Soft Loan for Domestic Installation of Solar Photovoltaic in Malaysia: Is It the Best Option?

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Abstract—Malaysia has passed the Renewable Energy Act in April 2011, in which the Feed-In Tariff (FiT) mechanism is introduced. The FiT gives much emphasis on the solar photovoltaic (PV). This paper presents, first, an overview of solar PV in Malaysia until the present time. Next, a general concept of the FIT Malaysia is explained and finally the loan financing option for solar PV is presented. It also analyses the impact of the proposed interest rate to household consumers in Malaysia, in terms of the total profit, the net present value and the internal rate of return. It is found that the FiT scheme could potentially help in increasing renewable energy penetration, particularly for solar PV. To provide upfront capital for domestic solar PV installation, the soft loan facility from banking institutions is a feasible source if the interest rate is 5% or less.

Keywords - solar photovoltaic; feed-in tariff; interest rate; total profit; net present value; internal rate of return.

INTRODUCTION

Malaysia is a non-Organisation for Economic Co-operation and Development (OECD) country that is experiencing a strong economic growth with a steady increase in energy demand. The national gross domestic product (GDP) grew at a rate of 5.7% during the past six years [1], and the Government of Malaysia (GoM) has forecasted its economic growth to be between 5% and 6% in 2012 [2]. In the Ninth Malaysia Plan [3], it was reported that the final commercial energy sector demand in Malaysia increased from 1,243.7 petajoules (PJ) in 2000 to 2,217.9 PJ in 2010, an increment of close to 80%. The same trend is also true for electricity demand in Malaysia. From 2000 to 2010, the electricity demand has doubled from 69,280 GWh to 137,909 GWh [3]. Electricity generation in Malaysia is largely produced from fossil fuels, mainly from natural gas and coal, which constitute nearly 90% of the overall generation [3]. This means that to sustain this increasing energy demand, while cutting the dependency on the fossil fuels, Malaysia needs to shift its energy generation to alternative energy resources.

Although there are potential in biomass, biogas, municipal waste and mini hydro, solar PV is identified to have the highest potential in delivering energy needs in Malaysia [4]. With a strategic geographical location, Malaysia benefits from a large quantity of solar insolation, ranging from 1,400 to 1,900kWh/m² [5], averaging about 1,643kWh/m² per year [6] with more than 10 sun hours per day [7]. It was calculated theoretically that 1 kWp of solar panels installed in an area of 431 km² in Malaysia could generate enough electricity to satisfy the electricity requirements of the country in 2005 [6]. Solar PV can be designed to suit a variety of applications and operational requirements. The fuel (sunlight) is free and no noise or pollution is generated from its operation. A well designed and properly installed PV system will require minimal maintenance and have a longer service lifetime [1]. Given its potential, it is almost impossible not to tap into this resource for Malaysia’s benefits, both in rural and urban cities. However, the main setback and uptake of deploying this technology is due to the high cost of PV modules and equipment [1].

To tackle the high capital cost of solar PV, the GoM launched the Malaysia Building Integrated Photovoltaic (MBIPV) Technology Application Project on the 25th July 2005 [8]. The main objective of this programme was to reduce the long-term cost of the BIPV technology in Malaysia, which later will lead to an increase in the BIPV technology applications whilst reducing emission of the greenhouse gas of the country. This project ended on the 31st December 2010, with a total capacity successfully installed and commissioned of 1,516.00kWp, covering 109 buildings. The cost of PV also reduced greatly from RM31,410.00 per kWp in December 2005 to RM19,120.00 per kWp in March 2010, a reduction of about 40% of the cost [8].

After the completion of MBIPV project, the Malaysia Parliament passed the Renewable Energy Act 2011 (REA) in April [9] where the Feed-in Tariff (FiT) is introduced. The new act targets at domestic users to generate electricity in their houses by using the renewable resources [10]. It aims to achieve 5.5% of the electricity generated from renewable energy by the end of 2015 [11].

FEED-IN TARIFF (FiT)

The FiT schemes, basically, pay renewable energy producers a set rate (tariff) for each unit of electricity fed into the grid, and generally oblige the power companies to purchase all the electricity from eligible producers in their service area.
over a long period of time - usually 15 to 20 years. As of 2011, the FiT has been enacted in 80 countries [12].

A research by the Fraunhofer ISI in 2010 [13] concluded that with regards to solar energy, in most of the European countries with significant PV deployment, the vast majority of installations have occurred following the introduction of a FiT scheme. The FiT policies have led to the deployment of more than 15,000MW of solar PV power between 2000 and the end of 2009 in Europe [13]. In many European countries, the annual solar PV installation increased in excess of 300% in the first year of FiTs [14]. In 2010, solar PV system was identified as the fastest growing renewable technology, followed by the biodiesel and wind [12]. The grid-connected solar PV has an average annual growth of 81%, mainly driven by the FiT scheme [12].

Malaysia is convinced that FiTs is the way forward to shift to renewable energy. The 2011 document [15] states, “The Ministry of Energy, Green Technology and Water has conducted a thorough study on the effectiveness of the major renewable energy policy instruments practiced globally. The findings of the study showed that FiT is the most effective renewable energy policy mechanism in promoting and sustaining renewable energy growth.” As mentioned in the preamble to the REA, its creation is with a specific purpose, which is to establish and implement a special tariff system or FiT to catalyze the generation of renewable energy. The feed-in tariff system will be administered and implemented by the new entity called the Sustainable Energy Development Authority (SEDA) created by its Act.

The FiT in Malaysia gives much emphasis on solar PV. In Malaysia’s case, only two meter readings are required, which are the generation and the import meter. All the electricity generated will be exported back to the national grid. The rate for the amount of electricity generated using solar PV, ranging from RM0.85 to RM1.23 per kWh produced, depending on the installed capacity. Additional bonuses are also introduced on top of the basic FiT rate (ranging from RM0.01 to RM0.55 per kWh) when the installation meets specific criteria. It has a payback period of 21 years and the regression rate is 8% per year [9]. The launching date for the implementation of the FiT is scheduled for the 1st December 2011 [16].

One of the requirements to implement the FiT is to ensure that the scheme will generate a good return and reasonable profit. Recently, a comparative financial study has been conducted to see the viability of the FiT in Malaysia and some countries in the world [17]. This study assumed a 2.5kWp PV panel installed in nine different world capitals, i.e. London (UK), Berlin (Germany), Rome (Italy), Washington D.C. (USA), Cape Town (South Africa), Tehran (Iran), Seoul (South Korea), Bangkok (Thailand) and Kuala Lumpur, (Malaysia). The study takes into account the PV cost in each country, the amount of solar insolation received and the rate of the FiT. It was assumed that the solar panel is fully paid for at the beginning of the installation. The study concluded that the FiT scheme in Malaysia is lucrative and could generate a reasonable return to the home owner, i.e. the second highest among the nine countries with an income of more than RM100,000 throughout the contract duration and also has the shortest payback period i.e. 10 years.

Another study was also carried out to compare the return from solar PV installation as a form of investment with other investment tools available in Malaysia [18]. Malaysians have the opportunity to invest in unit trusts, national unit trusts, Employee Provident Fund (EPF) government bonds, fixed deposits and savings accounts. This study however suggested that the return on solar PV is considered lower than most of those investment tools available in Malaysia, which further implied that Malaysians would not be interested in considering solar PV as a form of investment.

Both studies in [17] and [18] suggested that the high capital cost is not desirable and viable amongst Malaysians. This is similar to another research study [19] completed in 2009 which found that Malaysians will only invest in the solar PV systems if the cost is lower than RM5,500 per kWp, around a third of the current market price. As a solution to this, the GoM through the Ministry of Energy, Green Technology and Water is proposing to provide financial assistance to start the renewable energy project, including solar PV installations [20].

### FINANCIAL ANALYSIS

It is reported that the banking institutions in Malaysia are interested in providing loans to household consumers for the purchased of solar panels [20]. The Go is currently discussing with the Central Bank of Malaysia to produce a specific guideline which will be used by all the banking institutions. The GoM is proposing an interest rate ranging from 4% to 5% for the loan scheme [20]. There are two types of interest rate available in Malaysia; fixed rate and floating rate [21]. The fixed rate value will remain the same throughout the loan tenure. The floating rate takes into account the difference between the base lending rate (BLR) of the financial institution and an ‘agreeable’ rate. For example a bank could offer a rate of BLR 6.6% and an ‘agreeable’ rate of 2.5%; the effective interest rate of the loan will be 4.1%. The BLR will vary depending on the current economic status, and is contingent on the Overnight Policy Rate (OPR) determined by the Central Bank. The Central Bank of Malaysia requires that both the fixed and the floating rate must not exceed the value of 10% [21].

This section will analyze the impact of the interest rate on three things: the total profit generated over the period of FiT contract, the net present value (NPV) and the internal rate of return (IRR). The nomenclature required for the financial analysis are available in Table 1. The total profit ($P_T$) is obtained by deducting the total cost (down payment ($C_{dp}$), loan repayment ($C_L$), cost of operation and maintenance ($C_{O&M}$) and cost of replacing the inverter ($C_{INV}$)) from the total revenue ($R_{T-FIT}$) generated from the FiT as illustrated in Eq. (1). To obtain the annual revenue generated from the FiT ($R_{AN-FIT}$), this is calculated by multiplying four parameters: the power rating of the PV panel ($P_{PV}$), the average yearly solar insolation ($SI$), the overall efficiency of the whole PV and the FiT rate ($R_{FIT}$) as indicated in Eq. (2). A 4 kWp solar panel is expected to cost around RM600,000 [20] while the inverter cost is RM4,500, which needs replacement every 10 years [22].

Taking into account the losses in the balance-of-the-system, the efficiency of the solar panel is assumed to be 0.75 [23]. To maximize the profit, the highest value of the FiT rate is chosen, i.e. RM1.78. The O&M is assumed to 1% of the capital cost of the system [24]. Assuming the down payment for the loan is 10% of the capital cost ($C_{dp}$), i.e. RM6,000, while the balance
### Table 1: The nomenclatures and parameters needed for the financial analysis.

<table>
<thead>
<tr>
<th>Item</th>
<th>Abbreviation</th>
<th>Unit</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Cost of Operation and Maintenance</td>
<td>C_{AN-O&amp;M}</td>
<td>RM</td>
<td>600</td>
</tr>
<tr>
<td>Annual Loan Repayment</td>
<td>C_{AN-L}</td>
<td>RM</td>
<td></td>
</tr>
<tr>
<td>Annual Revenue Generated from the FIT</td>
<td>R_{AN-FIT}</td>
<td>RM</td>
<td>8,773.62</td>
</tr>
<tr>
<td>Average Yearly Solar Insolation</td>
<td>SI</td>
<td>kWh/m²</td>
<td>1.643</td>
</tr>
<tr>
<td>Capital Cost of Solar PV System</td>
<td>C_{PV}</td>
<td>RM</td>
<td>60,000</td>
</tr>
<tr>
<td>Cash Flow</td>
<td>C_F</td>
<td>RM</td>
<td></td>
</tr>
<tr>
<td>Contract Period</td>
<td>T_N</td>
<td>Year</td>
<td>21</td>
</tr>
<tr>
<td>Cost of Operation and Maintenance</td>
<td>C_{O&amp;M}</td>
<td>RM</td>
<td>12,600</td>
</tr>
<tr>
<td>Cost of Replacing One Inverter</td>
<td>C_{INV}</td>
<td>RM</td>
<td>4,500</td>
</tr>
<tr>
<td>Discounted Rate</td>
<td>r</td>
<td>%</td>
<td>10</td>
</tr>
<tr>
<td>Down Payment</td>
<td>C_{DP}</td>
<td>RM</td>
<td>6,000</td>
</tr>
<tr>
<td>Efficiency</td>
<td>E_F</td>
<td>%</td>
<td>0.75</td>
</tr>
<tr>
<td>FIT Rate</td>
<td>T_F</td>
<td>Year</td>
<td>1.78</td>
</tr>
<tr>
<td>Internal Rate of Return</td>
<td>IRR</td>
<td>%</td>
<td>≥10</td>
</tr>
<tr>
<td>Loan Interest Rate</td>
<td>i</td>
<td>%</td>
<td>0 to 10</td>
</tr>
<tr>
<td>Loan Tenure</td>
<td>T_L</td>
<td>Year</td>
<td>4 to 20</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>NPV</td>
<td>RM</td>
<td>&gt;0</td>
</tr>
<tr>
<td>Solar PV System Power Rating</td>
<td>P_{PV}</td>
<td>kWp</td>
<td>4</td>
</tr>
<tr>
<td>Total Cost of Replacing the Inverter</td>
<td>C_{T INV}</td>
<td>RM</td>
<td>9,000</td>
</tr>
<tr>
<td>Total Loan Repayment</td>
<td>C_L</td>
<td>RM</td>
<td></td>
</tr>
<tr>
<td>Total Profit</td>
<td>P_T</td>
<td>RM</td>
<td>&gt;0</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>R_{T FIT}</td>
<td>RM</td>
<td>184,246.02</td>
</tr>
</tbody>
</table>

1. The discount rate chosen base on the IEA Technology Roadmap: Solar Photovoltaic Energy study which can be retrieved in [24]. A similar value of discount rate is used by in IEA Energy Technology Perspectives 2010 - Scenarios & Strategies to 2050 which is available in [27].

2. The IRR value depends on the inflation rate. The study in [29] indicates that a 2% inflation rate could generate an IRR between 7% and 12%. To simplify the analysis, the mean value of the IRR is chosen, i.e. 10%.

### Equation

\[
C_{AN-L} = 0.9 \times C_{PV} \times (1 + i)^{T_L} \tag{3}
\]

\[
NPV = -CF_0 + \sum_{i=1}^{N} \frac{CF_T}{(1 + r_{0})^t} \tag{4}
\]

\[
0 = -CF_0 + \sum_{t=1}^{N} \frac{CF_T}{(1 + IRR)^t} \tag{5}
\]

Table 2 shows an example of the projected cash flow of the solar PV project with loan financing facility. If no loan is taken, the total profit is calculated to be RM102,646.02, the NPV is RM8,287.30 and the IRR is 11.97%. The payback period equals 6.96 years. When a loan is considered, a series of scenarios are analyzed. The interest rate is varied between 0% and 10%, and the duration of the loan tenure is also investigated, ranging from 4 to 20 years. The detailed results of the total profit, NPV and IRR are presented in Fig. 1. Any interest rate of 5% or lower with a loan tenure ranging from 4 to 20 years is viable since it meets all the criteria of feasible investment. In general, the amount of total profit, the NPV and the IRR are higher if the interest rate is smaller. When the interest rate is 6%, the appropriate loan tenure will be 12 years maximum. A 7% interest rate is possible to take if the loan duration is a maximum of 8 years while an 8% interest rate is only feasible if the loan tenure is less than or equal to 6 years. If the chosen rate is 9%, the tenure must be less than or equal to 4 years. No loan should be taken if the interest rate is 10%.

Based on these calculations, the proposed interest rate of 4% to 5% by the GoM is considered feasible for Malaysian context. However, if the GoM is serious about promoting solar as the main RE, it is also advisable to perhaps propose an even lower interest rate, maybe between 2% and 3%. The loan tenure also must be a maximum 10 years, to ensure that the return gain by the home owner will be as high as possible. This will enable the home owner gain a total profit of about RM84,000 to RM98,000 for the duration of 21 years. With a RM6,000 down payment, an interest rate of 2% for a tenure of 10 years will generate an extra cash flow of RM133 a month for the first 10 years and about RM681 a month for the next 11 years. This can act not only as the catalyst to increase solar energy penetration, but also as a tool to increase Malaysians’ monthly income hence helping in achieving Malaysia's target of becoming a high-income economic nation.

However, the GoM must ensure that the public is aware of this financing incentive, since some studies indicate that Malaysians awareness level relating to renewable energy is still very low [18],[19]. Without proper awareness scheme, people might be not choose to invest, especially in reluctant taking more loans from the bank, on top of their existing loans for properties and vehicle [31]. Another important point is to relax the requirement on applying for solar PV loans. This is because; the installation of PV is considered a low-risk investment, where the return is guaranteed [29], hence could help them in generating extra money for paying other loan commitments.
Solar energy has significant potential in Malaysia. The MBIPV project was the driving force to accelerate solar PV penetration in Malaysia. The recent introduction of the FiT MBIPV project was the driving force to accelerate solar PV installation and (iii) relax the requirement to apply for loan applications, hence making it possible to break through this barrier and see a successful renewable penetration in Malaysia.

**REFERENCES**


**CONCLUSIONS**

Solar energy has significant potential in Malaysia. The MBIPV project was the driving force to accelerate solar PV penetration in Malaysia. The recent introduction of the FiT scheme will definitely become the key driver to boost the solar PV industry in Malaysia; this has already successfully happened in Germany, Italy and the UK. It is calculated that the FiT rate in Malaysia generates reasonable revenue and profit, but an additional financing support scheme is required to start implementing solar PV installations, due to the high initial cost. As for individual homeowners, a soft loan from banking institutions is feasible if the interest rate is 5% or less. However, based on recent surveys [18], [19] that were conducted, they suggest that Malaysians have a low level of understanding of the numerous incentives, despite the fact that the solar PV industry has shown an increase in terms of the number of installations. With the low level of awareness of government policies available in Malaysia, it is not surprising that the Malaysians would not want to invest and appears to be one of the major barriers for the FiT scheme - especially solar PV.

Conclusively, the Malaysian Feed-in Tariff Program appears to be effective in accelerating the adoption of solar PV in Malaysia. However, there is still room for improvement in terms of public awareness and financing support. To achieve a sustainable future, the Malaysian government should continue to develop policies and incentives to promote the growth of the solar PV industry.
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Fig. 1: Analysis of the effect of various interest rates on the total profit, the NPV and the IRR using different loan tenure.

The loan financing is feasible if:
1. Total Profit is > 0
2. NPV > 0
3. IRR ≥ 10%