The New Role of Renewable Energy Systems In Developing GCC Electricity Market

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Abstract

Due to the present high oil prices, prices fluctuations and their future upward trend, some investments can be now directed to the utilization of solar and other renewable energy systems, such as hydrogen cells and cyclic hydro systems. It is believed that the infrastructure of these systems is particularly feasible through the already large constructions and investments in real estate industry throughout GCC countries. It is also feasible in rural areas such as farms and small villages due to the relatively low power demand and load characteristics. This can also lead to the disintegration, liberalization and privatization of energy systems. The electric energy and power disintegration of such small corporations would save resources, reduce interactions and increase reliability. This paper focuses on suggested new regulations needed to control the utilization of renewable energy systems in rural areas in order to make benefit of high oil prices. It also focuses on the category and types of renewable energy systems that can be implemented in this project.

Keywords: Oil price, Solar system, Investment, PV-Utility, Housing Complexes, Infrastructure, Ring Distribution

1. INTRODUCTION

It is apparent over the last 10 years that oil prices is taking a steady upward leap bringing the prices over a historical value of 60-70 $/barrel and more. This price can also move higher with increased demands worldwide and limited resources and raw oil reservoirs. This hick in oil prices also fluctuates chronologically with political and economical events. During this period, PV system installation costs for example, have been dropping to currently around 5 $/$W_p$. In the same time the efficiency of these solar systems is increasing during same period to around 10 ¢/kWh. The GCC countries are favorite zones for solar systems and can highly benefit from these advantages by substituting part of their conventional energy systems with solar systems.

Due to this increase in oil prices, much of the return funds have been reinvested in properties and real estate industries. Legislations have been passed to allow expatriates to own their properties in this region. There is a portfolio of housing complexes stretching throughout the gulf area. This rapid increase in real estate industries, and yet to increase even more, would initialize a rush in electric power demands. It is assumed that currently electric feeders are tied off from main busses to supply such expanded demands due to the fact that power generation stations normally require long time to be built. This makes electrical power distribution radial in nature and not circular, which reduces supply reliability and distribution control. However this can be rectified by supplying part of the power through solar systems with no time-consuming installation periods. It is assumed that this would be in favor to the customer paying the electricity bill. Normal home electrification can be achieved by PV cells, hot water by natural thermal circulation and cooling & refrigeration by hydrogen cells. Roofs of thousands newly constructed houses can be used as the infrastructure of this solar system. PV development, predicts that with a reasonable set of incentives the solar photovoltaic market in the US for

example could grow more than 30% per year over the next 20 years; from 340 MW of installed capacity to 9600 MW.

Therefore, new regulations are needed to control the integration of solar energy system with the electric grid in terms of housing, connecting and interfacing, pricing, and developing these systems. It is to be noted here that such regulations are applicable not only on newly constructed real estates but any remotely built site such as villages, communication sites and farms. The policy is that they must have solar electric supply beside utility grid feeders. These regulations may also address beneficial environmental aspects of such implementation of renewable energy systems. A comparison between fossil oil, PV and diesel units for different load types and irradiation is shown in the FIGURE 1. It is apparent that for $\$3/W_p$ PV system is competitive with either diesel or grid feeder cable extension of a few kilometers distance and for typical average daily loads of up to 100 kWh/day. This constitutes of more than 30% of the needed load for a small community area; say a residential street.

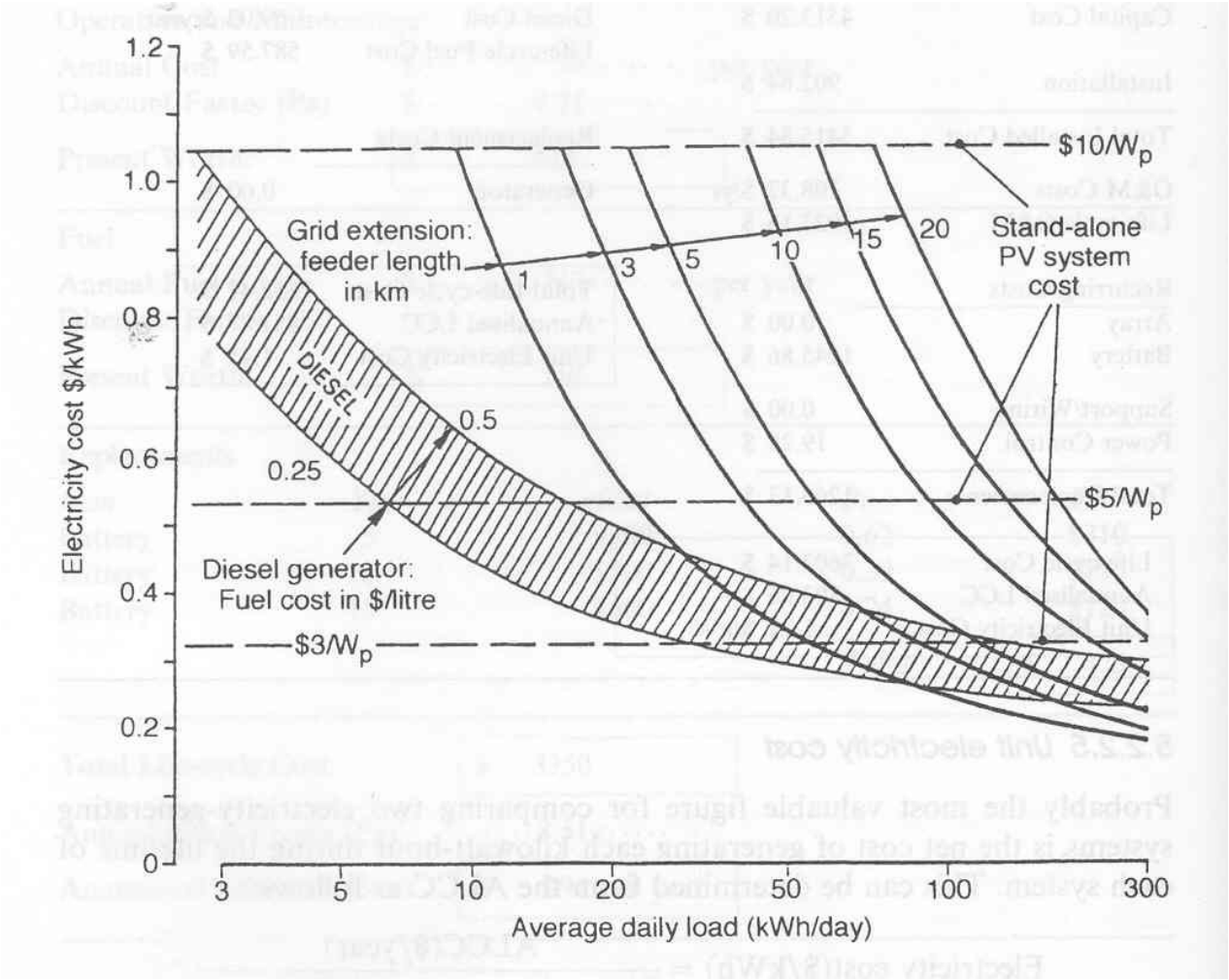

FIGURE 1: Unit electricity cost against load Comparison between PV, Diesel and Grid

OIL PRICES TREND

Oil prices have been more than tripled over the last a few decades and the trend is still up due to increasing demands and limited resources worldwide. Contrary to other raw materials, these prices experienced many fluctuations in the same period due to political and economic events. Some of these fluctuations tend to be sharp, which greatly affects energy and power planning.

FIGURE 2 depicts nominal world oil prices over the last three decades and their fluctuation events. The landmarks of these events are also shown.

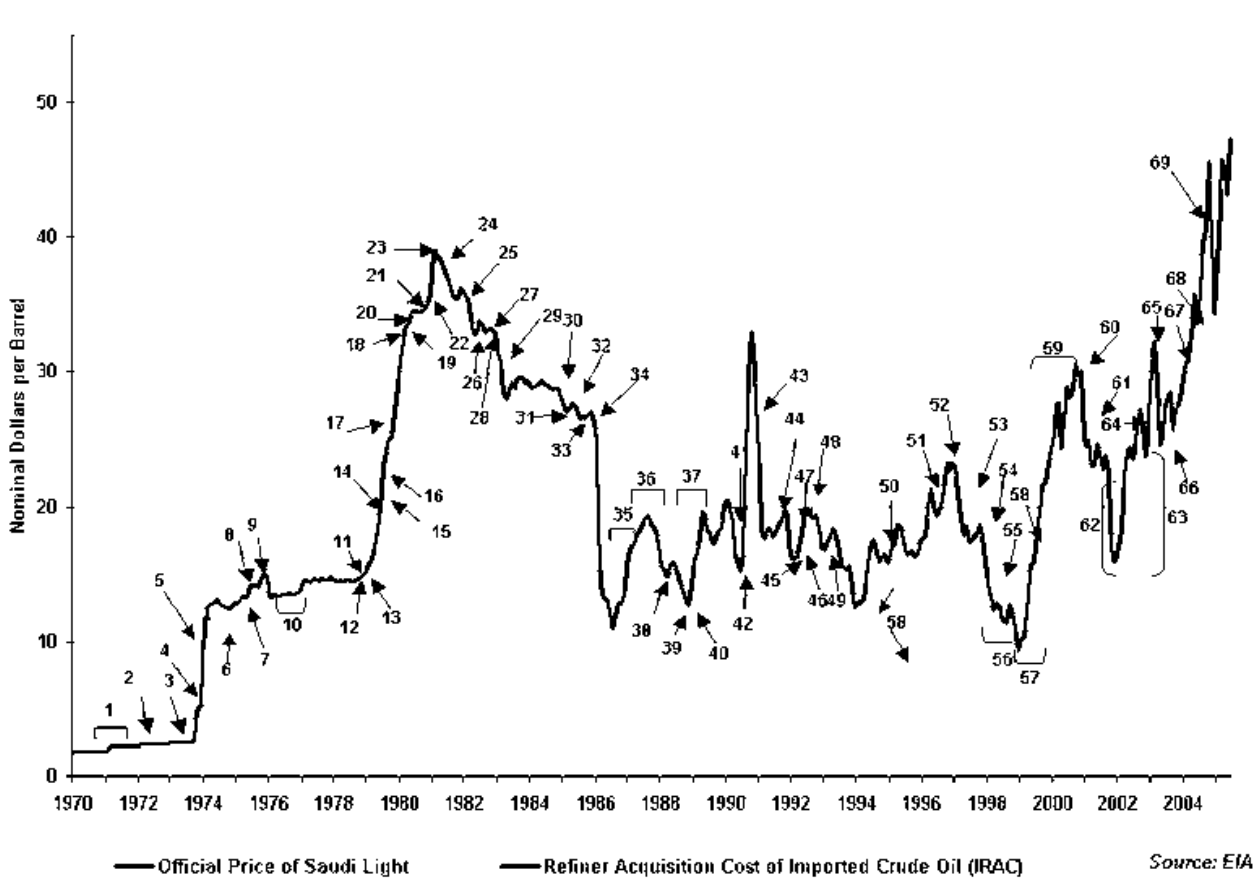

FIGURE 2: World Nominal Oil Price Chronology: 1970-2005

Currently oil price stands at 80 $/barrel and expected to rise. A lot of GCC revenues come from oil which constitutes a high value in return if pumped more to the export market and less to the local one by integrating part of the consumed energy with solar energy.

2. SOLAR ENERGY

Solar energy constitutes a primary and potential renewable energy source to all GCC countries due to high irradiation in the region. FIGURE 3 depicts this geographical fact. Solar power systems covering the area indicated by the red stars would provide the world's current total primary energy demand (assuming an available efficiency of 8 %). That is, all energy currently consumed is produced as electricity with solar cells, including heat, electricity, fuels, etc. The colors in the map show the regional solar irradiance obtained from satellite data.

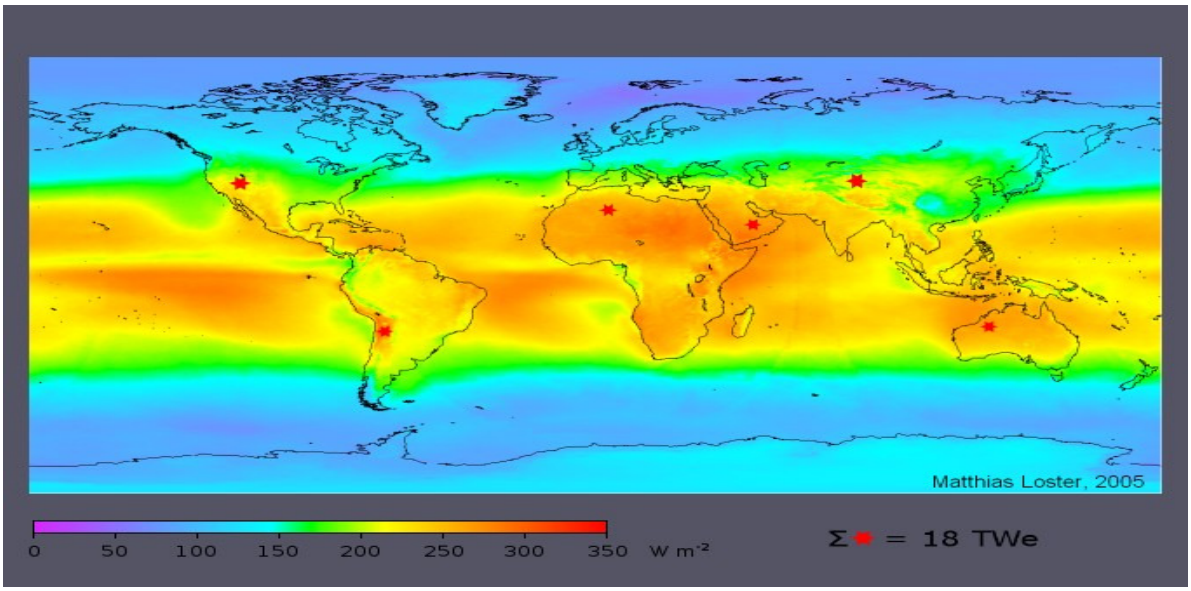

FIGURE 3: Global Solar Irradiation Map With Potential Landmarks

One study showed Photovoltaic systems installed in the areas indicated by the stars on the above map would produce an average electric output of 18 TWe, i.e. 3 TWe each when assuming a conversion efficiency from incident sunlight to electricity of 8 %. This corresponds to an energy output of 13,567 Mtoe per year (world total primary energy supply (TPES) in 2003: 10,579 Mtoe [4]). The following table lists the locations in the map to give an idea of land area requirements and availability, although the particular scenario shown is suboptimal for many political and technical reasons.

Location / Desert	Desert Size / km^2 [5]	Irradiation / $W\ m^{-2}$	Area required / km^2
Africa, Sahara	9,064,960	260	144,231
Australia, Great Sandy	388,500	265	141,509
China, Takla Makan	271,950	210	178,571
Middle-East, Arabian	2,589,910	270	138,889
South	139,860	275	136,364

America, Atacama			
U.S.A., Great Basin	**492,100**	**220**	**170,455**

TABLE 1: World Energy Production From six Assumed Areas

3. RECITES FROM PV ROADMAP

In 2001, we, the U.S. photovoltaic industry, stated a vision in solar electric power as "***providing consumers with competitive electricity generation products and services from athriving, self-sustaining domestic solar power industry.***" . Targeted goals for 2030 are solar power system costs of $2.33 per watt, solar electricity prices of 3.8 cents per kilowatt-hour (kWh) delivered to the customer, installed solar power generation of 200 Giga-watts (GW), and direct employment of 260,000 people. Recommended actions for market expansion are:

- Enact a residential and commercial tax credit that augments current state and federal support. The first 10 kW installed would receive a 50% tax credit capped at $3 per watt. Any amount above 10 kW would be eligible for a 30% tax credit capped at $2 per watt. Decreasing the caps by 5% per year will encourage a steady decline in prices and ease the transition to a market without tax credits.
- Modify the wind tax credit for solar so that it can be used in concert with the existing 10% investment tax credit.
- Establish uniform net metering and interconnection standards to give solar power owners simple equitable access to the grid and fair compensation.
- Boost federal government procurement of solar power to $100 million per year to build public sector markets for solar power.
- Support state public benefit charge programs and other state initiatives to advance solar power and build strategic alliances with public and private organizations to expand solar markets.

It can be deduced that due to recent and future developments in solar energy systems would make them very competitive with conventional ones. The following table summarizes such developments

	Unit	2005	2010	2015
Construction cost	**$/$W_p$**	**6**	**5**	**4**
Energy cost	**¢/kWh**	**15**	**10**	**8**
Efficiency	**%**	**10**	**15**	**20**
Generated power	**Annual MW**	**100**	**250**	**500**

TABLE 2: PV Systems Potential Developments

4. SOLAR ENERGY ROLE

Beside the use of cheap energy source, some of the other global benefits from a rapid and progressive transition to solar energy are:

1. It provides worldwide secure access to inexhaustible energy resources, some already at low and all at further decreasing costs: energy security. Cooperation will lead to understanding and peace rather than to armed conflicts.
2. It will reduce the dependence on a few oil and gas exporting countries and thus enhance *geopolitical stability*.
3.
4. It allows elimination of nuclear power and the continuing dangers of nuclear weapon proliferation: *strategic security.*
5. It requires the use of a variety of resources and many technologies: increased diversity for greater *supply security.*
6. Economy and reliability of supply can be improved by inter-regional exchange: Enhanced
7. It provides a timely pathway towards global greenhouse gas emissions reduction. According to the assessments of the IPCC, global emissions must begin to decrease at around 2030 to achieve global *climate security.*

In order to practically implement this, solar energy systems would be installed at thousands of newly built real estate complexes throughout the region, either as villa roof mounted, building facades or newly established community land. PV, dynamic and passive solar as well as hydrogen cell technologies can be utilized to supply part of the electricity, heating and cooling demand of such dwellings.

5. SOLAR ENERGY POLICIES

It can be deduced from above that utility grid-connected PV cells would have to be installed at each dwelling, forming a second feeder of electric supply which runs parallel to existing tie-off feeders and establishing a circular supply circuit. Appropriate metering, control and monitoring circuits are to be installed against nominal tenant fees, allowing both grid-connected and isolated stand-alone electrification switching operation. This is depicted in the following figures:

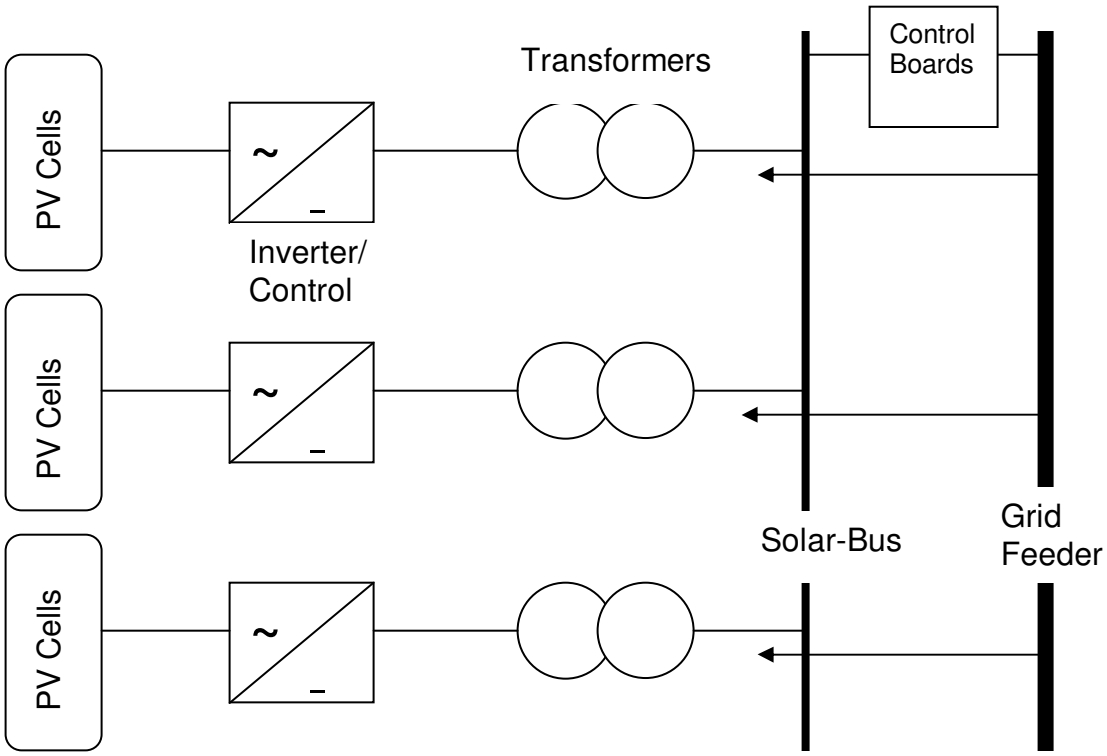

FIGURE 4: Grid-Solar Bus Connection

Besides PV cells installed per dwelling, other solar energy systems can be installed such as dynamic and passive thermal system for water heating and shedding, as well as hydrogen cells for some of the cooling power needed as depicted in the following figure. Community collective cooling system can also be integrated with these home dwellings so that one has an option to select own heating & cooling energy or relies on the electric grid.

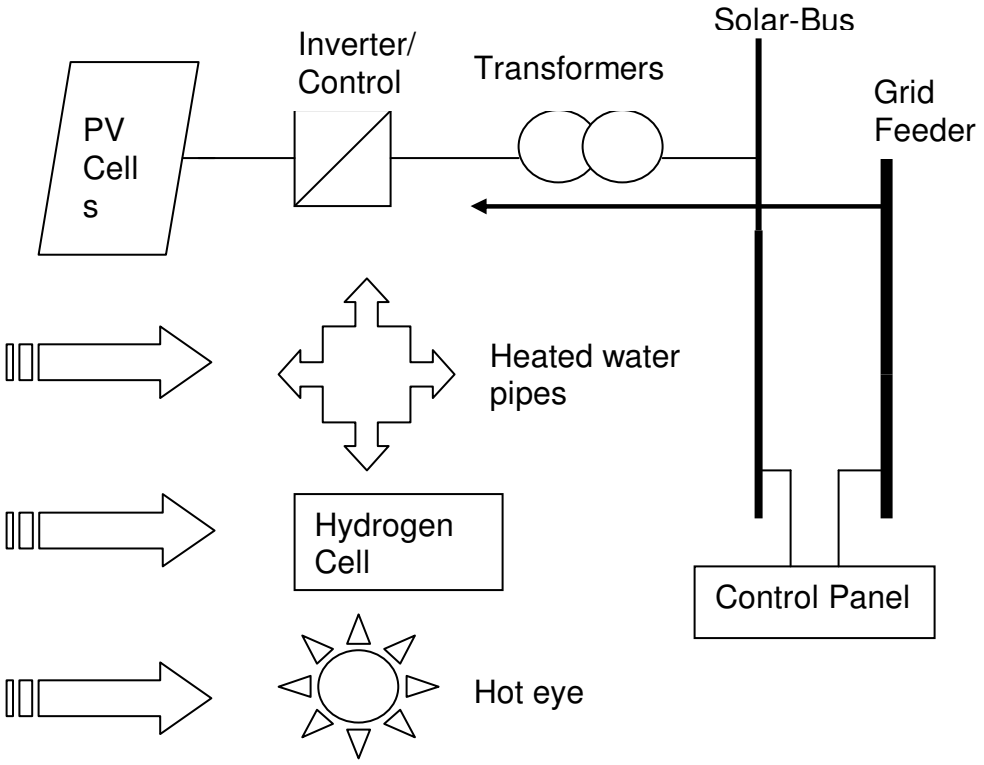

FIGURE 7: Home Dwelling Grid-Solar Electricity Connection

Since these installations are national grid properties, they are subjected to regular maintenance and monitored supervision. The occupants will receive collective energy price reduction according to community energy surplus. This would enhance the potential of solar and in general renewable energy systems in the community as a whole and improves environmental aspects in the region. Implementing a program of this size will create a substantial, new demand for the components and sub-components that go into solar systems installation.

6. CONCLUSION

It has been stressed in this paper that solar energy systems must be implemented in GCC region due to all-high and increasing and fluctuating oil prices, and decreasing solar systems with improving efficiencies on the other hand, as well as to improve environmental aspects in arid areas of heavy city concentrations with little plantations.

Due to recent huge investments in housing complexes, it is proposed in this study to employ policies for implementing solar systems in terms of using housing roofs, installing PV cells, inverters and transformers, control panels and metering and monitoring devices by the electric grid, as well as certain policies governing the installing of dynamic and passive heating and cooling systems by community collective companies, with national electric grid integration.

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