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Support of a SolarEnergy Applications in Urban Communities (Districts and neighborhoods)

CASE STUDY (THE EMIRATES NEIGHBORHOOD IN PORT SAID)

Ahmed Galal Mahmoud [1, *], Ashraf El-Mokadem [2], Nader Mohamed Gharib [3]

1.Architect and project manager The General Authority for Building and Housing Cooperatives- e-mail: Eng.galal2012@yahoo.com, 2.Architecture and Urban Planning Department, Faculty of Engineering, Port-Said University, Port Said, Egypt,email: elmokadem1@eng.psu.edu.eg, 3.Architectural department, and Environmental Design, ArabicAcademy For Sciences, Technology, Maritime, email: arch_nader99@yahoo.com.

* Ahmed GalalMahmoud , Email : Eng.galal2012@yahoo.com, Egypt,PortSaid

ABSTRACT : The goal of the research highlights the pressing demand for renewable energy, specifically endless solar power in Egypt to support various regions and neighborhoods in new cities and urban areas, demonstrating this through an application in a specific neighborhood of Port Said.

This research examines the implementation of solar energy solutions in urban communities, specifically focusing on areas and neighborhoods. It aims to determine the need for solar energy in all state sectors; whether residential, administrative, or industrial. Several national and international applications of solar energy systems in urban communities (Solar Cities) are examined. Through the theoretical part, the author has reached several controlling and influencing variables in supporting the use of solar energy applications for regions and neighborhoods in urban communities.The variables are the first output of the study. The study is based on two methodologies, the first of which is choosing the appropriate areas for using solar energy applications in urban communities. It was applied to one of the urban neighborhoods in Port Said (Emirates neighborhood). The second is to create a design that supports renewable solar energy applications for the selected area. The methodology ended with several design decisions for developing the Emirates neighborhood in Port Said and a comprehensive, detailed plan for the area. The results of many studies focus on the importance of using solar energy applications in urban areas and neighborhoods. This study discusses solar energy and solar systems and presents some examples of countries using solar energy applications. The pilot study for using optimum south axis orientation of the block emphasizes the shortage of roof area per block to support the needed electricity. It requires the installation of a stand-alone PV plant,or extra PV cells on other roofs in the area,such as central service buildings.

Keywords: ***Solar Energy Sources, Applications, Renewable, Non-depletable, Regions and Neighborhoods, Urban Communities***

Introduction

Since solar energy is clean, limitless, and the source of all other energy on Earth, using it as a substitute for oil has exciting possibilities. Motor power, heat, cold, and electricity can all be produced directly or indirectly from this energy. [1]

Solar energy is one of the most important sources of renewable energy. After the oil crisis in 1973, it gained the world's attention as it is a source permanent energy as long as life exists and the sun shines. Through research and development, it has become possible to reach all forms of use that humans need.[2]

The Egyptian regions and neighborhoods suffer from the lack of exploitation of renewable solar energy resources, especially in the new urban communities, and the failure to keep pace with progress and develop systems to preserve the built environment. Solutions for clean and environmentally sustainable renewable energy will provide our country with the needs for environment-friendly housing (area, neighborhood, dwelling), make it keep pace with the urban development of the new built environment, and handle the energy shortage that may lead to the collapse of our country's economies. This study introduces clean solar energy systems in new urban areas and neighborhoods and proposes solutions for developing urban areas and neighborhoods. These solutions prove that the use of clean and environmentally sustainable solar energy will develop these areas, help advance the country's economies, and promote the areas and neighborhoods of Egyptian cities, if possible, at the level of economic and social housing. [3]

As a result, utilizing solar energy sources is essential as one of the alternative and renewable energy options :

- The geographical characteristics of the Arab countries and Egypt in terms of having large quantities of solar radiation across vast areas of the desert, providing renewable, clean, and permanent energy, the abundance of sand used in the manufacture of solar cells, and its simple and well-known techniques. , -The provision of thousands of job opportunities and jobs, overcoming the unemployment problem. , - Positive environmental effects, as they are less polluted than other types. , - The availability of its material and environmental requirements in the Arab world. It may require a large capital at the beginning, but the costs soon decrease due to the initial provision of nature frequent use. , - Crises in the electricity sector resulting from the lack of fossil documents causing power outages. [4]

The study problem is the lack and scarcity of (inexhaustible) solar energy resources in new and old urban areas and districts in Egypt at the level of economic and social housing. , The research is to highlight the critical demand for renewable energy, particularly the unlimited potential of solar power, in Egypt to support regions and districts in new cities and urban areas, and to present a model by implementing it in a specific neighborhood of Port Said. , Research Methodology This study is based on the analytical method. This approach is applied by clarifying the extent of the need for alternative and renewable solar energy, as well as passive and active solar energy technologies, and presenting some examples in which passive and active energy technologies have been employed.

Research structure This study is divided into five sections. First: A historical overview of the development stages of the technology for generating electric power from the sun. Second: The advantages of utilizing solar energy as a renewable and alternative energy source. Third: The implementation of various solar energy technologies in the design process. Fourth: Results, Discussion, and Conclusion**.** Fifth :Conclusion**,** Sixth: references.

I. AN OVERVIEW OF THE DEVELOPMENT STAGES OF THE TECHNOLOGY FOR GENERATING ELECTRIC POWER FROM THE SUN.

The following explains an overview of the stages of developing technology to generate electricity from the sun.

1. Advantages of Solar Sources

Solar energy has many advantages, including:
- Solar sources are clean energy: all solar energy conversions do not produce by-products that pollute the environment.
-The enormous amount of energy carried by solar radiation: the earth receives solar energy of about (750 * 10 ^ 150) kWh annually.
- The convenience of utilizing this resource in different life sectors: the predominant applications of solar energy today are found in residential areas, farming, and the distillation of water.
- Production of Solar Energy: Electricity stands out as the most straightforward form of energy to generate, move, and utilize. In the future, solar energy has the potential to emerge as a primary source of electricity generation.
- Large-scale, substantial, and eternal energy source
- No radiation, combustion, or radioactive fuel
- Not contributing to climate pollution
- No moving parts during operation
- Working at ambient temperature
- No need to high temperatures
- The operating range is assumed to be 20 years. [5]

2. Problems of Solar Sources

The most important problems of solar energy are the constant need for cleaning dust off the solar panels, the storage and use of solar energy during night, or on cloudy or dusty days.

3. Solar Energy Applications

Solar energy can be turned into electrical and thermal energy through photovoltaic and thermal conversion as follows:
First: Thermal uses of solar energy:
- Solar water heating. [6]

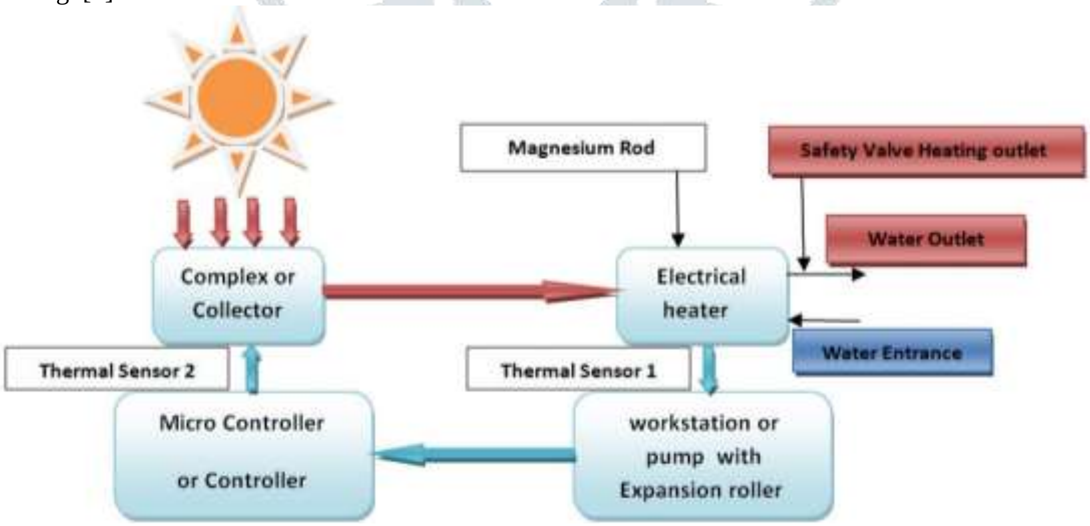


Figure (1) Solar Water Heating ,Source: Data processed by the author

- Heating swimming pools with solar energy**. ,** - Solar cooking
Second: The generation of electricity using solar energy
Photovoltaic cells can transform solar radiation into electrical power. Certain materials, like silicon, germanium, etc., are known to undergo photovoltaic conversion; these will be described in more detail. [6]

II. THE INEVITABLE REASONS TO BENEFIT FROM SOLAR SOURCES AS ONE ALTERNATIVE AND RENEWABLESOURCES.

1. Energy crisis in Egypt

Egypt suffers from an energy crisis, as follows:
1-Electricity accidents. , 2- Absence of planning.
3- Privatization: several electricity companies have been privatized during the past years, many government companies were sold, including the Steam Boilers Company, which was planned to become one of the most important boiler production companies in Egypt and the world, in addition to the leading electrical wires company, and the Hydelco and Eleject companies, which specialize in manufacturing switches and transformers.
4- The B.O.T. System: it is invented to work in two units, the first in Suez and the second in the area of Sidi Krier.This system failed because it was stipulated that the company first would build the power plant, obtain the gas at the local price, sell electricity at the world price, and deliver the station to the Ministry of Electricity after 25 years. This was disastrous because during that period the units had been worn out. A strategic commodity like electricity should not be left under the control of foreign companies.
5- The new power stations. , 6- Departure of competent staff.
7- Financial problems. , 8- Over- Employment.
9- Lack of consultants and competent staff. , 10- The Problem of Wages. [7]

2. Components of the solar system for electricity generation.

The solar power generation system consists of four basic elements:
Solar Panels (PV PHOTOVOLTAICS), charger controllers, Batteries, power inverters.[8]

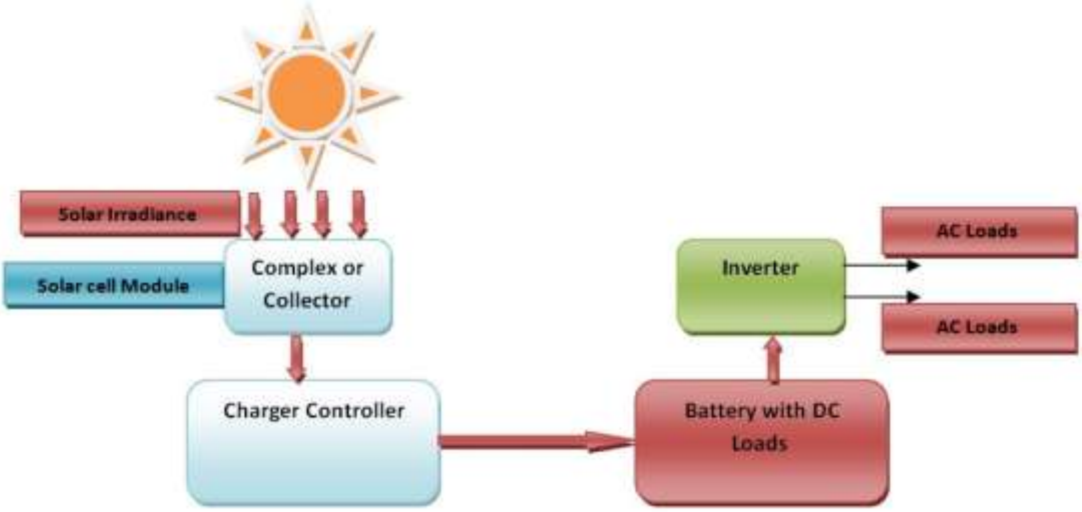
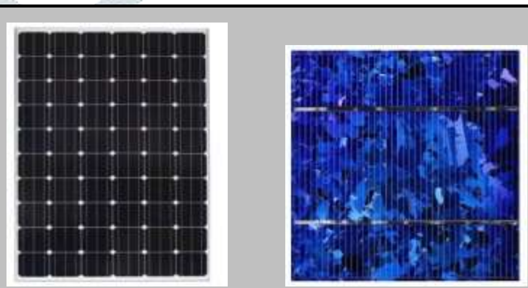


Figure (2) Components of the solar system for generating electricity , source: Data processed by the author

A - Types of solar cells:(Table 1) There are various kinds of solar cells, which can be categorized in the following ways:

(Table 1)A - Types of solar cells:	**Efficiency**	
1: Crystallized solar cells	From 0.3 m 2 to 1.5 m 2. 14%:17%.[9]	 **Figure(3) shows monocrystalline and polycrystalline cells**
A. Monocrystalline:	Efficiency up to 20%from 15-20%. [10]	
B. Polycrystalline:	efficiency ranges from 10-14%. [10]	
2. Thin cell	efficiency ranges from 7-12%. [10]	 **Figure (4) illustrates thin cell forms**
A.Multi-layer cells:	A.Efficiency ranges from 7-9%. [12]	

B.Cadmium cell:	A.Efficiency ranges from 7-10%. The absorbency layer of 1-micron thickness is 90% of light. [11]
C.Copper cells:	Efficiency reaches up to 18%. The absorbency of a 0.5-micron layer is 90% of the light. [12]
D.Gallium cells:	Efficiey of 35.6%.
3.Organicphotovoltaic cells (OPV):	Efficiency within 8%, and have efficiencies of between 12 and 15%. [12]
4. Concentrated photovoltaic cells (CPV):	Electricity efficiency at 7.4%.Its electricity generation efficiency is about 20% to 30%. [13]

Table 1-2 (EcoOne - SolarEnergy Presentation)

Figure (5) A group of organic pigment cells

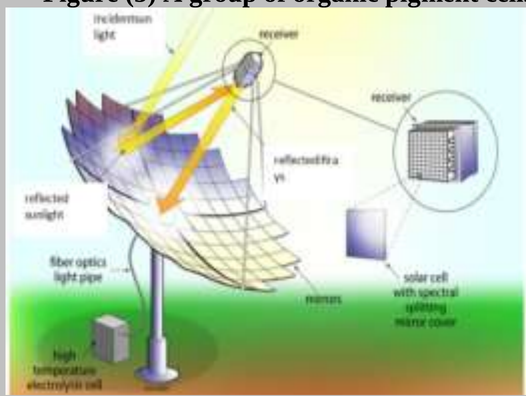


Figure (6) Concentrated photovoltaic cells (CPV)

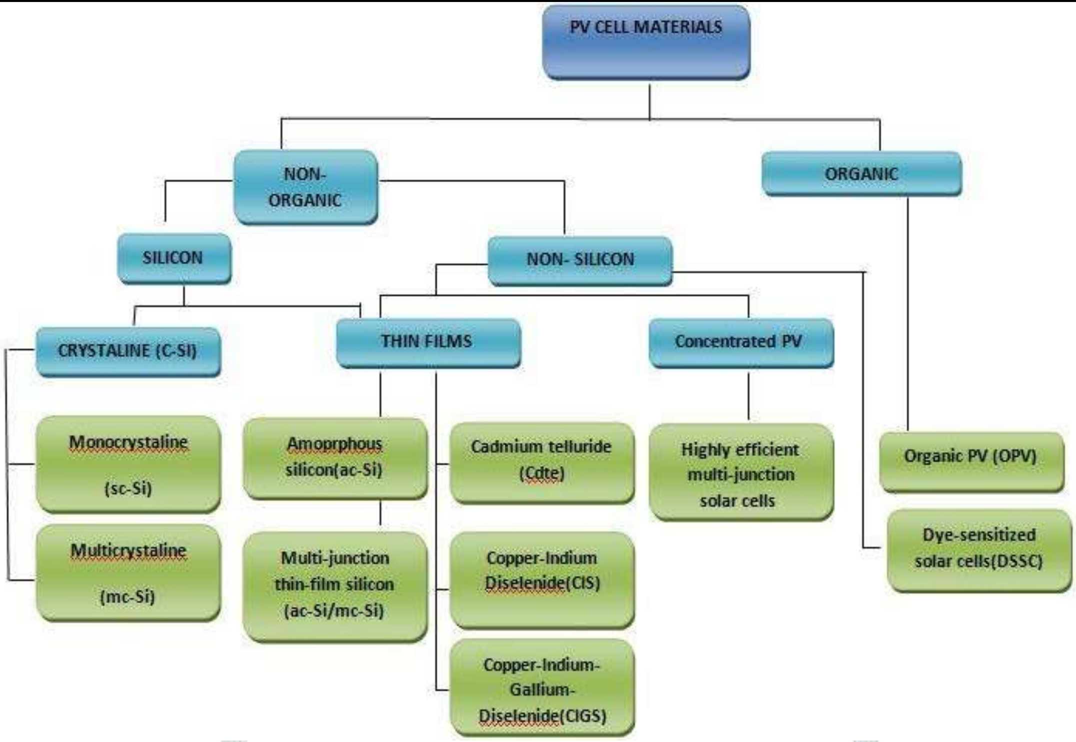
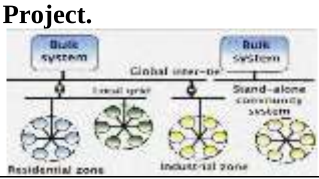
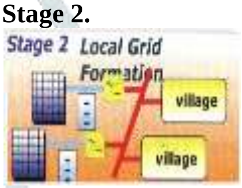
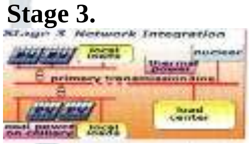
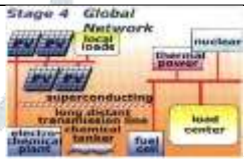
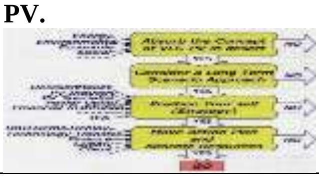


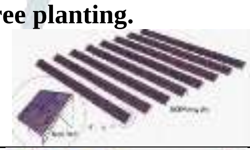
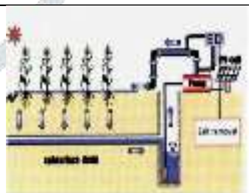
Figure (7) Illustrates the types of solar cells according to their manufacturing materials, Source Data processed by the author

III. EXAMPLES OF USING SOLAR ENERGY TECHNOLOGIES IN DESIGNING URBAN SCALE & CITIES

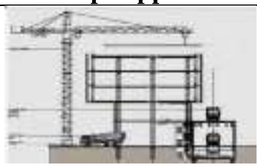
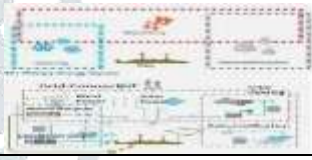
1. SOLAR ENERGY IN URBAN SCALE & CITIES

1. URBAN-SCALE SOLAR Power	**1.1 Widely Large Scale PV[VLS-PV]** **Project Title WidelyLarge Scale Photovoltaic – On the World's Deserts**
The Title of The Project: WidelyLarge-Scale Photovoltaic – in the deserts of the world	 **Figure (8) The large-scale concentrated solar collector facilities with electrical generators showcase a similar perspective as the photovoltaic plants constructed in the California desert, USA.**
Location	Villages close to deserts, Urban Outskirts, Vast aridUnused Lands, Deserts of the World's.
Work Staff	The Major Team :Peter van der Vleuten / David Faiman/Kosukekurokawa / Keiichi Komoto
General Information	Cooperation Countries:Germany, Canada, Italy, Israel, Korea, Japan, France, Netherland,and Magnolia. [14]
Project Overview	'Task 8' of this research involves examining and assessing the efficiency of very large-scale photovoltaic power generation systems, which have capacities from several megawatts up to gigawatts, and suggesting a feasible project for the future implementation of these systems.[15]
- Objectives & Justifications of the Project	The objectives of the project are to apply the system to worldly protect the environment and to use endless power in the long run. - take part basically in the needs of world energy. - participate in socio-economic growth, especially in developing nations that are desert areas. **Figure (9) Theworld Network pictureas Studied by theteam of the Project.** 

General Urban Considerations:	- Considering the widespread use and implementation of renewable energy, it is important to educate and inform government decision-makers, funding organizations, and the general public about the advantages of renewable energy sources. - Taking into account the strategies that are intended to facilitate the adoption of photovoltaic (PV) systems from small-scale installations to extensive large-scale applications. [16]	**Figure (10) The Task 8 Team with their450 KW PV System, Casalnoceto, Italy.** 
- considerations of Desert community.	- This project takes into consideration the establishment of novel sustainable societies in the desert involving PLS-PV plants. Therefore, the following issues are studied and examined: - determining if it is possible to use VLS-PV in the desert. [17]	**Figure (11) pictureof VLS-PV System in a desert placeas acomplex with planting and Tree Areas.** 
-Implementation methods:	There are three methods to be considered for spreading and making use of PV systems, as follows:1- creating a small-range system for PV; . - installing PV systems that stand alone and produce hundreds of watts for private houses, and installing systems that produce 2-10 kW on the houses' roofs, for being used (as the solar home system (SHS))in developing countries, - and, systems that produce 10-100kw on schools and office buildings,for being employed in countries based on industrialization. 2- constructing systems of mid-range which produce 100 to 1000 kW on the unexploited urban outskirts. 3- constructing larger systems that produce more than 10 MWon massive unexploited areas with high solar radiation. The whole system, there, can produce up to 1 GW.	. **Figure (12) AStage 1.** **.B Stage 2.**  **.C Stage 3.** 
The Design Stage:	The First Stage is to build an independent bulk system for facilities and areas close to deserts. figure 1-14.a The Second Stage is about far, isolated network installation. The regional grid is used to tie the germinated systems. figure1-14.b The third stage involves connecting the regional network to a main transmission line. This allows the load center and industrial zone to receive the generated power. See Figure 1-14.C. The Forth Stage is to establish a national network. Figure 1-14.d	**.d** **Stage 4.**  **Figure (13) The examination of Magnolia Desert for agricultural purposes in urban communities using VLS-PV.**
The Sources Policy:	The energy policy for the project outlines the primary practical strategies for implementing the project on a local or global scale: [18] - using the appropriate PV and setting development policies to evolve the renewable energy markets. - Initially recommending policies for applying VLS-PV. [19]	**Figure (14) verify the recommendation process regarding policy for VLS-PV.** 
- Energy Framework	**TABLE1-1**	**Brief outline of the progression of VLS-PV**
	Secondary phase	
	Technical problems	**Non-technical problems**

	S-0 Research andDevelopment stage (maybe not required for the advanced world)	- investigating proficiency of the PV systems in deserts.	- choosing the conditionally appropriate site for VLS-PV.
	S-1 experimental phase System Scale: 25 MW	- setting up the VLS-PV operation and maintenance processes	-Thriving the surrounding place of VLS-PV for stopping the expansion of deserts.
	S-2: Clarificationphase System Scale: 100 MW	- setting the technical criteria for O&M of VLS-PV.	- holding engineer training on producing at a large scale of PV and how the system production realizes the balance
	S-3 deploying phase System Scale: 1 GW	-building up the "solar bracer" concept from both technical and non-technical perspectives	
Specifications of the system:	In order to establish sustainable growth with a one GW VLS-PV system, the functional sample of the Gobi desert project was investigated. - **power source**: energy from the sun - **implementation**: VLS-PV electrical production. - **The desired system**: 1GW VLS-PV. - **kind of cellular technology**- : -the Kyocera 120s: a polycrystalline silicon PV module with a 12.8% efficiency. -**Kind of Installation :-** -flat array construction directed to the south.[20]	**Figure (15) .a 100MW System Sample of the Plant Modules.**  **.b The VLS-PV plants' conceptual model including power lines and tree planting.** 	
Examples of Installation:	Building-integrated system: - Solar house systems (SHS) are implemented on roofs in communities and nearby areas.,- Building Integrated Photovoltaics (BIPV) are built on office buildings and educational institutions' roofs and façades. System of Irrigation: System of Desalination; System of Power Plant: . [21]	 **a**  **b**	
- patterns for Installation	Integration System Development: - PV modules are employed on roofs and façades utilizing the BIVP method System of Irrigation: - utilizing the solar system for electricity with an irrigation-drainage system. Fig 1-18.a -or using the solar system for electricity with the underground irrigation method. Fig 1-18.b- - or using the solar system for electricity with drip watering with desalination. .Fig 1-18.c- System of Desalination System of Power Station.[22]	 **.c** **a, b ,c.** **Figure (16) The Irrigation System Options.**	
Lessons Learned	- The idea of installing a VLS-PV system in novel cities and deserts gives us a new perspective on how to research the desert's resources and greatly insulated solar power in these areas. - The VLS-PV initiatives give those who are responsible for making decisions the chance to reevaluate their perception of deserts and urban new neighborhoods considering them as useful sources rather than burdens.	 **Figure (17) Using of electrodialysis desalination system along with PV**	

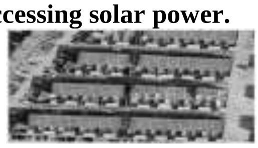
1. SOLAR ENERGY ON AN URBAN SCALE	**1.2 Case 1** **Title of Project: The Masdar city Development – Engineering of Climate for a Carbon-Neutral City**	
Title of Project:The "Masdar"city Development **– Engineering of Climate for a Carbon-Neutral City**	 **Figure (18) Masdar City, Top View as it Envisaged.**	
Location	Abu Dhabi, United Arab Emirates.	
Work Staff	**Foster & Partners, London, United Kingdom.**	
General Information	**Consultant**: Abu Dhabi Future Energy Company. **Area**: 6.5 km² - One thousand kWh/m²a of solar radiation every year. [23]	
Project Overview:	This initiative has been initiated by the Abu Dhabi Future Energy Company under the "Masdar Initiative" for generating energy. It covers 6 million square meters making use of both current technology and the walled city classical planning, to create a community that produces no waste or carbon. [24]	
-Objectives& Justifications of the Project	- The goal of this project is to demonstrate that people can live under the conditions of their environment while enhancing their living standards. [25] - It seeks to optimally take advantage of environment-friendly technologies by using the method of integration in designing and planning.[26]	**Figure (19) Masdar city, Master plan.** 
General Urban Considerations:	- taking into account the use of old Arabic cities as a model for city planning and architectural designs which concern more with humans, and the analysis of cultural context. - taking into account the current weather information, hiring climate experts for studying location structure and environment, ways to collect water, ways to make protection against the sun and sand, and conservation.[27]	**Figure (20) The city Model with the Green two parks.** 
Oriented:	- The orientation is affected by the environmental conditions and physical characteristics of the location. Thus, the perfect orientation of structures was SOUTHEAST-NORTHWEST. [28]	**Figure (21) The hopeful perspective on urban areas serves as a framework for exemplary research.** 
- Stages of Planning:	utilizations of 6 square kilometer area: -13 dedicated to trading uses, - 30% dedicated to apartments and houses.[29] - 19% dedicated to transportation and other services, -24% dedicated to the business-and-research area, - 6% dedicated to the MIST, - 8% dedicated tocultural and civic activities.[30] **Steps of the plan:** The initiation of the Masdar Institute of Science and Technology (MIST) marks the first phase in the city's seven-stage development plan.	**Figure (22) Conceptual Representation of the City. Source: Masdar Official Website** 

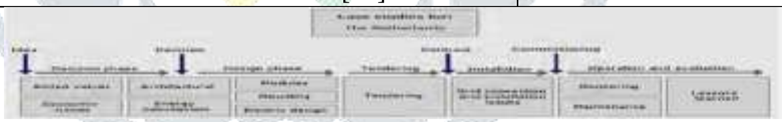
	Energy Composition: - CSP 26.0%, - PV 53.0%, - Solar Thermal Energy 14.0%, - Waste to Energy 7.0% = 320.0 MW. - Overall consumption: 30.0 kWh per person daily energy use (9.0% lower than the USA). [31]	 **Figure (23) a. comprehensive plan, landscape approach.**
	-Masdar City will use only about 8,000 m3 of desalinated water daily compared to the daily use of 20,000 m3 of the other cities. - It will have 50,000 citizens and 1,500 businesses and attract high-level experts in the field of environment-friendly power and worldwide trade.	 **. b Structure System Source: Ibid.**
The Design Stage:	-It is scheduled to achieve Masdar City in 2015. - By compact areas providing walking tracks and rest places by utilizing solar and wind control, the carbon footprint in the city is lowered. - Humid and hot weather in the streets of Abu Dhabi will be lowered by up to 20 ºC by makingthe streets narrow and full of shade.[32]	**Figure (24) Computational Model of The City. Studied Main Streets.** 
	Figure (25) Computational Model of The layers of the City Source: Ibid. 	
The SourcePolicy:	-The city needs two hundred megawatts of sustainable energy to realize a75% decrease in the capacity of power.- To supply the whole needed power to the city and the country grid, waste-to-energy techniques, Photovoltaic and Biofuel production methods, and concentrated solar energy systems are utilized. [33], [34]	**Figure (26) powerCycle and Studies.** 
- Installations Case:	- At the beginning of the city building, Photovoltaic panels with Thin-film modules will be installed in the outer station.- A Concentrated Solar Power Station is installed to produce power.,- Integrated Photovoltaic (BIPV) systems are installed on roofs after building main facilities.[35]	**Figure (27) Energy Cycle and Studies.** 
System Integration:	- Innovative technologies like photovoltaics, concentrated solar power, waste-to-energy, and the potential for biofuel production can meet all 100 % energy requirements. Moreover, supplying renewable energy to the national grid contributes to reducing carbon emissions regionally. [36]	**Figure (28) Masdar Institute interiors, shadedcourts by Photovoltaic devices.** 
Finance:	The three stagesof the program funding for manufacturing the newest version of photovoltaic (PV) modules with thin-film: - The first stage is funded with$600 million for building two factories; one factory in Germany and the other one in Abu Dhabi.	 **Figure (29) Computational model of the city,**
Learned lessons:	- The project's major schedule and the studied stages may turn it into a global role model. - With the employment of sustainable methods of energy, the integrated-system city will be an actual role model to other cities. [37]	**Figure (30) Masdar Institute interiors,Photovoltaic devices in roofs.** 

1. SOLAR power ON AN URBAN SCALE	**<u>1.3 CASE 2</u>** **<u>Project Title: Pichling Solar City, Linz, Austria</u>**	
Project Title: PichlingSolar City, Linz, Austria	 **Figure (31) Linz, Austria**	
Location	Linz, Austria	
Work Staff	**READ Group**;	
General Information	**Consultant**: Renzo Piano Building Workshop. [38]	
- Project Objectives & Justifications	- Building new 25,000 apartments for inhabitants by incorporating extensive use of solar energy.[39]	
GeneralUrban Considerations:	- A combined saving. [40]	
Oriented:	- Housing units.- By the utilization of central supporting and administrative facilities in vertical cores and integrated heat recovery, heat is decreased.[41]	**Figure (32) Linz-Pichling Residential Units** 
- Planning Stage:	- In 1992, Prof. Roland Rainer started the preparation for the comprehensive regional urban planning concept.,- In 1995, R & D was employed. The aim was to build a total of 1294 homes for 25,000 on an area of 32 hectares.	. 
The Design Stage:	- 1996: An announcement of an architectural competition.,-1997: Assignment of a landscape for the architectural competition.[42]	**Figure (33) Linz-Batteries'** 
- InstallationCases:	**Façadeand Roof Case:** - keeping high ventilation velocity spaces. **Passive Systems:** - spaces in combination city. [43]	. 
System Specifications:	**<u>Passive Houses</u>:** Making energy consumption of providing of 37 kWh newly built consume 65 kWh. [44]	**Figure (34) .a** 
Finance:	- For planning and construction, the EU gives 600,000 euros. [45]	**.b** 
Learned lessons:	- The project is an application of Learned lessons.,- The Urban Project addresses social, financial, technical, and organizational issues for the implementation stages.[46]	**.c** 

1. SOLAR ENERGY ON AN URBAN SCALE	**<u>1.4 CASE3</u>** **<u>Project Name: Solar Village in Amersfoort - Netherlands</u>**

<table>
<tr><td>Project Title: Solar Community in Amersfoort - Netherlands</td><td colspan="2">Aerial view of houses in Newlands, Amersfoort.

Figure (35) Site: A suburban development adjacent to Amersfoort, The Netherlands. [47]</td></tr>
<tr><td>Location</td><td colspan="2">Site: A suburban development adjacent to Amersfoort, The Netherlands. [47]</td></tr>
<tr><td>Work Staff</td><td colspan="2">National Architects, N.V. Regional Energy Company Utrecht (REMU) Ecofys, ENEL SPA). [48]</td></tr>
<tr><td>General Information</td><td colspan="2">The project was scheduled to commence construction in 1995 and conclude in 2002. <u>Manufacturers involved include:</u> Shell Solar, BP Solar, and BRAAS (a roofing company that utilizes Shell Solar laminates). The average annual sunshine is: 1,477 hours, which equates to about 4.05 hours per day. The average yearly temperature is: 10°C.</td></tr>
<tr><td>Project Overview</td><td colspan="2">The Netherlands has signed an agreement with electricity companies (REMU) to lower carbon emissions and provide 2% of sustainable power.[49]
Amersfoort is a novel Dutch project on fifty five kilometers in Amsterdam. In Water warrior area, it develops a 1MW PV project constructing over 12,000m^2 of modules. [50]
The basic idea is to examine the construction of a novel PV power city. Those who work on the project are tasked with proving the viability of utilizing solar power in the architectural design.[51]</td></tr>
<tr><td>- Project Objectives & Justifications</td><td>The targeted output of power is1,000,000 kWper year.
<u>The objectives of reducing the emissions of CO2 (1):</u>- Demonstrating the solar energy utilization effects on the city., - lowering the expenses of BIPV., - Clarifying how to manage the project., - showcasing the BIPV's possibilities for architecture and technology. [52]</td><td>Figure (36) .a Satellite view, Layout of Amersfoort District,
</td></tr>
<tr><td>GeneralUrban Considerations:</td><td>In the city planning stage, architects are tasked with providing creative designs considering pavements, roads, and water tracks.
-decreasing power usage., - Utilizing several passive applications inside houses. , - The axis is traversed by broad east-west and north-south roadways. ., - applying the photovoltaic systems to city designs to gain more integration benefits.[53]</td><td>.b privacy questions and accessing solar power.
</td></tr>
<tr><td>Oriented:</td><td>- The structure takes into account the accurate direction of the PV modules using the incorporation ways., -The east-west north-south axis in the roadway planning and the space between homes are taken into account.[54]</td><td>c.roofs with a Solar systemprecisely directed towards thesun.
</td></tr>
<tr><td>- Planning Stage:</td><td>Major 5-building kinds utilizing PVs are planned :- 3 primary schools of low energy., - 5 residential buildings for renting
- 19 houses employing solar power dwelt by their households., - 2 separate houses achieving balance in power use for overall power production evaluationof the area.[55]</td><td>Figure (37) Amersfoort as seen from abovedisplaying the dwelling unit distributions
</td></tr>
</table>

The Design Stage:	- The roof of a school (from 3 local schools) was provided with196 to 124 (AC) solar modules, as well as monitors for assessing the system., - The five hundred solar dwellings were built, with an average of twenty square meters of solar modules on each dwelling and one hundred W/m^2 maximum capacity., - Fifty rental dwellings employed solar power, with 5.6 m^2 of solar collectors for each dwelling. - Fifteen-KW solar or gas collecting modules are employed on each house. - 2 separate houses achieve balance in power use, -Ninety square meters is the module size, with 7,500 kWh annual energy for each house. [56]	**Figure (38) Solar panels are also utilized in urban applications and shading in Amersfoort.** 
The Sources Policy:	**The power policy:** is the generation of one MW/H throughout the following procedures:- constructing PV panels on the dwelling's facades and roofs., - Within twenty years, house owners were to buy the modules from REMU., - providing panel maintenance service and system evaluation for better production.	**Figure (39) REMU, Balance EnergyHouse.** 
- Installations Case:	**Roof Case;-** - constructing devices for collecting sun radiation utilized for warming water on dwellings., - constructing PVs oriented to the south on the sloped roof. **Façade Case;-** - well employing qualified thermal materials and passive systems for passive solar installations. **Other Case;-** - constructing solar modules on the city facilities, such as bicycle garages.	**Figure (40) Housing, Implemented Solar Cells of InRoof.** 
System characteristics:	- The photovoltaic system generates 1.323 kW for 500 residences, with monitoring data available for 44 homes featuring a 2.57 kW utility-interactive system. , - The cell technology utilized is multi-crystalline. - The module dimensions are 95 watts. [56] , produced by: Shell Solar. [56] - Each house is equipped with a central 2500-watt inverter from: Mastervolt. [57]	**Figure (41) Solar Pitched Roofs To The Sun Angle.** 
- Other Information, The Project Diagram,	 **Figure (42) Project Diagram, structureIntegrated PV–planning and implementation.**	
Learned lessons:	- Future cooperation between building companies, utilities, PV manufacturers, and city developers, is a must for developing the BIPV technology. - Checking the designed model is an elementary procedure for examining and operating the building. [58]	**Figure (43) School With Implemented Solar Cells in theRoof.** 

IV. CASE STUDY (THE EMIRATES NEIGHBORHOOD IN PORT SAID)

This is a short-term project (20 to 70 years). The neighborhood takes into consideration the new extension for Port Said city and settling the surplus and new population of the new industrial zone and the free zone.

The neighborhood contains the following Components:

- Economic Housing - level (1) *Zone (A-A), Zone (B-B)*
- Economic Housing - level (2) *Zone (E)*
- Economic Housing - level (3)*Zone (C)*
- The Main wholesale Center. (Commercial Center).*Zone (D)*

Advantages of the Site:

The neighborhood is a new urban area and a government housing model, suitable for studying solar energy applications in the industrial communities in Egypt.

Capsity and Volume : 38,160 N ~ 40,000 N

Fig 44-1 EL HEY EL EMIRATE-PORTSAID.
source: Data processed by author from (planning Ministry) and Google Earth;

4.1 Case Study Assumption
Examining the site requirements :

The Community
- In habitants of all levels of education .
- Maintenance needs .

The Current System
- Using the grid-connected system to avoid the use of batteries.
- Using high or medium efficiency Monocrystalline or 24% Polycrystalline depending on exporting of energy for the national-grid .
- 25% of the roof is designated for other uses, such as installing satellite dishes and water tanks, according to Building standards .
- Using the external facades of commercial and residential to achieve self -sufficiency and optimal production of energy and provide the grid with it .

According to recommended design criteria, the following is the examination of the EMIRATES Neighborhoods system. (Table 4-1) .

Table 4.1:Examining the Solar EMIRATES neighborhood work

TABLE 4-1	*Examining the Solar EMIRATES neighborhood work*		
CRITERIA	**URBAN SCALE**	**Evaluation**	**- Notes**
The Site	- New developmental urban region	√	**- New Architectural and technological area community**
	- New community	√	
	- New Area City	√	
The Urban Type	- Housing and Habitation	√	**- Urban Development**
Energy Accessibility	- Grid-Connected	√	**- Stable Electricity**
Objectives	- sustainable neighborhood	√	**- Achieving the principles of sustainable community for conserving the highly sensitive nature of the environment**
	- Environment-friendly Architectural Development	√	
	- Lowering the Emissions of CO2	√	
	- realizing good standard of lifestyle	√	
	- Initiatives for applying RE uses, such as Solar Energy	√	
Climate Conditions	- Moderate Climate condition (**Moderate Solar Insolation**)	√	**- the need for an architectural passive technique**
Main Considerations	- Self-sufficiency of power production and exportation through advanced phases	**N.A.**	**- The use of the PV systems makes it possible to achieve self-sufficiency and exportation of energy.**

Generation Stages of Execution	- Setting up an external power facility for electricity	√	**- Identical to VLS-PV implementation stages**
systems & Types	VLS- systems-	**x**	**- Identical to recommended panels (Silicon Technology)**
Types of Solar employment	- Building integration (BIPV)	**x**	**- Using BIPV and integration of other RE systems**
	- Power stations	√	
	- Combined techniques and systems	**x**	
Other Integrated Systems	- Warming Water inside houses	√	**- All systems are attached**
	- Wind power	**x**	
	- Geothermal power	**x**	

4.1.1 Studying The Installation of PV Models .

The followings are the studying of site components and classification of housing units, in order to determine the suitable orientated units for installing PV Modules on roof. [59]

(Fig 44-2a) Lifestyle-Level Classification Of The Emirates zones in POR TSAID.
source: Data processed by the author from Planning Ministry and Google Earth

4.2 System Specification

The former context of the city presents the feasibility of studying solar energy in the Emirates neighborhoods, which is located in the south of Port Said . The main zones of the study are shown in Figure (1-3). [60]

The main aspects of the study:

- Studying the percentage of net roof area /block related to the number of dwellings in the block and calculating the percentage of full-covered units by PV electricity.
- Studying the efficiency of neighborhood blocks by shape for using PV Cells on roofs, and the efficiency of roof area for covering the maximum number of dwelling units.
- Studying the area needed to cover the total energy of the neighborhood and recommending the needed place for installing the PV systems.
- Using high or medium efficiency Mono-Crystalline Cells with the efficiency of 24% polycrystalline.
- Using PV Modules in the area (module 1.2*0.33) with output power (250.0 watts).

From Hours of peak solar radiation 6:7 hours * 250 watt * 0.75 Efficiency factor = 1125 ~ 1312.5 Wh/Day
Efficiency factor for fixed PV Cell modules =1.4

- Using the external facades of commercial and residential buildings to achieve self-sufficiency to produce the largest amount of energy and export it to the grid
- Calculating the needed Power per unit level per day (Figure 1-3 a), (Table 4-3).

* - Level (1) needs= 5653w/h/day (For Unit = 270 m2 = 4 module = 14420.25 wh/day.
* - Level (2) needs= 4633 w/h/day (For unit = 230m2 = 4 module = 13400.25 wh/day.
* - Level (3) needs= 4315 w/h/day (For unit = 475m2 = 3 module = 13081.75 wh/day.

<u>**Tables 4.2 and 4.3 Classification of Energy needed for blocks/unit**</u>

<u>-All Calculations Related to The Energy Demands Per Unit.</u>

Table 4-2	The Energy needed for blocks/units				
Component	**Rated Wattage**	**Adjustment Factor 1.0 For Dc**	**AdjustedWattage**	**Hours per Day Use**	**Energy Per Day**
8 Lights*30watt	240	0.85	204	16	**3264**
Refrigerator	500	0.85	425	16	**6800**
3 Ceiling Fans	125	0.85	106.25	8	**850**
Dishwasher/other	600	0.85	510	2	**1020**
السخان / Washer	1500	0.85	1275	0.85	**1083.75**
Toaster/ H. Iron	1500	0.85	1275	0.25	**318.75**
TV / التليفزيون	1500	0.85	1275	0.85	**1083.75**
Total Energy (Watt-Hours/day)	**High LEVEL (1) : Shape E**	All Utilities			**14420.25wh/day**
	LEVEL (2) Blocks : Shape II	Without (Dishwasher)			**13400.25wh/day.**
	LEVEL (3) Blocks :Shape O	Wholesale Center Without (Dishwasher+ Toaster) Commercial buildings			**13081.5wh/day.**

Tables 4-2 and 4-3Classification of Energy needed for blocks/units.
Source: Data processed by the author from Planning Ministry.

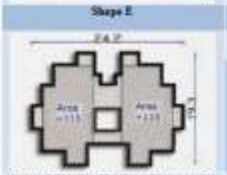
Continued Table 4-3	Total Numbers	Roof Area	Net Roof Area for PV	Total PV Area	Numbers of PV Modules	For 1 unit	For 1 Block	For all Blocks	Covered units	Un-covered units	Percentage %
Shape II 	4 Block zone D	270 M2	203 M2	812 M2	256 module (1.2*0.33) (4U*8k*2F*4B)	For unit = 270m2 = 3.09=4module= 13400.25 wh/day	214404 w/h	857616 w/h	4	0	2.44%
Shape E 	198 Block zone A 58 Block zone E 62 Block zone C	230 m2	173.5 m2	55173 m2	30528 module (1.2*0.33) (4U*6k*4F*318B)	For unit = 230m2 =3.77=4module= 14420.25 wh/day	346086 w/h	110055348 w/h	318	0	89.2%
Shape O (Wholesale Center) Commercial Building 	2 Block zone D	475 M2	356.25 M2	712.5 M2	96 module(1.2*0.33) (3U*8k*2F*2B)	For unit =475m2 = 3.88=3 module = 13081.5 wh/day	209304 w/h	418608 w/h	0	2	2.96%
Total PV forneighborhood					30880 module(1.2*0.33)		769794 w/h	111331572 w/h			111331572/(812*4+173.5*318+356.25*2*1.4) =1873.6=[illegible]

Table 4-4	Peak Power Production by untilizing PV & Needed Power for Self-Sufficiency.													
Blocks shape	Block Total Number	Roof Area	Net Roof Area	Covered Units	Un-Covered units	Covered units/City	Un-Covered units/ City	Total PV Area(all Blocks)	Number of PV Modules	Total Energy demand /Unit/ day	Needed Power/ Block	Produced Power	Extra power for Selfsufficiency Level	Percentage %
Shape II	4	270	202.5	4	0	243	237	812 M2	256	13400.25wh/day	74128 wh	60572	-59076	2.44%
Shape E	318	230	172.5	318	0	557	787	55173 m2	30528	14420.25 wh/day	135672 wh	52646	-74314	89.2%
Shape o	2	475	356.25	0	2	499	173	712.5 M2	96	13081.5wh/day	4357828 8 wh	108051	-37533	2.96%
	324			322	2	1299	1197	- 170923 watt/h						
						63.00 %	37.00%	Extra Needed Area of PV For Self- Sufficiency = 336.94 m2						

V. RESULTS AND DISCUSSION

5.1.CASE STUDY

The studies regarding the Emirates neighborhood in Port Said Governorate
help determine the potential of installing PV Cells on roofs and their capacity to provide the dwellings with the needed electricity and the number of the provided dwellings.

The Main Findings of the Study:-

1-Through Figure 1-4a, the pilot study for using optimism orientation of Block South Axis emphasizes the shortage of roof area per Block to support the needed electricity. It requires installing a stand-alone PV plant, or extra PV cells on other roofs in the area, such as The Central Service Buildings.

Results and Discussion: -

The study presents many recommendations for using PV Cells in the future, as follows:

A. URBAN SCALE / ,- General Urban Considerations,-

The requirements:

The following considerations are required:

- Using the maximum possible density of blocks to establish shadow areas in between, and providing additional areas for constructing PV Cells for the uncovered blocks and hinterland areas.
- Neglecting the needed area for roof services, (=25%) for water tanks and satellite dishesas specified in the Egyptian Building Standards, and installing Cells in the block roofs.
- Using optimal orientation (South) as possible for reducing the shortage of Electricity output.
- Cooperating with the government to support the region and to set up a station that serves the region, such as (Area D), which has commercial and administrative services.
- Using a network-connected system to avoid the use of batteries.
- Using a highly-productive power generation system to supply the grid during the day and at night.

B. Architectural Scale / Architectural Considerations

- Using of high-efficient PV cells (Mono-Crystalline Cells with an efficiency of 24%) for maximizing the energy output, if these technologies are less expensive then.
-Taking advantage of using various block shapes (E-O-II) for their efficiency and balance between the unit number and needed roof area.
- Using Pitched Roofs and infrastructure for maximizing the PV power output, in other cases.
- using as much available roof area for installing PV Cells, in order to minimize the distances of wiring cables to avoid energy losses through wiring.
- Using the external facades of commercial and residential buildings to achieve self-sufficiency to produce the largest amount of energy, and export it to the grid.
- Providing a converter to convert direct current to alternating current.
- providing tools, connections, rooms, and a converter for 1874 cells.
- Using parallel connection due to problems of series connection, including burning cells.
- providing a ppt current stabilizer to overcome the change in radiation with access to the network.

5.2 RECOMMENDATIONS

RECOMMENDATIONS FOR AREAS & DISTRICTS IN URBAN COMMUNITIES

• Distribution Network Operators (DNOs) should consider photovoltaic (PV) systems during the planning stage of new distribution networks to avoid potential voltage increases during periods of high PV generation and low energy usage.
• recommended that the PV power output be capped at 70 percent of the rated capacity of the respective feeding transformer.

Top suggestions at different project phases

These suggestions encompass all phases of advocating, designing, constructing, and maintaining PV systems in urban settings.

Policy phase – to encourage the adoption of PV in a locality

• Cultivate political support at every level, from national to local.

Project initiation

• Highlight synergies when applicable – utilizing PV for shading, as a building material, or enhancing visual appeal.

Securing funding

• Explore a wide range of funding options (both traditional and innovative): grants, earnings from electricity sales, feed-in tariffs, loans, sponsorships, solar investment funds, and community share schemes.

Design phase

• Ensure readiness for future renewable energy additions, for instance, by designing roof structures with designated mounting locations or making provisions for accessible electrical conduit pathways.

Construction/implementation

• If the project is groundbreaking for the area, ensure the design and construction are executed proficiently with input from a PV specialist.

Handover

• Provide an interface or display that conveys PV system performance and ensure users comprehend it (with visual alerts for operation issues and data on electricity generation). Also, make sure that guarantee documents are included.

Operation

• Keep information current when there are changes in building occupants or technical staff; consider whether a formal procedure is necessary.

Risk areas – initial planning

• If not included in the brief, it could lead to misunderstandings regarding the problem.

Risk areas – handover

• Changes in occupants may result in the loss of crucial information, There may be a lack of output without anyone noticing to rectify the issue.

RECOMMENDATIONS FOR STATIONS & PLANTS IN URBAN COMMUNITIES

Why VLS-PV?

- Photovoltaics (PV) stands out as a promising renewable energy solution to address global energy and environmental challenges, PV is projected to be the second-largest energy source by 2050, contributing the most to CO2 reductions among all power generation technologies.

VLS-PV is currently accessible!

- The PV market has been expanding rapidly, particularly in the latter half of the 2000s. By 2012, total global PV installations reached 100 GW, climbing to 140 GW by the end of 2013. The major PV market has transitioned from Europe to the USA, China, Japan, and other regions.

VLS-PV can deliver affordable electricity!

- The initial costs associated with PV installation have been declining. In certain areas.

VLS-PV is essential for an environmentally sustainable future!

- PV systems serve as alternative energy solutions .

VLS-PV supports sustainable social development!

- Large-scale gigawatt (GW) PV power plants will generate significant and consistent demand for components of PV systems.

How can VLS-PV serve as a primary energy source?

- The integration with other energy sources needs to be examined from a global energy supply perspective.

RECOMMENDATIONS FOR ALL

Background

• There is significant potential in the world's desert regions.

Technical aspects

• It has been demonstrated that a variety of photovoltaic (PV) systems can be utilized for very large scale PV (VLS-PV).

Economic aspects

• The current economic framework for VLS-PV remains inadequate at prevailing PV system prices without supplementary support mechanisms. Hence, it is necessary to lower the investment barriers.

Social aspects

• Developing renewable energy is a promising approach to fostering social development and is recognized as a crucial strategy in developing countries.

Environmental aspects

• Establishing a suitable green area alongside VLS-PV make lower carbon monoxide emissions, contributing to environmental mitigation.

REQUIREMENTS FOR A PROJECT DEVELOPMENT

- Define key success factors in both technical and non-technical dimensions.
- Showcase technical abilities and potential for expansion.
- Highlight economic and financial considerations.
- Present the environmental and socio-economic impacts at local, regional, and global levels.
- Create instructions or guidelines for implementing these methods. [61], [62]

GENERAL RECOMMENDATIONS

• Explore and assess potential future technical solutions for VLS-PV.

• Evaluate the local, regional, and global environmental and socio-economic impacts of VLS-PV systems from a lifecycle perspective.

• Identify key success factors for VLS-PV initiatives, addressing both technical and non-technical dimensions

• Create potential financial, institutional, and organizational frameworks along with general guidelines for practical project proposals aimed at implementing VLS-PV systems.

• The International Energy Agency (IEA) PVPS community will persist with Task 8 activities.

• The IEA PVPS community invites non-member countries to engage in discussions.[61], [62]

VI. CONCLUSION

The current study depends on many studies focusing on the importance of using solar energy application support for areas and neighborhoods in urban communities and the urban fabric. This study discusses solar energy and solar system.Then, it presents some examples of countries using solar energy applications.The study demonstrates the necessity of using solar energy applications in the regions and neighborhoods of urban communities as shown in the following results.

Table 4-5 (The Conclusion and Recommendations)	
A. URBAN SCALE / ,- General Urban Considerations,-	**B. Architectural Scale / Architectural Considerations**

The following considerations are required: - Using the maximum possible density of blocks to establish shadow areas in between, and providing additional areas for constructing PV Cells for the uncovered blocks and hinterland areas. - Neglecting the needed area for roof services, (=25%) for water tanks and satellite dishes as specified in the Egyptian Building Standards, and installing Cells in the block roofs. - Using optimal orientation (South) as possible for reducing the shortage of Electricity output. - Cooperating with the government to support the region and to set up a station that serves the region, such as (Area D), which has commercial and administrative services. - Using a network-connected system to avoid the use of batteries - Using a highly-productive power generation system to supply the grid during the day and at night.	- Using of high-efficient PV cells (Mono-Crystalline Cells with an efficiency of 24%) for maximizing the energy output, if these technologies have lower cost. -Taking advantage of the use of the various block shapes (E-O-II) for their efficiency and balance between the unit number and needed roof area. - Using Pitched Roof sand infrastructure for maximizing the PV power output, in other cases. - Necessity for using as much available roof area for installing PV Cells, in order to minimize the distances of wiring cables to avoid energy losses through wiring. - Using the external facades of commercial and residential buildings to achieve self-sufficiency to produce the largest amount of energy, and export it to the grid. - Providing a converter to convert direct current to alternating current. - For 1874 cells, tools, connections, rooms, and a converter are provided. - Using parallel connection due to problems of series connection, including burning the cell. - The change in radiation with access to the network is a problem that needs a ppt current stabilizer .

The pilot study for using optimum orientation of Block South Axis emphasizes the shortage of roof area per Block, to support the needed electricity. It requires installing a stand-alone PV plant,or extra PV cells on other roofs in the area, such as The Central Service Buildings. [63]

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