Economic of Solar Photovoltaic for Rural Electrification in Agriculture Area-based in Ratchaburi Province, Thailand

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***Abstract*— this paper presents the economic analysis of solar photovoltaic (PV). From using solar PV system supply to the agriculture electrical load (AEL) in the Ratchaburi (RB) province, Thailand. The area of agriculture in the Ratchaburi has 1,900 square kilometer and 10 districts. First of all, the AEL data was investigated from all farming each district. Subsequently, the electrical load data was evaluated and classified by the load power and energy consumption of all the Suan-Phueng (SP-09) provinces its case study. The results are obtained the economic indices such as the capacity factor (CF), cost of unit (COE), net present value (NPV), internal rate of return (IRR) and payback period. This results help government for decision of investment solar PV system in agriculture or farming area in Ratchaburi province.**

Keyword: *Solar Photovoltaic, agriculture electrical load (AEL), Economic indices*

I. INTRODUCTION

Energy is essential to our society in ensuring the quality of life and to strengthen all other elements of our economy. Energy is a key driver for the betterment of human life and occupation. One of them is agriculture or farming area in long distance from the transmission line. [1]-[4] That area needs the energy consumption for being and agriculture. This paper focuses the study on economic of solar PV system for agriculture electrical load (AEL).

However, due to growing population coupled with global warming and depleting fossil resources, mankind is in desperate need of alternative renewable energy technologies based on solar energy etc. Sunlight is the largest available renewable and carbon-neutral energy source. Every hour the sun provides the earth with more energy than is consumed in an entire year. The solar photovoltaic device is the one that converts sunlight into electricity. An elementary photovoltaic device, called a photovoltaic cell (also referred to as solar cell), is mainly composed of two adjoining layers of semiconductor with separate metal contacts that have been doped thus creating the n-layer, n is negative, with a surplus of electrons and below that, the p- layer, p is positive, with an electron deficiency.[5]

The amount of energy available from the sun outside Earth's atmosphere is approximately 1350 Watt/Sq.m. . However, the solar radiation reaching the earth is lower because when entering the Earth's atmosphere, part of the incident energy is removed by scattering or absorption by air molecules, clouds and particulate matters. Although the global irradiation on the surface of the Earth can be as high as 1000W/Sq.m., the available radiation is usually lower than the maximum value due to the rotation of the Earth and the adverse weather conditions [7], [8]. On a monthly or annual basis, the amount of solar energy available also depends on the location. Generally, useable solar energy greatly depends on the availability of solar energy, weather conditions, technology used and type of application.

This paper introduces an economic evaluation of solar PV using the agriculture electrical load (AEL) in the Ratchaburi province. The rate of solar PV panel is determined from AEL. The cost of energy (COE), capacity factor (CF) and capital costs of solar PV are the economic indices. Finally, the study on Suan-Phueng (SP-09) district is example by survey on AEL data after that evaluating economic parameter.

II. ECONOMIC INDICES OF SOLAR PV SYSTEM

This section is to estimate the Wh cost and the economic indices of solar PV.

A. Capacity Factor (CF)

The net capacity factor of a power plant is the ratio of total amount of energy produced by a plant during a certain time period and the amount of energy the plant would have produced at full capacity. The capacity factor (CF) is defined in Eq. (1) by the sum of the actual generated electrical power, P_{gen} over timespan "t" and nominal power of the PV power. [1]

$$CF = \frac{\sum_{q=1}^{t} P_{gen,q}}{P_{nominal} \times t} \quad (1)$$

From Eq. (1) The calculated capacity factor depend on the actual generated electrical power and nominal power and timespan.