



# BULLETIN OF ENVIRONMENTAL SCIENCE AND MANAGEMENT

WEBSITE: <http://journal.hibiscuspublisher.com/index.php/BESM>



## Preliminary Study of Community Readiness Towards Building-Integrated Photovoltaic in Raub, Pahang

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### HISTORY

Received: 5<sup>th</sup> of October 2014  
Received in revised form: 29<sup>th</sup> of November 2014  
Accepted: 26<sup>th</sup> of December 2014

### KEYWORDS

renewable energy  
building-integrated  
photovoltaic  
feed-in tariff  
community readiness

### ABSTRACT

Between 2000 and 2010, the total energy demand for Malaysia has doubled. In order to promote production of renewable energy in Malaysia, the government has introduced a Feed-in Tariff (FiT) scheme under the Renewable Energy Act 2011. This paper examines community readiness towards adopting Building-Integrated Photovoltaic (BIPV) in Raub, Pahang, Malaysia through the FiT scheme. By using the Community Readiness Model proposed by the Tri-Ethnic Center, the analysis shows that the people in Raub are not ready to accept the FiT scheme and to adopt the BIPV system. The main reasons for this are the lack of information about the FiT scheme and high initial installation cost for the BIPV. The study concludes that more measures need to be done to increase community readiness to implement BIPV.

### INTRODUCTION

The annual electricity demand in Malaysia has doubled from 69, 280 GWh in 2000 to 137, 909 GWh in 2010 [1]. Due to the increasing electricity demand, the Malaysian government has begun to look at development and utilisation of renewable energy (RE) to reduce the dependency on fossil fuels [2]. Several programs have been launched including Malaysia Building Integrated Photovoltaic (MBIPV) project. The objective of the MBIPV Project was to reduce Malaysia's greenhouse gas (GHG) emissions, which in 2005 stood at 138.04 million tonnes [3]. This can be achieved by reducing long-term cost of Building-Integrated Photovoltaic (BIPV) technology via development of a sustainable BIPV market [4]. By the end of the MBIPV 5-year project duration in 2010, a total of 1070 tonnes of CO<sub>2</sub> had been avoided and there was 40% reduction in PV technology cost [5]. Based on that programme, several constraints in promoting BIPV in Malaysia have been identified. The major constraints are lack of awareness and understanding on BIPV and high initial investment cost. Other constraints include misuse of monopsony power and information asymmetries as well as financial and technological problems. Besides that, arbitrary renewable energy (RE) prices [6], absence of regulatory framework and poor governance and lack of proper institutional measures to meet the informational and technological needs of the RE promotion put further hindrances to acceptance of BIPV [7].

After the MBIPV, the Malaysian government launched the National Renewable Energy Policy & Action Plan (NREP) 2010 to increase utilisation of indigenous RE resources and to

contribute to the national electricity supply security. In addition, Malaysia also passed the Renewable Energy Act 2011 in which a feed-in tariff (FiT) scheme was proposed. The FiT scheme emphasises on several RE resources and one of the REs is solar Photovoltaic (PV). Such FiT scheme has been successfully implemented by over 40 countries, including Germany, which has the biggest PV market, Spain, Italy and Thailand [5]. However, in Malaysia, many are still hesitating or even unwilling to adopt a greener source of energy generation through solar PV. Other than that, many Malaysians are not aware of the promotion of FiT scheme by the government in order to further enhance the adoption and utilisation of solar PV, as only a small amount of residents were selected to participate in the RE projects such as the MBIPV projects. A community readiness study can help determine whether the community in Malaysia is ready to adopt BIPV. The paper is based on a preliminary study of community readiness to adopt BIPV through the FiT scheme in Raub, Malaysia. It also provides concise discussions about Malaysian renewable energy policies in promoting BIPV.

The NREP 2010 aims to enhance the utilisation of indigenous RE resources to contribute towards national electricity supply security and sustainable socio-economic development. The policy is projected to better promote RE by *inter alia* addressing current market failure, stimulating new industrial growth, developing human capital and improving coherence of current policies related to energy and environment [7].

Among the objectives of the NREP 2010 are to increase the RE contribution in the national power generation mix; facilitate the growth of the RE industry; and ensure reasonable RE generation costs. Several strategic thrust have been outlined to achieve the objectives of NREP 2010. One of the thrusts is to introduce appropriate regulatory framework to provide incentives for firms or individuals to enter the RE generation market. The FiT and RE Fund mechanisms have been introduced and implemented under a new RE law. The FiT mechanism allows electricity to be produced from RE sources and to be sold to the grid provider at a fixed premium price for a specific duration. RE fund was established to support and pay for the higher FiT rates. Electricity consumers would be required to contribute to the fund. Another thrust is to provide conducive environments for RE businesses. For example, RE borrowers used to be treated as normal debtors and thus ignoring the nature of the RE businesses. With the introduction of the FiT mechanism, this should help convince financial institution to provide loans to FiT holders.

Following the NREP 2010, the Renewable Energy Act 2011 (the RE Act) was passed. It provides for the FiT mechanism to promote more RE in Malaysia. The renewable resources that covered by the 2011 Act are biogas produced by anaerobic digestion or fermentation of bio-degradable organic materials, biomass comprises of bio-degradable organic materials, small hydropower and solar photovoltaic. Application for the feed-in approval is available for the four RE mentioned, with producer utilising only one type of RE installation or utilising more than one type of RE installation. Later increased in RE capacity can also be applied for the same or different renewable sources. In addition, bonus FiT rate can be applied for the renewable sources mentioned with the exception of small hydropower. The bonus rate takes into account the efficiency of the technology, source of fuel and the use of locally manufactured and assembled technology. The basic FiT rate would depend on the installed capacity and the type of renewable sources utilised. For the current solar photovoltaic FiT rate, it is shown in **Table 1**.

Upon approval of the application of feed-in approval, the distribution licensee would need to enter a renewable energy power purchase agreement (REPPA) with the feed-in approval holder. The provisions in the REPPA would include the price and duration of which the energy would be purchased. Besides that, it also includes the energy in which the feed-in approval holder should sell and deliver and the distribution licensee shall purchase the RE generated, metered at the connection point. It is also provisioned that if either party breached the agreement, the distribution licensee or the FiT approval holder shall have the option of purchasing or selling the RE installation for the purchase price determined in accordance with the agreement. The FiT holders are paid from a RE Fund which is funded by electricity tariff levied and collected by Malaysia's national electricity company, the Tenaga Nasional Berhad (TNB). Before the eligible producer apply for the feed-in approval, the distribution licensee shall check the technical possibility of electrical connection between the grid and the RE installation. For an installation exceeding 180kWp, a power system study is required to be submitted to the distribution licensee. The types of connection to the electricity distribution network depend on the location, capacity and the types of RE installation. It is also

necessary for the feed-in approval holder and distribution licensee to install an electrical protection scheme for technical fault which can affect the distribution network or the RE installation. The FiT shall commence when all relevant certificate and documents are submitted to the authority and distribution licensee. The revenue meter can be checked at any time with a written request. Any fault in the meter will be repaired, recalibrated or replaced by the distribution licensee.

**Table 1.** Feed-In Tariff rates for solar photovoltaic

| Description                                                           |                                                           | FiT Rates (RM per kWh) |             |
|-----------------------------------------------------------------------|-----------------------------------------------------------|------------------------|-------------|
| <b>(a) Basic FiT rates with the installed capacity of:</b>            |                                                           | <b>2013</b>            | <b>2014</b> |
| (i)                                                                   | up to and including 4kW                                   | 1.1316                 | 1.0411      |
| (ii)                                                                  | above 4kW and up to and including 24kW                    | 1.1040                 | 1.0157      |
| (iii)                                                                 | above 24kW and up to and including 72kW                   | 0.9440                 | 0.7552      |
| (iv)                                                                  | above 72kW and up to and including 1MW                    | 0.9120                 | 0.7296      |
| (v)                                                                   | above 1MW and up to and including 10MW                    | 0.7600                 | 0.6080      |
| (vi)                                                                  | above 10MW and up to and including 30W                    | 0.6800                 | 0.5440      |
| <b>(b) Bonus FiT rates with the following criteria (one or more):</b> |                                                           | <b>2013</b>            | <b>2014</b> |
| (i)                                                                   | use as installation in buildings or building structures   | +0.2392                | +0.2201     |
| (ii)                                                                  | use as building materials                                 | +0.2300                | +0.2116     |
| (iii)                                                                 | use of locally manufactured or assembled solar PV modules | +0.0300                | +0.0300     |
| (iv)                                                                  | use of locally manufactured or assembled solar inverters  | +0.0100                | +0.0100     |

**Source:** Reference [8]

Details of the FiT and the quantity of electricity purchased by the distribution licensee from each feed-in approval holder are required for the claim of moneys by the distribution licensee from the RE Fund. An intentional overstatement of claim is liable to a fine or imprisonment. This is to prevent the misuse of the RE Fund. The distribution licensee may claim money in its subsequent claim if there is an understatement amount. It is also mandatory to allocate administrative fees to the distribution licensee and the authority namely the Sustainable Energy Development Authority (SEDA). SEDA is a statutory body formed under the SEDA Act 2011 to administer and manage the implementation of the FiT mechanism mandated under the RE Act 2011 [8]. The distribution licensee shall be paid at the rate of two per centum and SEDA three per centum of the claim made from the RE Fund. The fee claimed by SEDA is paid into the SEDA Fund established under the SEDA Act 2011.

## MATERIALS AND METHODS

### Instrument of study

The Community Readiness Model (CRM) developed by the Tri-ethnic Center for Prevention Research was used to assess the readiness of the community in Raub towards BIPV. CRM has been used to evaluate programs [10] as it can provide an accurate way to determine the readiness before and after a program implementation. The assessment could also provide guide for a program development [10]. Therefore, the current study could provide some insights that are useful for the FiT scheme proposed to promote BIPV.

### Respondents of the study

Interviews with key respondents consisted of local political leader, journalist, teacher, event organiser and university student were conducted. Each of the respondents represents different segment of the community. While the local political leader had knowledge on BIPV technology, FiT scheme and the governmental efforts in promoting BIPV, the journalist was selected because she might had reported news on efforts to promote BIPV in Raub. The teacher represented school segment on whether the community of Raub were aware of BIPV technology and its uses. The fourth respondent was an event organiser who had organised events that attracted community in Raub. The last respondent was a university student actively involved in community activities. All five respondents were selected due to their interaction with the community at large and their knowledge of the community affairs.

### Location of study

The location of the study was in Raub, Pahang. The area has a population of 88,469 excluding non-Malaysian citizens. Raub is a small town, which was developed initially due to gold mining activities. Total households in Raub is estimated to be around 19,816 and living quarters around 21,533. The population in Raub consist of approximately 63.1% Malay, 30.2% Chinese, 6.4% Indian with the rest comes from other ethnicities [11].

### Data collection

The community readiness assessment procedures for the study were based on the guide provided in the CRM. It involved open-ended questions which were adapted to the issue being studied and to the community. According to the CRM there are six dimensions of readiness which are the key factors that influence a community in taking action on an issue. Hence, the interview questions are closely tied to these dimensions [10]. **Table 2** shows the description of dimensions and the sample questions tied to those dimensions. The primary data for interview was collected between March and May 2013. A brief explanation about BIPV and the issue of BIPV adoption through the FiT scheme was given to the respondents before the interview began. During the interview, discussion was avoided to avoid any interruption during the interview and to avoid second guesses of what the respondents meant. The interview questions were asked based on the sample questions tied to each dimensions. Dimension A and B as seen from **Table 2** was combined to promote the flow of question during the interview. A tape recorder was used to record the interview and all respondents consented to the recordings. Each interview took about 30 minutes to an hour to complete. The interview results were then transcribed.

### Data coding

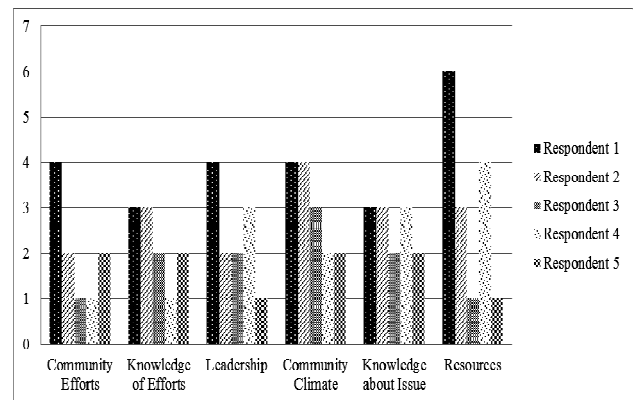
A content analysis of the interview transcripts was done to identify quantitatively the level of readiness of the community in Raub towards BIPV. The interviews were scored by 2 scorers to reduce bias according to the anchored rating scale as shown in the appendix. For each interview, a score of 1 to 9 was given for each dimension. Consensus scores were reached by the two independent scorers and the scores were averaged across interviews for each dimension. The final average score across six dimensions represents the community readiness stage for BIPV adoption in Raub.

## RESULTS AND DISCUSSIONS

### Raub community readiness towards BIPV

The consensus scores agreed by both scorers were displayed and calculated as shown in **Table 3**. Based on the respondents' feedbacks, the table shows the average score for each dimensions and the overall community readiness score for Raub in adopting BIPV system is 2.53. However, the scores correspond with the numbered stage should be rounded down rather than up [10]. Therefore, the overall community readiness score is 2, which shows a denial stage.

The bar chart shown in **Fig. 1** below displays the consensus score of both scorers. In overall, the scores of respondent 1 was the highest for both scorers, which also means that he perceived the level of Raub community readiness was high. In contrast, the score for respondent 5 was the lowest suggesting that he felt the level of community readiness was low.



**Fig. 1.** Consensus scores for two scorers.

Looking at the community efforts dimension, respondent 1 scored 4, which was the highest amongst all respondents. This may be due to respondent 1 had involves in some initiatives related to BIPV. Scoring 2 in the community effort dimension were respondent 2 and respondent 5 whereas respondent 3 and respondent 4 scored 1 for this dimension. Overall average score for this dimension is 2 which signified that the community perceived that there were no efforts to address the BIPV issue. On the second dimension of community readiness namely knowledge of the efforts, respondent 1 and respondent 2 scored 3, while respondent 3 and respondent 5 scored 2. Respondent 4 scored the lowest which was 1. The average score for this dimension is 2.2, which suggested that the community had no knowledge about efforts addressing the BIPV issue. This stage of readiness also matches with the community efforts stage where both have a score of 2. The next dimension of community readiness is leadership. In this dimension, both scorers agreed that respondent 1 scored the highest among all respondents. Respondent 1 perceived that leadership in relation to BIPV adoption was high in Raub community. The lowest leadership score would be 1 by respondent 5. This suggests that while politicians or leaders believe they have done many efforts for the BIPV programme, such efforts may have not reached the community at root level like students. Despite this, the average leadership score for Raub community is 2.4. This means that on average leadership in BIPV implementation was not an issue in their community.

**Table 2.** Community readiness dimensions and sample questions.

| <b>Dimensions</b>                      | <b>Description</b>                                                                                                       | <b>Sample Questions</b>                                                                                                                                                                                                                                                 |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A. Community Efforts                   | The extent of efforts, programs and policies that implement BIPV                                                         | <ul style="list-style-type: none"> <li>• Are there any efforts in your community to implement or promote BIPV?</li> <li>• What are the strengths and weaknesses of these efforts?</li> </ul>                                                                            |
| B. Community Knowledge of the Efforts  | The extent of community members knowledge about local efforts and their effectiveness                                    | <ul style="list-style-type: none"> <li>• Not including those who directly involved in the planning and implementation of the efforts, approximately how many in your community knows about these efforts?</li> <li>• What do they know about these efforts?</li> </ul>  |
| C. Leadership                          | The extent of appointed leaders and influential community members support of the issue                                   | <ul style="list-style-type: none"> <li>• Who are the “leaders” specific to address this issue in your community?</li> <li>• How does the leadership engage this issue?</li> </ul>                                                                                       |
| D. Community Climate                   | The prevailing attitude of the community toward the issue                                                                | <ul style="list-style-type: none"> <li>• Do the community members believe that this is an issue to be addressed?</li> <li>• How concerned do you think your community towards this issue?</li> </ul>                                                                    |
| E. Community Knowledge about the Issue | The extent of community members knowledge about the causes of the problem, consequences and how it impacts the community | <ul style="list-style-type: none"> <li>• What type of information is available in your community regarding this issue?</li> <li>• Does the community aware of the Feed-in-tariff scheme to in compliance with this issue?</li> </ul>                                    |
| F. Resources Related to the Issue      | The extent of local resources available to support BIPV efforts                                                          | <ul style="list-style-type: none"> <li>• What other resources are available to address this issue in the community?</li> <li>• Are you aware of any proposal or action plans that have been submitted for funding that address this issue in your community?</li> </ul> |

**Source:** Reference [10]

**Table 3.** Consensus score for Raub community readiness.

| Dimensions                       | R1 | R2 | R3 | R4 | R5 | Average |
|----------------------------------|----|----|----|----|----|---------|
| A Community Efforts              | 4  | 2  | 1  | 1  | 2  | 2.0     |
| B Knowledge of the Efforts       | 3  | 3  | 2  | 1  | 2  | 2.2     |
| C Leadership                     | 4  | 2  | 2  | 3  | 1  | 2.4     |
| D Community Climate              | 4  | 4  | 3  | 2  | 2  | 3.0     |
| E Knowledge about the Issue      | 3  | 3  | 2  | 3  | 2  | 2.6     |
| F Resources Related to the Issue | 6  | 3  | 1  | 4  | 1  | 3.0     |
| Average Score                    |    |    |    |    |    | 2.53    |

Community climate dimension scores are consistent with all five respondents. Respondent 1 and respondent 2 scored 4 in this dimension while respondent 3 scored 3. Both respondent 4 and respondent 5 scored 2 in community climate. Respondent 1 and respondent 2 believed that the community was interested in BIPV and thought that they had to do something. The only problem was the community does not know what to do. However, other respondents had different opinions. They perceived that there was prevalent apathy among the community in Raub towards BIPV. The community saw no immediate benefits in adopting BIPV and thus needed not involve with the programme. The average score for this dimension is 3, which is one of the highest levels for Raub community among all the six dimensions of readiness.

For readiness dimension related to knowledge about the issue being addressed, the scores were rather constant. Respondent 1, respondent 2 and respondent 4 had a score of 3 while the remaining respondents scored 2 in this dimension. Some of them felt that a few in the community had little knowledge on BIPV and hence scored 3. Others felt that the community has no knowledge at all regarding this issue and therefore the score was lower. On average, the score for this dimension is 2.6, which suggested that the community has insufficient knowledge on this issue.

Lastly, the dimension on resources related to the BIPV issue relates the availability or the potential resources in Raub to promote BIPV. Once again, respondent 1 scored 6, which is the highest among all respondents. This might be due to his knowledge on the availability of resources in Raub required to promote BIPV. The respondent also had knowledge of what resources needed to successfully promote BIPV. Respondent 3 and respondent 5 scored 1, the lowest score in the dimension. This maybe because they did not know what type of resources are needed and available for BIPV implementation. The average score of this dimension is 3, same as dimension on community climate where both of these dimensions achieved the highest level of readiness among other dimensions. This level of readiness means that the community are not sure what are needed in order to initiate BIPV project.

#### Challenges of BIPV adoption in Raub

Based on the interviews, several barriers have also been identified. **Table 4** shows the barriers mentioned by the respondents and the percentage of times mentioned by the total respondents.

**Table 4.** Mains barriers for BIPV adoption.

| Main Barriers       | Percentage of times mentioned (%) |
|---------------------|-----------------------------------|
| Lack of information | 60                                |
| Cost                | 40                                |
| Public acceptance   | 40                                |
| Belief              | 20                                |
| Land title issue    | 20                                |
| Building structure  | 20                                |

The main barriers in adopting BIPV in Raub are lack of information followed by high installation cost and lack of public acceptance. Pusat Tenaga Malaysia [6] also identified lack of awareness and high investment cost as the major issues in implementing successful BIPV. The lack of public acceptance of the BIPV can be linked to the lack of information on BIPV and FiT scheme publicized at local level. This is reflected in the Respondent 5 statement:

*"I think knowledge is important... There is no publicity... If the people know about it, I think they will want to get involve with BIPV"*

Due to the lack of information on FiT, most of the people in Raub perceived that they have to pay for the system all by themselves. Furthermore, most property owners are unaware that they could become independent power producers (IPP) through the FiT scheme introduced by the authority.

Lack of confidence towards the BIPV and FiT scheme is another challenge to promote BIPV in Raub. According to Respondent 4:

*"the people... don't believe in all these plans and schemes like the FiT. They will think that you lie to them [and that]... the FiT contract may be ended earlier [before it expires]"*

This issue arise partly due to low public acceptance. Respondent 2 has clearly linked how the lack of information creates fear and rejection towards BIPV.

*"To the people in Raub this technology is still new..er..It's not that we have no confidence in the BIPV efforts but we don't know enough about it. When we don't know enough about it, there is fear, there is rejection"*

Respondent 4's response also suggested that the lack of awareness and willingness to adopt BIPV is due to the lack of

