, It provides solutions to minimize phenomena destructive to future life from acid rains, climate change, and gas emissions. Lately, solar power is the best alternative operator energy with high quality when complying with appropriate regulations and standards. The comparison of the two case studies is to improve the concept of a sustainable city only into a sustainable and developed city at the same time.

The paper presents solar energy in housing from theoretical and practical as a case study. It provides information for the compatibility of the homes with solar power, consumption data, innovative vision, presents facts to explain ideas. Literature review part appears solar energy techniques are beginning solar collectors types, ending with the services provided to the residential house in smart cities. Using a quantitative research method was in data collecting and analysis. The second step analyzes case studies in UAE to clarify the concept of research and give live examples of solar energy activation.

The terms renewable energy and sustainable energy are interrelated. Sustainable energy comes under renewable energy, enabling it to preserve it for as long as possible. Renewable energy is the reproduction of the same energy continuously, but sustainable energy keeps energy for the longest possible time (J.M.K.C. Donev et, 2020).

The whole world is interested in the field of alternative energies. Brundtland's report in 1987 included the progress that society has reached as a result of meeting current needs, while the next generation will inspire new systems that keep pace with future aspirations. It realized the extent of energy activities and integrated with all areas. The use of sustainable materials is one term of an agreement issued in 1992 from the first universal agreement. The use of sustainable materials is one term of a contract issued in 1992 from the first universal agreement. Since that time, expression sustainable has been used and recognized by the world (Russell, I, 2008, 121,126).

There are many types of renewable energies between wind energy, geothermal energy, solar energy, bioenergy, and fuel cells. In the renewable energy world, every kind of energy has compatible in a specific sector (REN21, 2020, 24). Wind energy is powered depending on wind speed, geographical location, and wind turbines site. Wind energy overrides three phases to arrive at operating energy, firstly kinetic energy, secondly mechanical energy lastly electrical energy. It faces many difficulties thru opening a new project. The problem is the raised estimated amount of investment, the difference in building heights, Infrastructure weakness (ANDERSEN, A, 2017, 14-15).

Fuel cells are a mixture of hydrogen with oxygen in specific proportions to create a reaction and energy. The environment does not negatively affect the combustion of the elements to get energy (Sealing technology, 2020).

Fuel cells' mechanism of action depends on continuous power, resembling engines that didn't store energy. The fuel cells characteristic is simplicity in a system that enables working in an energy framework. It is based on long-term and direct interactions no need for complicated steps (Besenic, T, 2016, 4). Bioenergy comes from BioSource, a combination of liquids, degradable residues, agricultural crops, gases, and micro-organisms (Ferreira, S., Moreira, N, & Monteiro, E, 2009, 1568-1569). The biofuels extraction method causes continuous increases and fluctuation in prices for agriculture crops. The instability of prices leads to a continuous increase in the prices of bioenergy and less in demand (World Energy Council, 2013, 289-291),

The deep layers of the earth contain a type of energy called Geothermal Energy. It is the result of physical properties composition within the layers of the earth without human obtrusion. It is located in Hard to reach places, including volcanic, deep oceans, mountainous regions, and the highest ice caps. Key factors determine the methods used to get geothermal energy, such as sustainability, heat sources, location, maturity energy, and state (ESMAP, 2012, 15, 16).

As for solar energy, it creates radiative energy by the meeting of proton and neutron elements. The intersection is transforming solar radiation into electrical power produced by photon absorption (M. Girvan, 2018, 45-46). Semiconductors interact with sunlight creating electrical charges that enable systems to operate (Matungwa, B, 2014, 24-25). The minimum solar energy annually that a site receives to be the best is 2800 kilowatt- hours. Between 2000 to 2800 kilowatt-hours of energy, the area was classified as only working on solar power. Middle East countries aim to have high-performance solar systems operating in different fields (Nagarajan, S, Barshilia, H, 2010, 9-10).

Using solar energy in housing indicates the ability of clean energy, reduction of damage, and operational cost. The existence of solar energy in GCC is prominent, so taking advantage of solar is support for the economy, the environment, and political sectors (PEG and CEG, 2006, 11). Choose solar energy in particular because it's the basis of all energies. In 2017, the world attracted 98 GWs of solar energy for projects. This number overrides gas, coal, and nuclear power total together (ISRA, 2019, 12, 11). Wind energy, geothermal energy, and bioenergy are either the second or third derivatives of solar energy (Kiss, G, Jansen, H, Castaldo, V, Orsi, L, 2015, 330). The most important reason for using solar energy is weather problems. Fuel emissions cause air pollution and losses of people's property and the environment. There is plankton in air particles making the atmosphere layers disorders and reducing the ozone layer (Demirbas,A ,2006, 76). Acid rain presents chemical elements found on the earth through hail, fog, rain, or snow. Precipitation of acids with chemical materials creates dangerous and corrosive substances. Previously, the damage was only affecting the surrounding area. Unlike now, acid rain has become a global threat because of Indifference to the magnitude of losses. The Material erosion index increased from 2 to 10 times faster than the impact of other pollutants (Singh, A, Agrawal, M, 2007, 15-23). Greenhouse emissions are one of the community's main issues, frequently discussed by International conferences. Greenhouse emissions caused a reduction in water level, the devastation the system of life, threatening the health of the living. The presence of small amounts of harmful energy, in the long term, causes greenhouse gas emissions. (Bastianoni, S, Pulselli,F ,Tiezzi, E, 2004, 253).

Solar energy is competitive with other renewable energies because of obtaining high potential, qualified and accurate technologies. The success of solar energy in housing is an interconnected chain that generates efficient operating

energy. Establishing a complete system at home should select the home solar generation method, either solar photovoltaics or concentrating solar photovoltaic systems. PV panels are remarkably effective, and productive capacity stays a long time. After ten years of work, the production capacity is 90%, 25 years later is 80% (Devabhaktuni, V, Alam, M, Depuru, S, Robert, C, Green, II, Nims, D, Near, C, 2013, 2-4). The (PV) panels may not grant an effective outcome when the sun's intensity fluctuates. The solution is in the most potent generator (CSP), which deals with weather changes. It is a complete advanced system that includes assembly and reception designed to collect large amounts of solar rays then Convert them to solar energy. TRNSYS program is working with data of location, space and weather to affect solar energy issued by (CSP) system. The TRNSYS program has become an essential operator for concentrating solar photovoltaic systems quickly. (TRNSYS 18, 2018, 4). Heat exchangers are the base of buildings solar collectors working to transform sun rays into solar electric power. Solar technology generally has two stationary state collectors and solar-tracking collectors. Stationary State collectors are fixed to the ground, with limited focus because they do not follow the sun's movement. The Stationary system covers four types of collectors: evacuated tube, flat plate, solar air, and compound parabolic (Kalogirou, S, 2004, 240).

Evacuated tube collector (ETC) is operating in low and high-temperature countries consist of several layers, each one having a specific characteristic. The upper layer is for the transmission and conduction of heat radiation. The next layer is for water flows and produces heat energy, and the final layer works according to convection characteristics. Flat Plate collector (FPC) contains a diverse class that starts at 75 ° Fahrenheit and reaches 785 ° Fahrenheit. The system has featured in the interior section: absorption, continuity of work, conversion radiation, equation of heat and pressure. Solar air collector (SAC) is less complex types include solar energy plates and paths for air running. The density and thermal conductivity play a significant role in improving the (SAC) performance (Hohne, P, 2017, 16). Compound Parabolic Collector (CPC) working mechanism is the proportions of the acceptance angles with indicator performance. Two or more solar collectors can be combined to increase the adequacy and meet housing needs, such as (CPC) with (FPC) (Bellos, E, Korres, D, Tzivanidis, C, Antonopoulos, K, 2016, 54). The gaining for solar energy is more than the stationary state system in the tracking system. The tracking solar systems are constructed on several axes that Provide flexibility to follow the sun's movement. It includes a single-axis design and two axes design. Single-axis design owns light sensor and motor working according to a degree of fall of the sunbeam. The tracking solar systems with single-axis are included three types of sun collectors' cylindrical trough, linear Fresnel, parabolic trough. Cylindrical trough collector (CTC) t has a large surface compared to the previous collectors. (CTC) is expensive and complicated at work, so most of the time isn't a perfect option (Hussaina, Ménézob, C, Kimc, J, 2018, 128). Linear Fresnel Collectors (LFC) designed according to wide spaces produce many energy works for HVAC systems and other home services. Linear Fresnel Collectors falls under concentrating solar photovoltaic systems. (Zhu, G, Wendelin, T, Wagner, M, Kutscher, C, 2014, 639-641).

Parabolic-trough collector (PTC) doesn't work evenly in all seasons. The outer shape is a straight line with an interspersed arched crescent and center point dividing the collector into two equal parts. The dereliction is in the autumn and spring seasons, while it works great in the winter and summer. It can apply to the parabolic trough with other types of collectors to raise energy production capacity (Fuqiang, W, Ziming, C, Jianyu, T, Yuan, Y, Yong, S, Linhua, L, 2017, 1315- 1316). More energy is extracted by the collector's two axes design involving parabolic dish

reflector and Heliostat field collectors. Annual, the produces energy is more than one-axis design collectors as much as 36% and stationary state collectors about 48% (Prinsloo, & Dobson, 2015, 26-27). Parabolic dish reflector (PDR) has a high capabilities job mechanism that matches home systems. The solar collector consists of structure and condensed, has uniqueness in reflectors system, potent, resistance to wind, and long life. Heliostat field collectors (HFC) work as integral sets of external shapes of altazimuth mount and concave mirrors. The heliostat system obtaining concentration ratio from 300 to 1500 stored excess heat and was used when necessary. Receiving tower is the control center of the heliostat system surrounded by sun-absorbing surfaces and reflectors (Kalogirou, S, 2004, 251-252).

The main objective of installing solar collectors over homes is to continue prosperity and enable housing systems to work on solar power. It is affected positively on consumption and efficiency and reduces wasted electricity. The essential home services are water heating, optical technology cooling, and heating systems. The heating water in residential buildings is done through solar collectors by converting sun energy to heat. It is it works separately from the rest of the home systems. It falls under the water heating systems, active systems, and passive systems. The operational system applied the antifreeze category of environmentally friendly for transferring thermal energy into the water. Water heating systems contain five branches that work according to the amount of water and the purpose, such as the swimming pool, different from washing clothes. The active section includes direct circulation, indirect water heating, Pumped Circulation, air-water heating, and Pool heating systems. The passive system depends on gravity to move the fluid without the intervention of pumps. The mechanism of labor uses the sun heat, unlike active pumps that rely on the sun on together with exterior materials. Passive systems are designed to work with different water densities divided into thermosyphon solar water heaters and Integral Collector Storage (ICS) (Kalogirou, S, 2004, 258-281). Solar air heating is used less than water heating systems. After 2010 the average consumption of solar air heating and lighting is increased, 1.4% for buildings heating and 1.7 buildings solar lighting (REN21, 2020, 60-193).

Solar energy started during Einstein's research review in 1905 then expanded until 1998. Solar energy technologies continued progress and development until they spread in most countries worldwide. Solar energy is becoming related to modern technology and the ability to balance balancing housing consumption and generating power (Heffron, R, Halbrügge, S, Korner, M, Obeng-Darko, N, Sumarno, T, Wagner, J, Weibelzahl, M, 2021, 72-73). According to studies, it will increase annually by 68%. By 2050, solar energy investment will be around 6.4 trillion dollars (IRENA, 2019, 31). Protecting the energy sources, finding ways to continue, and meeting the needs are solar energy security standards. Energy security is associated with perspectives of strength, resilience, robustness, development, sovereignty (Proskuryakova, L, 2018, 203-204). The Levelized cost of solar energy is competitive compared with other energies resources. The investment cost in solar energy is entirely different from fuel energy. Fuel energy investing starts with a low capital cost, but the actual value of the crude fuel is expensive and estimated to increase annually. The initial cost of solar power is high-priced. There is no price for solar energy itself. After passing the first stage, the costs of solar energy projects will be fewer (IRENA, 2012, 30). Gulf countries' solar energy consumption is high. Compared with other countries, the consumption rate is high back to extraordinary levels of luxury. (Umar, T, & Wamuziri, S, 2016, 1-2). Coinciding with the progress in the presence of new technologies in

solar energy, this is supported by intelligent cities that complement the development system. The purpose of future smart cities is to improve life quality by improving the standard of living. The transformation of ordinary cities into intelligent cities is a set of sequential steps founding elaborate networks, advanced techniques, innovative infrastructure, and renewable energy (Awad, J, Hyder, A, Irfan, A, 2017, 44).

Smart cities arise through the alliance of a group of specialties groups to present evolving environment. When there is a developing place to live and relax in one environment called an intelligent city, it varies rated based on the size of the luxury. (Angelidou, M, 2017, 1-2). The GCC countries are actively trying to evolve future aspirations and promote several concepts. Support wireless phones, solar systems, intelligent transportation, and expand the possibilities of services. (Awad, J et al., 2017, 60-61). The invisible infrastructure section is the central part of the superstructure development, the visible section. In the invisible section, signals are sent and received through networks and control devices. Accordingly, the information will be accurate, and the services provided in the homes will be more efficient (Al-Hader, M, Rodzi, A, Sharif, A, Ahmad, N, 2009, 94)

Residential buildings are not classified as simple projects. Familiarity with economic studies, political, cultural, financial, social aspects is needs years to reach the desired result. Adding residential buildings to intelligent cities increases the task's difficulty and the accuracy of planning. (Santamouris M, & Cartalis, C, 2017,130). Systems are connected and programmed, making housing technology and artificial intelligence techniques easy to utilize. The function of underground networks is to serve a large geographical area and provide the highest comfort levels. Detail the communication technology in more depth shows the two parts connected to residential homes, either wireless or wired (Haidie, A, Hassani, S, Aqqal, A, El Hannani, A, 2016, 61-64). Selecting an appropriate network is a starting point in order to deal with advanced home- based systems through an operating system. The home energy management system is working automatically. It controls and turns on the systems by using solar energy technologies produced. The (HEMS) saves 30 % house energy and has become a priority in developing homes. (Lobaccaro, G, Carlucci, S, & Lofstrom, E, 2016, 13).

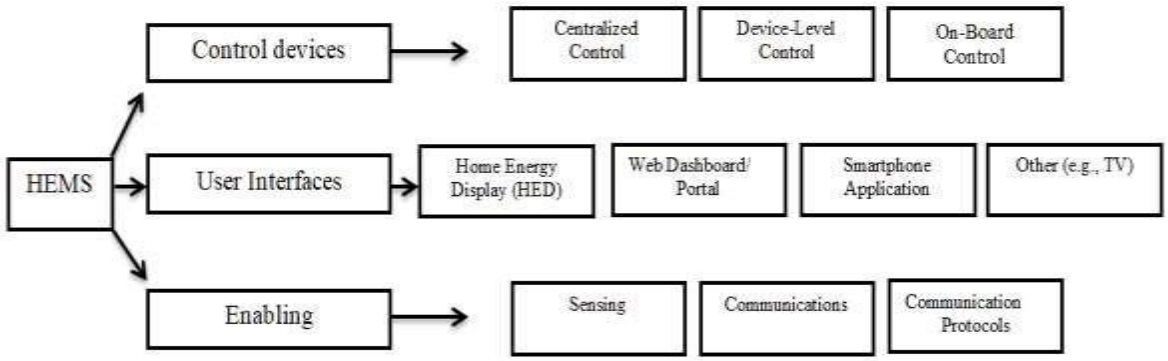


**Figure 1: The apparent details of HEM system**

The user interfaces operate to present information and data on consumption and times of use budgets. (LaMarche, J et al., 2017, 166-167). The visible HEM systems inside homes are the control device و user interfaces and enabling figure 1.

In Smart cities, the external shape of the building is no less important than the effectiveness. Modern construction methods combine the structure with solar systems named Building applied Photovoltaics (BIPV). The modern design method (BIPV) integrates the panels within different places in the house, giving it the character of overlapping construction and one structure. (Liu, B, Duan, S, & Cai, T, 2010, 1419). Solar collectors are various, so they need advanced solid systems to be activated in intelligent homes. The active houses may always need systems for supporting normal solar systems, such as cogeneration and hybrid technology design. The use of sophisticated systems increases the efficiency of a building and the ability to provide all services with high power. Homes do not always need to limit sunlight and use collectors but rather prefer creating a design that allows the sun to reach the house through direct, indirect, and isolated methods. (Ma, D, & Xue, Y, 2013, 10Despite the positive results of architectural expansion, it increases carbon emissions into the air. Paying attention to the select good and low-emission materials in housing significantly reduces environmental risk and simultaneously maintains the aesthetic form for future cities.

The study of projects in Abu Dhabi looks to uphold raising the standard of the residential complex to be an intelligent residential complex that relies on solar power. Masdar City and the Al Falah proved to enhance the residential environment vision. Sustainability, efficiency, and advanced construction are the elements represented in Masdar City. This city exposed the possibilities of advanced construction using 100% of sustainable energy. (Nambiar, S, 2011). Solar energy is the major electricity generate in Masdar city, about 93%. (Masdar (PV), 2021). The smart residential complex Masdar prepared an unrivaled facade containing several ideas for residential homes. In addition to the unusual shape, protects homes from direct rays and dust in the air (Palmer, R, 2011, 3). The residences have taken waves character in the design located on a lively street that serves the residents. Waves design creates a large area of shadows and breaks direct sunlight. (Hassan, A, M., Lee, H, & Yoo, U, 2016, 54).

In Masdar city, there are towers spread made of specific materials subject to several investigations to balance temperature and reduce thermal conductivity. (Nambiar, S, 2011). Having high technics in Masdar city aided studies and research had become a fresh air in the space.. The wind tower enhances the flow and increases wind productivity via entering air from the upper of the tower and comes out from below see fig 2. The task of the sensor system is to decide the percentage of consumption during the day.. The consumption of the natural population is indicated in blue light, and consumption above the permitted rate is marked in red light (D'Eramo, A, 2021, 10).

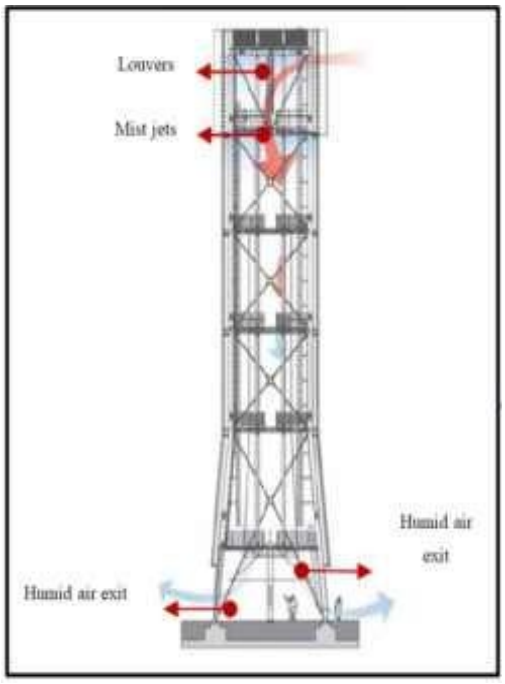


**Figure 2: Wind tower (Hassan, A, et al, 2016, 45)**

Five thousand residences are the number of houses in Al-Falah city located in the middle of Abu Dhabi city. The project is intentional to provide sustainable government housing for a large number of people. The separate units are the distinctive mark Al Falah complex includes heritage, modern form, and the Andalucia form fig 3 shown. The sizes of the residential units are various between three rooms, four rooms, and five rooms that serve the large family. Al-Falah city dwellings don't need to use high-emission materials due to the naturalness of the design. (Eyre, J, Hart, R, Connolly, G, 2013, 3-5). The speed of implementation and delivery within a short time is the goal sought by the Al Falah project, implemented through concrete structures. (Abuimara, T, & Tabet Aoul, K, 2013, 5).


**Figure 3: Al Falah Dwelling Types (Abuimara, T, & Tabet Aoul, K, 2013, 5).**

Masdar City is a personification example of an integrated city working more than 60% on solar power. Al Falah City's governmental, residential complex provides privacy and independent housing in the UAE. The existence of two different housing ideas helps find ways to support lowest capabilities housing to reaching the highest capabilities housing. There are criteria designed to improve ordinary buildings into advanced and smart buildings. The factors that move buildings to a smart level are services, dashboards and applications, data and Information, communication networks, sensors, devices, business layers, and Physical Infrastructure. These criteria support the progression of Al Falah City until becoming a landmark smart project like Masdar.

Built Masdar City was in the calculated stages during 17 years of examination, research, bring experiences from abroad. Al-Falah complex didn't take much time reduced working years in two to three years, as the five residential phases had been completed.

The urban planning of Masdar City cared on the distribution of services between housing, thus achieving the coherence of an integrated residential community. The facilities don't take one side of Masdar City, and they are scattered between houses around the institutes, close to the main streets. The transportation stations and the facilities are located in different places on a project to serve all housing sites. Al Falah City applied a repetition design plan, all sections an exact copy of the other. The existence of an active part at the specific section of the project has not served all houses. Al-Falah City didn't care to estimate the distances between residential, services facilities, main streets, and vital areas. The distances are classified as very long.

Masdar City took into consideration. Benefiting from infrastructure spaces included the provision of transportation in various forms, underground floors, and services. The goal is to support the individual’s comfort and meet

requirements in the smart city fig 4 shown. Masdar City saves water resources by 70 % due to accurate design, robust construction, and organization. Project transportation is varied between electric cars running on solar energy, underground capsule cars rapid transport, and a train. Enormous lands divided into groups of houses this is a definition of Al-Falah city urban planning. Asphalted roads separated each plot from the other.

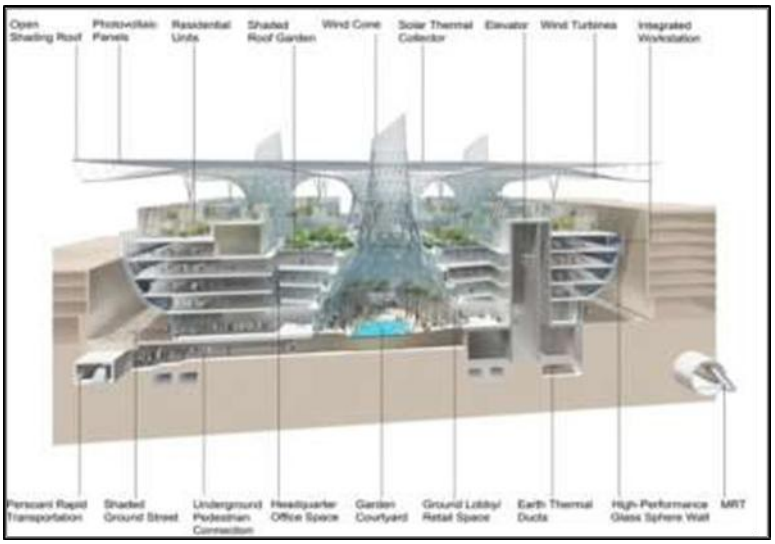


**Figure 5: Masdar City active infrastructure (Elgendy, K, 2010).**

All residences overlook the wind tower, as the wind tower has the ability to deliver the message of high consumption to all residents. The smart city works through sensors that connect the houses with the wind tower, and thus the vision becomes clear when certain levels are reached. AL Falah Complex Housing can reduce water and electricity consumption by rationalizing and controlling use. It is possible to use devices that connect homes and make a sound or light that expresses high consumption. The Masdar project chooses a place where the sun is hotter most of the day and creates buildings compatible with high power fig 5 shows. Masdar City didn't want to block the sun completely but created an interaction between the source of light and housing by passing rays through the openings. The (HEMS) works well with sustainable buildings, therefore, it is present in both projects.

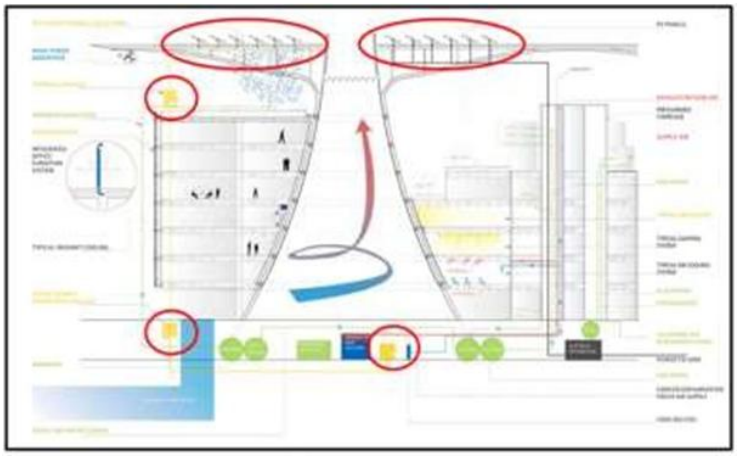

**Figure 4: Structures in the Masdar Headquarters (Elgendy, K, 2010).**

Masdar City has installed the solar panels on the opposite residential building in new ways that create a shadow on the road to protect the residents from the sun's intense rays. Provide a wind tower to renewal air quality in the city squares. Masdar city builds massive structures that interact well with the sun and support the presence of ventilation and cool air.

Al Falah Complex Housing chose to have a simple construction style free of complications while considering safety rules. Al-Falah city faced the problem of all services being gathered in one area that is difficult to access by all residents. Simple ideas can develop the environment of Al-Falah Complex Housing and improve the quality of life. Restructure two or three houses in each village and turning them into service buildings will meet the population's needs and relieve pressure on the town center.

Masdar City uses three systems to absorb solar energy, simple PV panels (CSP) and (ETC). Residential buildings and some facilities are used simple photovoltaic panels occupied 53% of the entire project. So, Masdar City uses

solar energy by 93% .through used sensor systems and reduced the water consumption was by 54%. Al Falah Complex Housing relied on simple solar systems, maybe simple solar collectors or panels connected to each residential unit separately, shown in figure 6.

In the head office of Masdar City, there are 11 columns cone-shaped connected to a wave plate from the upper part. The highest part connected between columns absorbs the solar energy to operate the project and stores the surplus. The columns reflect the sun's rays through specialized materials and enter lighting to the inner city fig 7 shown. It can be a set of simple, successful, useful, and inexpensive ideas Improvement of AL-Falah project. The presence of a half-opened glass roof allows sunlight to enter and blocks glare. This design gives expanded, ventilation and lighting to the spaces. The presence of areas including wooden pillars surrounded by trees (pergolas) will help adapt to high temperatures and applied the sustainable idea. It can help Al-Falah City's population and advance the project environment. Using more than one type of transportation will support the approximation of distances between housing and services.

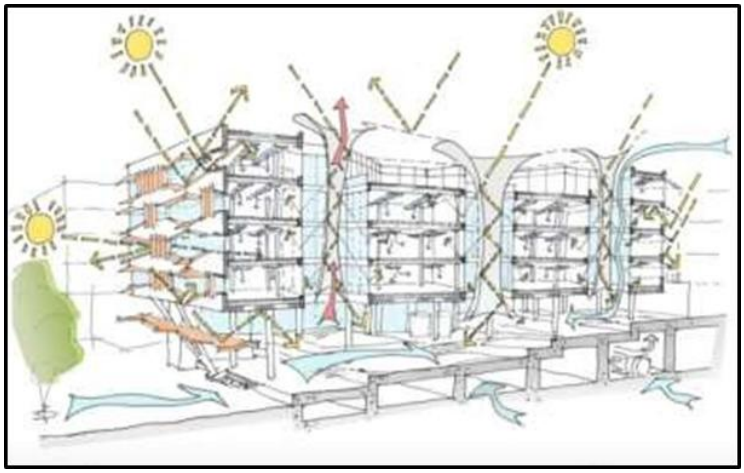

**Figure 7: Interacting structure with the sun (Elgendy, K, 2010).**

## 2. CONCLUSION

Year after year, the Gulf countries open large projects based mainly on solar energy, proving the Gulf countries' extent of progress and the high capabilities of solar power technology. It is estimated that renewable energy has expanded after the development of solar energy technology solar energy has become a requirement for sustainable homes. The houses need solar collectors to have solar energy. Their types change according to the home size, power used, consumption percentage, and building capabilities. In new construction, HVAC systems, water heating, and optical fiber are fully compatible with solar energy. The main relationship that connects solar collectors with comfort services in smart cities is strong internet lines in the city's infrastructure supported by HEMS home systems. Masdar and Al Falah city don't agree on the same goals when planning the project. After the development stages, the weakest project may reach the technology that enables it to compete. Not all projects agree on a unified basis in construction. Some of them focus on the infrastructure, and others focus on the superstructure, networks selection, materials, and others that differ from one project to another. Masdar City confirmed that living in a technology environment does not differ from relying on renewable energy and caution regarding environmental damage. The aforesaid reasons in the paper are project guidelines leading to improvement and reach success. Adequate knowledge and effective organization for investment in sun power projects provide a future vision full of achievement. Finally, sustainability and modernity are the framework for the future population environment, which gives comfort and quality. Also, improving ordinary residential environment into a developed it’s considered a future plan that supports renewable energies.

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