ANALYSIS OF FEED-IN TARIFFS FOR RESIDENTIAL GRID CONNECTED PHOTOVOLTAIC SYSTEMS IN MALAYSIA

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ABSTRACT

Power generation is more demanding in today's world and green energy is the way of the future for the world to survive climate changes. This form of energy are environmentally friendly and sustainable. Solar photovoltaic can be arranged as a large commercial scale or distributed as domestic usage. Therefore throughout the world governments introduced feed-in tariff (FIT) for grid connected photovoltaic for public participation in implementing large scale residential solar photovoltaic. To many governments the FIT rate are considered high but for the public it is low compared to their invested sum. Therefore need for a right formulation of FIT rate that will please the utilities and public. Levelised cost of energy need to be calculated with annual photovoltaic energy output for the analysis of FIT. Based on this project, cheapest investment for photovoltaic design is without battery storage but higher income will come with battery storage from Homer software simulation. The analysis also show that Malaysia 2016 FIT rate is only financial feasible for above 3 kWp capacity. Financial feasibility is determined with model on 'minimum internal return rate' and 'internal rate of return'. Financial model made shown that for 1.5 kWp capacity its MIRR at 3% and IRR at 1% that is losses incur for the investment. The IRR vs MIRR for 3 kWp and 6 kWp are 6% vs 4% and 8% vs 4%. The new formulated FIT rate shown on financial model for 1.5 kWp its MIRR at 4% and IRR at 5% as well as for other capacities. This show the FIT formulation provide profit to public for all installation capacities and also saving for large capacities for utility companies. The best photovoltaic design is those that are able to export more power to the grid at higher price while importing more power at lower price.

ABSTRAK

Penjanaan kuasa amat diperlukan pada zaman kini dan tenaga hijau adalah harapan masa depan bagi dunia untuk menghadapi perubahan iklim. Tenaga jenis ini adalah mesra alam dan boleh baharu. Fotovolta suria boleh dibentuk sebagai penjana berskala komersial ataupun teragih kegunaan domestik. Oleh yang demikian kerajaan di seluruh dunia memperkenalkan tarif galakan bagi fotovolta suria untuk merangsang penglibatan orang awam untuk implementasi fotovolta suria domestik berskala besar. Bagi kebanyakan kerajaan kadar tarif galakan adalah dianggap terlalu tinggi tetapi sebaliknya bagi pihak orang awam berbanding dengan jumlah pelaburan mereka. Oleh yang demikian ada keperluan bagi formulasi kadar tarif galakan yang dapat memuaskan hati pihak utiliti dan orang awam. Kos tenaga yang diselaraskan perlu dikira bersama dengan jumlah tahunan tenaga terjana dari fotovolta suria untuk menganalisa tarif galakan. Berdasarkan projek ini, pelaburan termurah bagi fotovolta suria adalah rekabentuk tanpa bateri tetapi sebaliknya menjana pendapatan lebih tinggi melalui simulasi perisian Homer. Analisa menunjukkan tarif galakan Malaysia tahun 2016 hanya memberikan keuntungan pada kapasiti 3 kWp ke atas. Pulangan modal dinilai melalui model kewangan dengan ‘minimum internal rate of return’ dan ‘internal rate of return’. Model kewangan menunjukkan pelaburan bagi kapasiti 1.5 kWp dengan nilai MIRR 3% dan IRR 1% alami kerugian. Perbandingan IRR dengan MIRR bagi kapasiti 3 kWp dan 6 kWp adalah 6% dan 4% serta 8% dan 4%. Model kewangan melalui formulasi kadar tariff galakan baru bagi kapasiti 1.5 kWp menunjukkan MIRR 4% dan IRR 5% sama dengan kapasiti yang lain. Ini menunjukkan formulasi kadar tarif galakan baru memberikan keuntungan kepada pihak awam dan penjimatan bagi kapasiti besar kepada pihak syarikat utiliti. Rekabentuk fotovolta suria terbaik adalah yang mampu mengeksport kuantiti tenaga yang banyak kepada grid elektrik pada harga tinggi manakala mengimport kuantiti tenaga pada kadar harga yang lebih rendah.

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ARR	-	Accounting Rate of Return
DB	-	Distribution board
EOY	-	Earning of Year
FIT	-	Feed In Tariff
FIT_FV	-	Feed In Tariff Future Value
FVIF	-	Future Value Interest Factor
GST	-	Goods and Services Tax
HOMER	-	Hybrid Optimisation of Multiple Electric Renewable
IRR	-	Internal Rate of Return
JB	-	Junction box
LCOE	-	Levelised Cost of Energy
MIRR	-	Minimum Internal Rate of Return
NPV	-	Net Present Value
O&M	-	Operation & Maintenance
PV	-	Photo Voltaic
RE	-	Renewable Energy
RES	-	Renewable Energy Sources
ROI	-	Return of Investment
SEDA	-	Sustainable Energy Development Agency
Solar PV	-	Solar Photovoltaic

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CHAPTER 1

INTRODUCTION

1.1 Background

Greenhouse gases have polluted the world from finite resources fossil fuel. The pollution is critical and triggered climate changes. The world then focus on green energy that is considered infinite and renewable. The green energy available currently includes,

i. biofuel
ii. wind
iii. wave
iv. solar

Technical feasibility in industries as well as the domestic sector have made solar PV become the focus of green energy. Solar PV efficiency increases enable it to be a large scale power generation. However due to human population and urban living there is a shortage of space to implement solar PV generation. Therefore one of the viable solution is to have rooftop solar PV in having highest number of public to participate. The problems in public participation is cost and incentives. Governments' worldwide therefore introduced feed-in tariff for grid connected solar PV to get more public participation. Hence public participation have been warm with the feed-in tariff.

Various countries come out with various rates through their costing calculation. Some countries have succeeded in meeting their target via feed-in tariff while other fail due to excessive pay out by utilities companies despite achieving its target. The feed-in tariff introduced are to,

i. ensure maintenance and long term operation
ii. draw local and foreign investment
iii. achieve renewable energy target

1.2 Problem Statement

Solar power is considered as clean energy of the future suitable for industries and domestic especially the photovoltaic system. PV system can be stand alone or grid connected. Many governments try to adopt this alternative to increase the generation of electricity in the country. However, government alone have limitation in implementing PV systems. A much easier option in large scale PV generation is to get the public to adopt roof top PV system. But when it comes to public, the concern is who will bear the PV cost and how will it benefit them. In encouraging the public to support and implement PV systems government worldwide introduce feed-in tariff for excess generation to the grid. The current practice in Malaysia is that the authority will provide a 21-year term feed-in tariff with a definite ‘return of investment’ within 7 – 9 years depending on the complexity of the installed system. The feed-in tariff rate is currently considered too high by private or state owned Utilities Company. There is a need to formulate a proper tariff rate that benefit both the utilities company and public PV owner.

1.3 Objective

The objectives of this report are,

i. To design and analyse appropriate rooftop PV systems for middle class households in Malaysia

ii. To investigate the effect of feed-in tariff on rooftop PV systems
iii. To formulate appropriate pricing mechanisms for feed-in tariff scheme

1.4 Scope

This report will focus on the existing feed-in tariff for residential, single house with rooftop PV of 1.5, 3 and 6 kWp, grid connected with 21 year project period, costing and revenue in Malaysia Ringgit and formulate an alternative feed-in tariff together with alternative power output optimised calculation from global solar PV power equation.

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