Developing solar energy in household scale at Tan Binh District, Ho Chi Minh City, Vietnam

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Abstract. In 2019, Ho Chi Minh City has a total population of 8.99 million with GRDP around 6.021 USD/ year [1]. Given the population size and the above GDP level, the electricity consumption demand for production and living purposes in the City was 83 million kWh per day in 2019 [2]. With high electricity demand, it must have developed the rate of renewable energy supply. And in Tan Binh district area, the population is considered quite high and is one of the economic development areas of the city. In Ho Chi Minh City, the sufficient supply of electricity is the top concern. And Tan Binh district is one of 24 districts belong to Ho Chi Minh City with crowded residential and industrial parks, that also has 1-2 houses applying solar energy. In there, solar energy is developing with industrial scale in many enterprises. So, this research was initial survey the potential using solar energy for household and the challenges of resident in Tan Binh district about applying solar energy for their home. According this study, now there is 1 house using and rating positively about solar energy combine national power grid. Around 92% people (1,500 interviewers in 15 wards) think that using solar energy is potential applying in their home because it gains the economic efficiency for reducing electricity fee. But it’s only 23% household interested in using solar energy in their house, when 50% citizens unsure about that. As the results, the factors effective their decision are the policies support from national government about using solar energy and the increasing of electricity bill. It’s a point for encourage the applying solar energy in household scale in Ho Chi Minh.

1. Introduction
Tan Binh District is a metropolitan district of Ho Chi Minh City, Vietnam. The region is located in the northwest, 4.7 km from the city center along the flight path, is considered the gateway district to the north of downtown Ho Chi Minh City. Tan Binh incorporates of 15 wards, of which ward 11 is the center of the district.

According to the Statistical Yearbook of 2017, Tan Binh District has an area of 22,43 km², a population of 491,300 and a population density of 30,592 people/km² [1]. With an immense population density but a small-scale area, the district's planning orientation is to adjust the planning towards reducing density, increasing height, and allocating land for social infrastructure development. In particular, priority is given to build sky-scrapping buildings, combining residential and service functions through the combination of synchronous planning between embellishment and clearance of new construction and development of transport networks.

In addition, the economic structure of the district progressed according to the trend of commercial, industrial and handicraft services. Deluxe services such as finance, credit, office leasing, high-class housing, tourism services, etc. are growing resolutely. Industrial development of clean and high-tech manufacturing industries. Thus, the insistence for electricity for living and business purposes still plays a key role in economic development in Tan Binh.
Specifically, in Tan Binh district, according to master plan of land use in this area, forecasting the population size to the year 2020 will be 200,00 people and the conventional power supply standard is 2,500 – 3,000 kWh/person/year. With such tremendous strain on electricity, Ho Chi Minh City, especially Tan Binh district should focus on orientation and development of renewable energy [2]. With the characteristics of densely populated areas, high population density, high radiation and sunny hours, the economic structure and planning orientation has helped Tan Binh District have immense potential to develop solar energy, towards the proposed energy development orientation. However, this potential has not been fully exploited for many reasons. In particular, people's awareness of this energy source is also one of the most interesting reasons. That’s why this study was focus on the situation of solar energy using and the awareness of citizens about implement its in future.

2. Research method

2.1 Overview
The general information about location, population, area, socio-economic situation, etc. collected to evaluate the ability for applying and developing solar panel in Tan Binh district, Ho Chi Minh City.

2.2 Interview and analyzing data
This study was investigated 1,500 residents at 15 wards in Tan Binh district about the situation using solar energy and their opinions in applying it's in future.

3. Results and Discussions

After interviewing 1,500 households of 15 wards in Tan Binh district, the following results were obtained as below.

3.1 Age
According to the survey data, the result of age shown in the figure 1 that the highest proportion of age was from 30 to 39 years old with 30%, following was the age between 16 and 29, at about 24%. Therefore, Tan Binh district has young generations that is very suitable for awarding and receipting solar power (in Figure 1).

![Figure 1 - The age of people in this area.](image)

3.2 Gender
The percentage of gender in Tan Binh district shown that it was not quite different the ration of gender between men and women, has only 2%. While electricity prices rise, women play as a key role in taking
care of family incomes, when men focus on solar technology. Therefore, it is able to develop the solar energy using in households because the interested of all family member in this field (Figure 2).

![Figure 2 - The demonstrates citizens’ gender in this area.](image)

3.3 The electricity consumption types in Tan Binh district

The type of electricity consumption in Tan Binh district is data on Figure 3, it can be seen that the dominant type was large stores and restaurants equivalent to 46%. However, the development of solar energy in restaurants and shops were not attached special importance due to the interest in business purposes. Therefore, the ability of solar energy development in households scale was the optimal option to help save electricity bills significantly (Figure 3).

![Figure 3 - The electricity consumption types in this area.](image)

3.4 Energy consumption

The average in amount of electricity was from 101 to 200 kWh, with 51.7%. This was the average in amount of electricity that each household uses in Tan Binh district. Therefore, with this use, the
selection of solar energy ensures not only saving electricity bills but also reducing the electricity load for the national grid.

Figure 4 shows the average electricity consumption per household in Tan Binh is 6.8 – 8.5 kWh/day. It is forecasted that by 2020, approximately 200,000 people and expected electricity supply standard of 2,500 – 3,000 (kWh/person/year), each Tan Binh citizen will consume around 6.85 - 8.22 kWh/day. This is a testament to the growing pressure of electricity supply in future and its will become a solution to overcome this problem.

![Electricity consumption in households in Tan Binh district.](image)

**Figure 4** - Electricity consumption in households in Tan Binh district.

3.5 The interest of people about using solar energy

The Tan Binh’s citizens are most interested in replacing traditional electricity with solar power and a percentage of "Yes" accounting for 92%. This is a positive signal about improving people's awareness of using this renewable energy. However, it still has 8% not interested because solar power and its benefits were unknown, or electricity price still have the ability payment, etc.

![The level of solar interest of Tan Binh’s citizens](image)

**Figure 5** - The level of solar interest of Tan Binh’s citizens

3.6 Investment costs
According to the investment cost for a solar energy system in household scale is estimate around 18,000,000 VND to 80,000,000 VND, people who live in Tan Binh district had changed their opinions and the results are shown in Figure 6.

Although 92% of people was interested in solar energy, but only 23% think about using this kind of energy. It has 24% of people do not agree to invest because of some reasons: high investment costs, still capable of paying electricity bills, not knowing that their exceeding electricity will be purchased, etc. So, people need more information about power price adjustment policy, supporting financy for implement solar panel in household from government, the technology and benefits from using solar energy in household, etc.

![Figure 6](image.jpg)

**Figure 6** - The ratio of people accepting to investment on solar cells in this area.

3.7 The opinion of Tan Binh citizens about using solar energy system in house

The consent rate of people on this energy was very positive, with 66% approved. This is a good signal for developing solar energy system at Tan Binh district.

![Figure 7](image.jpg)

**Figure 7** - The agreement of solar electricity purchasing price.

4. Suggested solutions

In order to develop the solar panel system in the Tan Binh district area, there are necessary solutions to consider:

4.1 Laws and regulations
Due to the high investment money of the solar panels, it requires reasonable incentive policies from the government to receive the public response.

Because the public is unfamiliar with the document, they need to be introduced and made clear with the issue. Since this decision only takes effect until 30/06/2019, if the rule is not accessible, the people who are using the solar energy system after the commencement date will not receive the generated energy. That’s why it’s has 13% of no idea about using solar energy system in house (at content 3.7). Therefore, if people can be access to information and technology of solar energy, it will contribute to change awareness and willingness to invest in solar PV installations at home.

There are needs to have an early executive decision for developing renewable solar energy such as a clear list of specific issues, supporting areas, and the amount of solar photovoltaic (PV) generate electrical power.

4.2. Technology

Currently, solar energy consumption is still new to the public and has not yet popularized. Therefore, it is necessary to have an instruction manual when install and maintenance of solar panels for all households to avoid dangerous situations.

Besides the instruction manual, there should have a handbook about solar energy calculating tools and energy storage for the consumers to be able to easily manage the consuming amount of residual electricity. Thus, it is easy to calculate the performance of the solar panel.

4.3 Economy

Completion of distribution and consumption of goods, usage of solar energy for the households. There are needs to have distinct documents about trading electricity between households.

There are regulations when supporting the people about using this energy source; such as assisting with the installation cost, electronic devices, solar energy calculating tools, etc. to encourage the people using this clean power source.

Introducing and keeping up-to-date about economic advantages when using solar power. For example, when using solar energy, people can reduce their monthly electric bills. Not only they benefit with the cost but also the long-lasting lifespan of the solar panel.

The electric bill has increased more than 8% since 20/03/2019 with the influx of sunlight; therefore, by encouraging the public using the solar energy, it not only saves electricity costs but also reduces the generate energy from the national electricity source. [4]

5. Conclusion

In conclusion, this survey has offered many factors to judge the development of solar energy in Tan Binh district. In addition, the significant growth of population and energy consumption is responsible for the burden of nation electric source. Therefore, with high number of populations, socio-economic development scale and expectation about a smart city, using renewable energy resource is primary factor and Tan Binh is seemed the most suitable place to develop solar energy.

According to quantitative and qualitative analyses about the efficiency of the “Solar energy in the roof” program in Tan Binh district, this region can be a center as well as a model in solar energy industry in
Ho Chi Minh City. Moreover, the program will use the empty roof for business to create a new income for citizens, create new careers related to solar energy like installation, maintenance and operation the solar systems. This is also the opportunity for local companies in solar energy field can widen their investment to other areas across the country.

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