Journal of Asian Scientific Research

journal homepage: http://aessweb.com/journal-detail.php?id=5003

SHOULD IRAQIS GO SOLAR ON HOUSEHOLD LEVEL?

N. I. B. Jallo

Department of physics, College of Science, Baghdad University Baghdad Iraq

ABSTRACT

This work presents an assessment of the potentialities for using solar photovoltaic electricity in Iraqi houses. It is pointed out that going to solar electricity on household level may form one good solution for the present grid electricity crises in the country. Different aspects of the issue are discussed. The discussion is based on first hand experience of the author. Some economical, cultural and technological suggestions are made.

Keywords: Iraq electricity, PV solar.

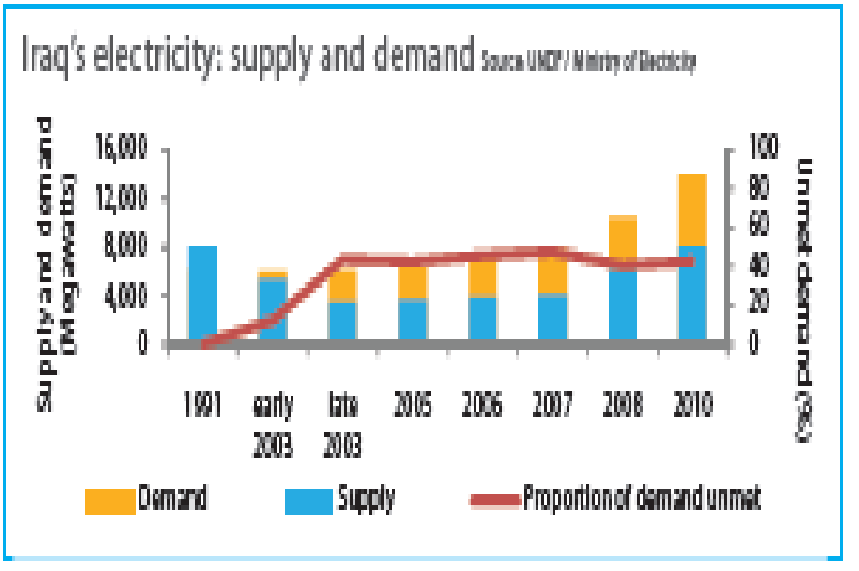
1. INTRODUCTION

Iraq may be a unique case as far as grid electricity supply is concerned. Prior the first gulf war in 1980, the Iraqi population enjoyed the luxury of a twenty four hour round the clock stable grid electricity supply. At the beginning of the war, several major stations suffered damage to one degree or another. This coupled with major cuts in maintenance spending and personnel, led to a situation where the national grid could never meet the demand at any time. The effect of this was more felt by the entire population during summer when temperatures are normally around 50 degrees centigrade. Even so, the average power cuts were in the range of two to four hours per day.

The real blow came during the second gulf war in 1991. Almost all power stations suffered heavy damages during the six weeks of bombing and the whole country was in a state of complete blackout. After the war, the government, made a big issue claiming political victory when they managed to put back some power stations in partial operation. In a desperate attempt to achieve this goal, they have used every spare part item in their warehouses. This has resulted only in about twelve hours of grid supply every day. However, UN sanctions [(1)] have made maintaining such limited supply almost impossible. With no more spare part to go on with, the situation deteriorated further drastically. People became content with four to six hours per day. It must be said however that power stations were not targeted during the 2003 war. A summary of the official electricity supply – demand situation in Iraq is presented in figure (1) [(2)]. In spite of the fact that the figure shows a shortage in electricity supply in the range of 40 -50% between 2003 and 2010, these figures should be treated with some caution even if they have to be taken literary. This is because they do not reflect the actual shortage suffered by the average family. This is due to the uneven

distribution [3]. A significant proportion of available electricity is usually allocated to what authorities consider as having priority. This translates into 24/24 hour power supply to places like hospitals, and other highly sensitive locations. This leaves the average Iraqi family with about 75% power shortage.

Figure-1. Iraq's electricity supply – demand relation 1991-2010



Under such circumstances, the Iraqi population has to find other alternatives. One important alternative was in the form of installing diesel powered generators in every district. Each generator has a capacity in the range of 100 kW, Distributed by a primitive and highly dangerous grid. Figure (2) shows a life example on how such networking is done.

Figure-2. Local electric districts networks connections in Iraq

The environmental impact of the presence of these generators within populated urban areas is being felt by every one. Demand for electricity has increased several folds after 2003 due to the increase in the average number of electrical appliances in almost every Iraqi household due to the improved standard of living.

Over the years, different governments have made **to** put substantial efforts to improve the grid supply [(4,5)]. However, these efforts did not seem to produce the anticipated improvement on the situation. Security problems, poor management, low administrative levels and some other factors may be all to blame. No solution to the problem is in sight for the near or medium future. The situation almost resulted in political riots during the summer of 2010 when people demonstrated demanding solutions.

In an almost desperate attempt by the authorities to lift some of the load away from the national grid, solar PV panels have been installed and are operating on some street lamp post in major cities in the country. Figure (3) shows one example[(6)] .. Even so, the average Iraqi house was not getting more than 10 hours per day of grid electricity during peak summer and winter month's 2012 in most areas [(7)]. This has increased to a maximum of eighteen hours per day during the relatively moderate spring season.

Figure-3. Installation of PV solar streets lighting in Iraq

It is the purpose of this work to suggest an alternative green solution to the problem. The solution is based upon considerations related to the averages Iraqi way of life. Photovoltaic solar electricity (PV) is proposed as a good candidate.

1.1. Case study: Going PV on Household Level

The typical average Iraqi house is a one or two story concrete and/or brick building. The building covers an area of between 100 and 200 m^2. The rooftop is usually flat and accessible through stairs. This is an advantage in any consideration for installing solar energy collecting devices. Even with low efficiency PV collectors of about 15%, there will be enough area to obtain about 15 kilowatts of electric power on an average day. This is well in excess of 2-3 kilowatts average consumption rate in a typical Iraqi house if one excludes electric heating during winter. The latter can be easily substituted for with kerosene heating which is the traditional way still in use.

The average Iraqi family usually uses electricity distributed as follows

1- Lighting 500 watts

2- Television, PC, and satellite TV 250 watts

3- Evaporative air coolers 1000 watts

4- Refrigerator, and deep freezer, 1000 watts.

The total amounts to about 2750 – 3000 watts.

Under the present system of using districts distribution, privately run, diesel generators, this amount of power costs the Iraqi household about 150-200 US$ per month. Lower income families have to be content with 1000 watts for about 50 US$ per month.

In order to reshape the way electricity is generated and consumed in a country where almost nothing can be lost as a result of such restructuring, the use of solar generated DC power represents an attractive alternative. In view of the current world awareness concerning the environmental damage caused by fossil fuel burning, PV power is considered one of the best ways to generate green electricity. However, such change from grid AC to solar generated DC must come at some additional cost. In countries which have a well established stable grid supply, the change may have to take longer period of time and some different technological tracks may have to be followed. It may be wiser in such cases to build large scale solar stations that pump their output power generated directly to national grids. However, in a country like Iraq where the national electric grid system is in a state of potency, further investments in such large scale solar stations or even in fossil fuel electricity generation may not be the wise decision to take. Bad as it is, this situation may present the perfect laying ground for a revolutionary green way of life as far as electricity generation and consumption is concerned.

Considering the four basic household utilities listed above, it can be said that the bulk of electricity consumption is concentrated in air cooling and refrigeration. As far as present day technology is concerned, it can be said that the invention of brushless DC motors [(8)] has contributed to a big step forward as far as the conversion of DC to mechanical energy is concerned. Anyone searching the web for DC motors, DC refrigeration compressors, or complete DC refrigerators and deep freezers can find a large number of manufactures, and dealers of such items. Even so, prices

remain to be an important issue. The authors have made a tentative search for these items. Prices of ½ - 1 HP DC motors of the type suitable to drive an evaporative air cooler are in the range of 300US$. Prices of DC refrigeration compressors are in the range of 150 – 200 US$. Prices of complete refrigerators and deep freezers are in the range of 500 - 1000 US$ depending on capacity. The problem of selecting the optimum combinations of DC and AC operated utilities for different family sizes and abilities may form an interesting operational research task. It can be said however, that any partial use of these types of utilities in conjunction with small PV modules can result in considerable improvement in the Iraqi family way of life with only relatively small capital spending.

The main item in any going green strategy using PV power at any level are the PV solar modules themselves. Prices of such modules have been on the steady decrease over the years since the nineteen seventies. Judging from the drop from a price of about 35 US$ per peak Watt in 1975 to 1.5 – 2.5 US$ today [(9)], It can be safely said that getting to a price of less than one US$ per W is not a far away dream. Even so, the cost calculations will be based on the minimum today price of 1.5 US$/W. On these bases, a typical Iraqi home will need to install solar modules on their roof tops at a cost of about 4000 US$ to be able to do away with diesel generated electricity. Operating at 15% conversion efficiency, with average sun light radiation of 1000 W/m^2 [(10; 11; 12)], these will cover about 20 m^2 which is only about 10-20% of the available idle area on any typical Iraqi rooftop.

As a first estimate, one may assume that about one half of the electricity generated by PV modules need to be stored to guarantee continuous operation of utilities during the night. Using 12 or 24 volt storage batteries, this will need about twelve 100 Ampere-Hour capacity storage. At a local price of about 100 US$ per unit, the cost will amount to about 1200 -1500 US$.

The one additional item needed for such a system is the inverter unit and some associated control units. These units are available at prices of 100-200 US$ /kW for sinusoidal AC generating inverters (square wave types can come at a much lower price). This will bring the total cost of such installation to about 5500-6000 US$. This is consistent with prices of currently available turn key based systems produced or sold by several manufactures all over the world.

Substituting the current dependence on diesel generators with solar electricity on household level can prove it self to be an economically feasible venture. From purely economical point of view, a system of this type will be able to pay back its initial capital cost within 40 months. This is well within the attractive limit of any economic project.

Unfortunately, such systems are seldom used in Iraq. Three main reasons are to blame

1. General public lack of awareness of the existence of such solution
2. General ignorance by local and international investors and suppliers of the potential market for such systems in Iraq
3. The relatively high price of such systems relative to average Iraqi family income.

All the above reasons are interconnected. The public lack of information is partially the product of lack of efforts paid by investors and suppliers in building public awareness through advertisement, shows, workshops and demonstrations. The government and public media have shown no interest in filling the cap.

The third reason related to prices and in spite of its importance, can not be truly regarded as the direct main cause for the present situation. Iraqi public attitude toward consumer rather than investor type of spending which has become more enhanced in recent years may be more to blame. A typical Iraqi family will spend any 5000-10000 US$ extra money at hand on changing the family car rather that any investment in a project of this type.

For all such reasons, it is believed that the first step towards solving a good part of Iraq's electric energy problem through the use of solar energy , will be to start building wide public awareness of the available technology, its cost, its direct and indirect advantages. The main burden in this task should fall on producers and suppliers of solar energy parts and systems all over the world as they will be the second direct beneficiaries if they can persuade the Iraqi general public to go for solar electricity use. Government, universities and other scientific establishments have a significant role to play in this respect. Local financial institutions and government can play a major role in facilitating credits specifically directed to be used for small solar energy units.

2. CONCLUSIONS

Iraq can form a potentially excellent market for producers and suppliers of electric PV solar energy parts and systems provided that enough attention is given to this issue. Some pioneering projects to demonstrate the operation of such systems will help in creating public interest. Local media, universities and government need to put more efforts toward achieving this goal.

3. ACKNOWLEGMENT

I would like to thank MR. H. Babahami for his valuable help and comments on this work

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