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Barriers and drivers of Malaysian BIPV application: perspective of developers

Kai Chen Goh,^{a,*}Hui Hwang Goh,^b Aaron Boon Kian Yap,^aMd Asrul Nasid Masrom,^a Sulzakimin Mohamed^a

^a Faculty of Technology Management, Universiti Tun Hussein Onn Malaysia, Parit Raja, Johor and 86400, Malaysia.

^b Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia, Parit Raja and 86400, Malaysia.

Abstract

Sustainable development is one of terms that widely known and crucial in the context of world development today. In order to achieve sustainable development, global community has identified the construction and energy sectors as the prioritisation area. Malaysian government has set up various plans and development related to Renewable Energy (RE) especially in related to construction sectors. One of the main initiatives taken is the promotion of Building Integrated Photovoltaic (BIPV). Even so, the BIPV implementation is rather new and still in the infancy stage. There is no research indicated details on the BIPV application in Malaysia especially in related to construction sectors. Current industry stakeholders tend to reluctant in investing in BIPV due to its high initial investment. However, BIPV has become a good prospect in construction industry due to huge development and the latest economic investment in Iskandar regions, Johor, Malaysia. This research provides insights where housing developers act as a catalyst or push factor in the BIPV implementation in Malaysia. In depth interview is employed with 15 developers to get an in-depth angle and a wider perspective in the barrier and drivers for the BIPV implementation. All developers provide positive feedback and determine in implementing BIPV into the development project. This research shows that BIPV has the propitious potential and encourage positive thinking among the construction industry stakeholders towards sustainable development.

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* Corresponding author. Tel.: +6-074-533-928; fax: +6-074-533-833
E-mail address: kaichen@uthm.edu.my

1. Introduction

The combination between the environment conservation, economic viability and social equity is known as sustainable development [1]. In year 2000, Malaysia began shifting its focus to sustainable development by including renewable energy through the three major plans that are the 8th, 9th and 10th Malaysian Plan [2]. By the application of green technologies, the construction sector helps to achieve sustainable development. Among all the green technologies, Building Integrated Photovoltaic (BIPV) is functioned as the technologies that can achieve the sustainability in the energy sector and construction sector. BIPV is one of the the cleanest technology for electricity production as well as having about four times of the world's fossil fuel reserve [3]. It is essential to carry out BIPV by the stakeholders in the road of achieving global sustainable development. In the world, Malaysia is having the second largest solar photovoltaic module producer. Besides, it has a proven expertise for large BIPV capacity installation in several government and private building such as Centre of Environment, Technology and Development, the Green Energy Office (GEO) of Pusat Tenaga Malaysia (PTM) and Monash University (Sunway) along with a few residential building in Cheras, Semenyih, Bukit Sebukor (Malacca), Setia Eco Park, Putrajaya and Bangsar [4]. Currently, BIPV was the plan to start a community-based solar power project in the Iskandar Region Economic Corridor in Johor by the Iskandar Regional Development Authority (IRDA). Developers are regards as the construction stakeholder that able to carry out BIPV into the project [4]. However, there are many issues arising from adoption of sustainable materials as [5] puts it. Based on [6], among the issues are such as the affordability, or lacking of readily available accessible information. Developers become indecisive when there is lacking of information particularly on BIPV. It further create obstacles to the developers in the implementation of BIPV. Furthermore, there is no clear statement, requirement or legislation that emphasises developers to adopt and develop BIPV. Hence, this paper discusses a research project that investigated the barriers and drivers of BIPV in the implementation in Malaysia from the perspective of developers. These factors are explored on an integral basis through in-depth interview approach. The most crucial ones will then evaluate and further develop into BIPV implementation framework. The resulting framework will provide valuable references specially to developers involved in future investments decisions for BIPV into their construction projects.

2. Literature Review

As BIPV adaptation is relatively new among the developers, a clear concept of sustainable materials that addresses the environment aspects of BIPV needs to be established. This can serve as a guide for developers. Besides that, the weak governance and regulations after 10 years being introduces is due to the developers whom are lack of interest which requires a more overarching policy making from the government [2,7]. The BIPV efforts have been hampers because of the short of information pass on and the cooperation among the government and private sector [11]. All these occur because of the hesitation in implementation by the government. As such, the barriers in BIPV need to be determined first in before any policy can be shaped to drive the BIPV implementation and adaptation among the developers. These concerns are portrayed in Table 1.

In Malaysia, the dependency on fossil fuel such as natural gas and coal for generating electricity is relatively high. Because of the production cost, inflation rate and limited stocks in the market, and appreciation of exchange rates, tighter demands, that does not side the Malaysia's present day economy, it causes the price for the supply of natural gas and coal becomes very sensitive fluctuating [22]. With these sensitivities escalation, Malaysian government may be facing the risk and challenge as the supply could be interrupt. Taking into consideration that the relocation of heavy subsidisation in fossil fuel electricity into the short-term assistance of BIPV projects, it can relieve the government of the long-term subsidy burden plus driving the BIPV implementation even further, reducing the risks from the volatile sensitivities.

On the other hand, BIPV still shorts of the overarching solar policy framework. This framework is essential in giving the guidance for the BIPV implementation. Besides, it can be functioned as the BIPV push factor [10]. The government's hesitant in implementation hence creating the lack of information flow and cooperation between the private sector and the government which hampers the RE and BIPV efforts [11]. The development of the Sustainable Energy Development Authority (SEDA) Malaysia portal, it smoothen the flow of information by allowing the online clarification and application. This shows that the government has the intention to give support to RE and BIPV [21]. In addition, the government also has allocation quota for each RE under SEDA to make it looks

profitable, meanwhile unfavorably making it hard for the investors who are keen to invest. The above-mentioned aspects are in respect with government's role on BIPV that can significantly influence BIPV advancement or adverse effect of retardation for BIPV implementation.

Table 1. Concerns in implementing BIPV

Concerns	Description
Affordability	There is a lacking in terms of financial resources. The stakeholders will be lacking in resources to support when the initial expenses is high although a project has a high return after the building is constructed [8]. Furthermore, the cost of sustainable materials are still uncertain as the specifying of sustainable materials will often take place a year or more before the actual purchase and procurement of the materials [9].
Concept of Sustainable Material	There is a lacking of awareness among construction practitioners in protecting the environment. They are not aware on the importance in protecting the environment from continuing contaminated by the waste generated by the construction industry [8]. Besides, sustainability is still a relatively new concept for construction industry in the developing countries of South-East Asia [9].
Code and Regulation	Public policies and some regulatory frameworks nowadays do not encourage the development of the construction sector [7,9]. Thus, it is directly affect the adoption of sustainable materials by developers for new construction projects. By the provision of code and regulation compliance, it will motivate more developers in the adoption of sustainable materials in their construction project.
Limited Availability of Sustainable Materials	Due to the limited and variable availability of sustainable materials, not many stakeholders from the construction industry know the application of sustainable materials. Some examples for this case is the difficulties faced when developers need to find adequate quantities of Forest Stewardship Council (FSC) or other certified sustainably harvested wood for projects larger than small house [6].
Lack of Readily Available Accessible Information	During the design and selection process, lacking of readily accessible and reliable information comparing alternative structural materials and systems is a significant barrier. It caused the stakeholder unable to make proper decision to adopt sustainable materials [6].

Besides, a study conducted by [23] regarding to the general public awareness for RE has shown constructive comments from Malaysian public perspective in the RE and a remarkably high response in solar. Despite the existing barriers in BIPV field, the results are still very encouraging. There are some financial limitations where financial institutions are still unconvinced to approve loans for the adoption of BIPV because it is still not worth taking PV modules as it is known as the detachable fittings and not as a fixture as one of a pre-requisite for large amount of investment or housing loan that possess a risk [10].

The interest rates are relatively high, extending the long payback period nearer to the lifespan of solar modules which makes it not lucrative enough plus the FiT rates are not "economic to scale" friendly with a capping in stage as the PV watt peak capacity increases. There is no need for the end user to fork out extra for maintenance. Furthermore, the cleaning is in the minimum state. This is because BIPV do not have any mechanical parts, for this reason, this makes it easy to maintain and very reliable, thus, making the month payback a significant amount [24]. Conversely, the long paperwork trail for application and inability to finance BIPV projects on the consumer side was due to the slow in response for BIPV implementation. Consequently, the developers are introduced to play a part as the BIPV catalyst for the government where they are will facilitate implementation and the end user are consumers [4]. As according to [21] the developers are not included in the current stakeholders for the implementation of BIPV, therefore this research tends to include the developers as one of the existing stakeholders, along integrating barriers and adaption of BIPV in it.

3. Research Methodology

This research utilises qualitative approach through in-depth interview method as the data collection tool. The targeted respondents are the developers in Malaysia, in which they had completed housing project(s) in the Iskandar Region in Johor, Malaysia. Purposive sampling is used in this matter of selection of respondents' as it is a common method for identification and selection of information-rich situation but has very limited availability of resources

[12, 13]. The respondents are also selected by their willingness to share their experiences and opinions in an articulate, expressive, and reflective manner, aside from only having knowledge and experience [15, 16]. The prerequisite of the respondents' company are: must have an office in the Johor region, particularly in Iskandar region and currently developing or completed a housing project in the Iskandar region. The contact information is being obtained from Real Estate and Housing Developers' Association Malaysia (REDHA) with over three hundred developers and narrowed down to 15 respondents from the IRDA. One of the reasons for the limited number of sampling is due to the limited numbers of developers that have already involved and completed residential projects in Iskandar region. [14, 16] mentioned the importance of availability and willingness to participate from the respondents can affect the purposive sampling. There are only 15 respondents that are willing to participate.

Table 2 indicates the participant background from top and middle management level. There is one participant from the top management which presently is the Managing Director as one of the developer's company with more than 10 years of experience in the construction industry, However, the bulk of the data comes from the middle management as the top management usually assigns the middle management to attend to interviews as the top management have a more busy schedule but the middle management are more to project coordinators or project engineers who are involved in the whole construction process from planning to completion. The analysis of the data from this research is by thematic analysis.

Table 2. Analysis of participant background

No.	Management level	No. of Participant
1.	Top Management	3
2.	Middle Management	12
	Total	15

Thematic analysis is one of the foundational methods for qualitative analysis. It involves the process of "thematizing meanings" to identify, analyse, and report patterns (themes) within data. It minimally organises and describes the data set in rich details [17]. Thematic analysis is used to analyse the data obtained from the interview. Thematic analysis uses rigorous and overt techniques to compile the results of research in order to provide reliable answers to particular question. Often the answers are cross check multiple times in order create consistent set of data [18]. The advantage of thematic analysis is its flexibility and does not require the detailed theoretical and profound technological knowledge of approaches to apply it [19]. An overall question is used to start the interview; however subsequent questions, sometimes impromptu, are used to obtain broader range of answer from the respondent. There is no necessary relationship between the question, the responses and the codes, and often desirable that there is a disjuncture between them [20].

4. Results and Findings

With the proposed developers as the new stakeholder member in the BIPV implementation, the many barriers, drivers, selection criteria etc. were identified in this particular study.

4.1. Barriers

Barriers are the hindrances that bottleneck BIPV implementation in the housing industry that is currently faced by the developers. This is an important step so that solution can be work out to solve the barriers or at least keep it under watch to help minimise impacts on the implementation. There are six themes that act as barriers for BIPV implementation that needs to be tackled at present.

- Expertise Limitation

Expertise is an essential in any profession including construction industry. Without expertise, there is not a benchmark quality for the job performed. All respondents concur to this barrier that it may hinder expansion of BIPV in the Iskandar region.

“We have known a few contractors that specialises in BIPV, however, mostly are not based in Iskandar.” (Res. D)

This also shows expertise limitation is one of the barriers where there are very few contractors in Malaysia that is certified and specialises in BIPV. In the context of Iskandar, there is literally only very few. However, the positive response from the developers shows promising outcome if the BIPV implementation were to go full scale in Iskandar with their willingness and openness to changes with sourcing from local and foreign if necessary.

- Lacking Promotion

All respondents agreed that currently the government has not done enough on current promotion to push BIPV towards the developers in the Iskandar region that is one of the reasons behind slowing the BIPV implementation in Malaysia since its conception. This lacking of information flow and cooperation are due more to the government hesitant to do a national wide promotion drive for BIPV among the private sector, as how the developers see it as a barrier. Without this first step of promotion, it hinders any cooperation between the private especially the developers who would prefer to stick to conventional construction rather to explore in newer green technologies such as BIPV. Furthermore, without any promotion from the government to fully implement BIPV, developers are more reluctant to extend and channel some of these benefits to the house buyers.

- Subsidised electricity (electricity price)

Subsidised electricity is one of the major barriers to full implementation of BIPV. The conventions energy source in the input is given subsidy and usually waived of taxation to give a cheap output in electricity. The electricity in Malaysia is currently considerably cheap.

“Electricity is cheap...it is very hard to convince the customers....” (Res. D)

This is because the conventional electricity generation fuel is from the raw materials like coal and natural gas. This fuel is heavily subsidised by the government as indicated by [2]. This subsidy given greatly reduces the competitiveness of green electricity especially BIPV, making it a barrier and looking unattractive towards both the house buyers and the developers, though BIPV has more potential than conventional electricity and taps on an unlimited source as [3] puts it. Thus, it adds difficulty for developers to convince the house buyers into installing BIPV in their houses, hence a barrier for the full implementation of BIPV. Furthermore, the electricity in Malaysia is tax free to the consumer, hence reducing the price even more. However, with the introduction of Good and Service Tax (GST) in 2015 to the electricity, definitely there is an increase the electricity pricing and help BIPV to be more competitive in electricity pricing in the future.

- Adoption Readiness

Adoption is a technique to replicating existing process into a project by a new party, in this case developers trying to implement BIPV in their housing project. The developers are unprepared to adopt the BIPV into their housing project. The current practice in Malaysia is using Feed-in-Tariff for BIPV where the utility company buys the electricity at premium price between the government and the house buyers and does not involve the developers. However, the exclusion of the developers in the conceptual framework has its implications. Most of the developers are left unprepared should an adoption of BIPV into their housing project should take place. It serves as a barrier to BIPV implementation that needs proper guideline and planning to help reduce cost and fully implement BIPV in the housing projects [7]. This may seem like a straightforward temporary barrier but it is crucial to explain the state of the developers who are currently on BIPV in the Iskandar region.

- Technology (Reliability)

Technology can also be a barrier in BIPV implementation, especially the reliability of the technology. BIPV panels have a high reliability as guaranteed by most of the BIPV manufacturers. Technology has always been for advancement but there are still questions concerning the reliability of the technology. Though BIPV has no mechanical parts, it is easy to maintain and very reliable, the developers think otherwise.

“Other than that free maintenance and a lower house price for green houses are a marketing strategy, provided the green material or BIPV is lower in cost and higher in reliability.” (Res. G)

BIPV system main consist of three things, which are the cabling, the panels and the inverter to convert direct current (DC) to alternating current (AC) which is a common electricity voltage that is used in houses at present. BIPV panels have a high reliability as guaranteed by most of the BIPV manufacturers with an average of 20 years lifespan. Cables on the other hand have no much problem, as it is the standard cables that are available in the market and commonly used for internal electrical distribution in houses. Therefore, the next questionable component is the DC/AC inverters. A faulty inverter renders the BIPV panels useless, as electricity is unable to flow through. This has financial implications and maintenance implications for the developers if BIPV is actually implemented in the housing project. Hence, this is a barrier for BIPV implementation in a long-term manner.

- Finance

Finance is a barrier to overcome by the developers when implementing BIPV in their housing project. Finance is essential in any project and is the lifeline of the project. Major developers may have a good cash flow and does not require the bank to intervene; however, most projects require banks or financial institution to act as a guarantor and the implementation of BIPV can be an additional burden to the developers in the housing project scale. Finance often affects a project and can be a barrier.

*“Other than that lower house price for green houses can be a great incentive, however this is not up to us to decide. The costs of green material are not cheap and the banks financing the project are the **determinant factor**.” (Res. D)*

In this case, banks play an important part. There is significant implication when the requirement for a financial institution as guarantor to the project is a wide common practice in housing industry. The interest rates that the financing bank charges on the project can be a major barrier to the implementation of BIPV in the housing project. Developers definitely intend to make a profit from the project; BIPV may be deadweight that reduces the profit margin of the developers. Besides that, finance also encompasses green material cost also. The cost of the BIPV materials is high for developers to procure. This is in line with the cost of sustainable materials where is susceptible to price fluctuation as the specification of the materials is takes place a year or more before the actual procurement occurs [6].

4.2. Drivers

Drivers are positive agitators that stimulates and expedite the BIPV implementation in the housing industry. Drivers can come in many forms and are usually a proposed solution to counter one or more barriers when fully applied. The drivers' approach in solving barriers is usually more pragmatic to be applied in the real world situation. Normally it is more logical and timely approached to solve an issue or a barrier; however, some new ideas are also accepted if it helps speed up the resolution of the issue, in this case, BIPV implementation among the developers in their housing projects. There are five themes under drivers in BIPV implementation.

- Incentive

Incentives are benefit given to help motivate the recipients to achieve a goal or an objective. In this case, the recipients are the developers in the construction industry and the goal is to implementation BIPV into their housing

projects. Incentive can be a motivation for developers in this case. However, the incentives discussed in this driver are more to non-financial incentives. All respondents agreed that accreditation is the most sought after incentive.

“Accreditation as green initiative project should be given, recognition from GBI or QCLASSIC perhaps. As for now, we look to CONQUAS and GREENMARK to attract foreign investment such as from Singapore to become potential house buyers.” (Res. C)

The reason is that this incentive gives a more marketable perspective for house buyers towards their housing projects. This accreditation acts as a guarantee for standards and quality, especially when BIPV implementation is still very new in the market. The accreditation also serves as a security for house buyers as first impression towards the company and its projects, a broader recognition from the local as well as the international community can be obtained. Incentive can be a financial or non-financial benefit, but in this case, the financial incentive is discussed under a subsequent theme and the incentives proposed under this theme are solely non-financial benefits.

- Policy

Policy is a set of principles or course of actions that helps the government to regulate or to change a certain situation. Policy acts as a guide for the implementation by providing a framework for action. [10] mentioned that the lacking of overarching solar policy framework to address BIPV implementation is the current situation in Malaysia. Formation of a policy is a definite driver to the developers in Iskandar. Not only there is a provision of the framework for implementation, but also as standardisation and by-law for BIPV implementation in the housing projects. Hence, the widespread of BIPV implementation in the Iskandar region can be done. Besides that, this policy provides a quality standard for implementation of BIPV and also governs the BIPV implementation. This helps in improving the information flow and cooperation between the government and the developers by the policy framework.

- Finance

This theme finance is the other incentive that takes account of the financial or monetary benefits of BIPV implementation. These benefits are incentives that the developers mind set are lucrative enough to motivate them to implement BIPV in their housing project.

“Other than that, tender priorities and green tax rebate would be good. For now, the corporate tax is at 25% and is said to be dropped to 24%. However, additional percentage can mean a lot to the company.” (Res. D)

This kind of incentive can be in a form of the corporate tax rebates given for employing green technology such as BIPV. The monetary benefits as the financial aids for developers can be in many forms, such as tax rebates or subsidy for material. At present, the corporate taxation stands at 25% of the developers' company income. The tax rebate given for every 1% brings significant value to the developers' company. This helps in increasing the liquidity and smoothening out cash flow within the developers' company besides having to pay the interest rates of the project in the case where the bank is financing their projects. Furthermore, material subsidy can be a plus for developers to gain benefits financially. This can be done via reimbursement or taxation reduction for green materials. Overcoming the barrier of high material cost for green material, especially for BIPV, which is, consider expensive, can be done through the green material subsidy. For instance, the price of the solar panels as of 2013 is estimated to be average around MYR 10,000 kWp. In the sense of cost allocation, the price for the solar panel is considerably high and people may be willingly to allocate this cost into other areas such as paying the overheads. By green material subsidy, it is able to further motivate the developers' company to apply for it and create a wide use of BIPV in the housing industry.

- Comprehensive housing loan

Normal loan packages have certain aspects of the house that are included. However, BIPV is not one of the aspects that are covered in the loan. This can benefit both house buyers and developers' in financial terms. As the loan package considers, it implies the increase in the approved loan amount, which then increase the chances of successive transaction between the buyers and the developers. The current loan practice does not include BIPV inside the housing loan as the PV modules are still considered as detachable fittings and are not a fixture; therefore, it poses risk to the banks that is lending.

“Comprehensive house packages that include BIPV as part of the house to reduce burden of the house buyer to come up with initial upfront would help.” (Res. C)

On the other hand, a house with BIPV is going to cost much more than the conventional houses. If BIPV is included in the loan, it increases the principal amount; hence increasing the amount needed to repay the loan or extends the number of years on the loan repayment. Therefore, comprehensive housing loan is necessary. This includes considerations such as transferring BIPV from fittings category to fixture instead and reducing the lending rate from houses equipped with BIPV to help ease the burden of the house buyers. It is also a point of attraction to market the houses to attract local and foreign investors to invest into houses in Iskandar region.

- Maintenance

The context of maintenance in this case is the free maintenance as an after sales service. Maintenance is an attractive driver that can help boost BIPV. The developers proposed free maintenance as a selling point for the houses, other than the ability to be above to generate additional income from the selling of the electricity via FiT mechanism. However, there is still the barrier of technology reliability that in this case is the DC/AC inverter. If the developers can still provide free maintenance for this after considering the cost for replacement incurred and the frequency of replacement, BIPV is definitely be very lucrative offer for the house buyers. Besides that, free maintenance can also include cleaning services for the BIPV glass panels to maximise the BIPV input due to dust as most research has taken it as an assumption factor.

- Promotion

Promotion is an important driver, as it can drive a wider awareness and knowledge of BIPV among the public. Promotion does not only help in creating awareness but also enhancing knowledge of the house buyers. It also helps the housing developers to increase marketability of the houses. On the developers' part, they suggested that exclusivity and price reduction for eco-houses. The exclusivity is more as special feature for the house. This maybe a short term but a powerful driver as the exclusivity decreases as the number of house with BIPV increase. This serves as an initial push factor for rapid BIPV implementation. Price reduction is a major driver under promotion for BIPV long-term but it is a chain effect from other drivers such as green material subsidy, working hand in hand. Hence, price reduction must have the collaboration from construction stakeholders such as banks and developers to achieve this promotion driver.

5. Discussion

BIPV Implementation framework is crucial in encompassing the whole situation to ensure the implementation of BIPV is a successful one. Fig.2 shows the entire framework. This framework shows the implementation of BIPV in the region of Iskandar from the barriers to the drivers. On one hand, the barriers are the limitations that the developers' face in the implementation. On the other hand, the drivers are the solution proposed by the developers to help overcome the barriers and boost BIPV implementation in Malaysia. Both themes are interconnected. It is for the purpose in achieving the objective, which is to investigate the Malaysia developers for the application of BIPV. The study done is in the Iskandar region, with the second largest number of stock houses among the states in

Malaysia. The subsidised electricity and limited finance are the consistent barriers faced by the developers meanwhile it is also highlighted by the previous researchers [6,8]. The consistencies of the barriers prove that the issues are critical and it has protracted for a period of time. Although there are some solutions that could push the BIPV implementation forward have been proposed by the developers. Among the solutions are such as comprehensive loan, financial benefits, and policy. Nonetheless, there is some difference in the researchers with the developers on the technology standpoint.

There are different opinions between researchers and developers whereby researchers support the cost saving in the maintenance part of BIPV while developers are still sceptical about the reliability and the additional burden for long-term maintenance. This contrasts could lead to the issues in which the developers is hesitant to implement BIPV despite the profits it can produce [6]. The developers also mentioned some new barriers and drivers for BIPV that has not pointed out by previous researches. As there is no policy that requires BIPV, among the reasons that cause the developers do not want to implement BIPV in full scale on the projects are the lack of promotion, adoption readiness, lack of incentive and also lack of expertise [2]. Some drivers use to help in overcoming some of the existing and new barriers are suggest by the developers in spite of facing many barriers. One of the drivers is incentives and promotion. It helps in the implementation of BIPV in the developers’ housing project. Moreover, these incentives and promotion bring mutual benefits towards the developers and help them to complement to one another. Incentives such accreditation and the eco-house price reduction are key drivers towards both the guiding developers and house buyers [10]. During the implementation of BIPV projects, these drivers effect are observable. These driver effects encompass the marketing from the developers to the house buyers and bring reduction to the principal amount for loan needed by the house buyers.

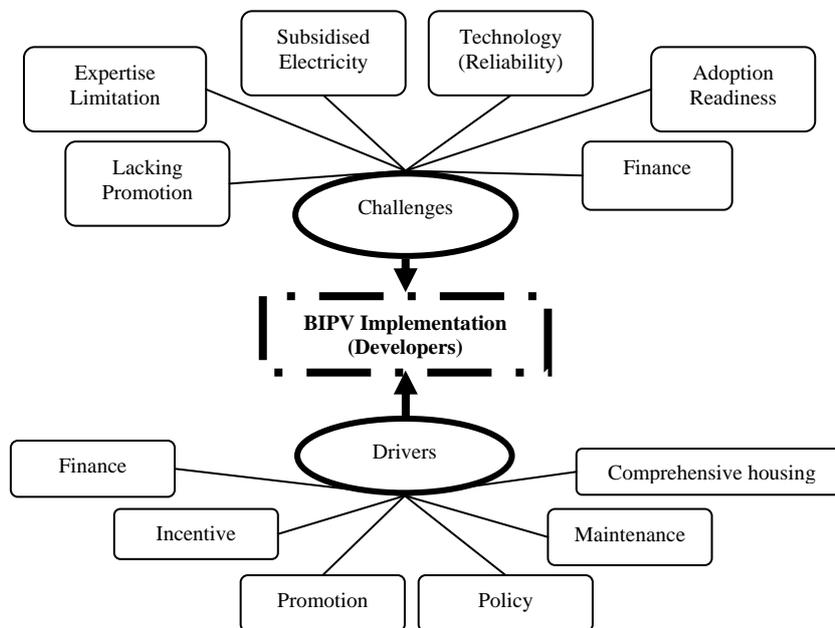


Fig. 2. BIPV Implementation Framework

6. Conclusion

Malaysia is still pursuing sustainable development especially in the construction industry. With the influx of investment in Iskandar, the blooming housing industry needs to look into sustainable development. BIPV is very promising as part of this initiative. Developers must play an important part to ensure this happens. This research reveals that the developers in Malaysia still face many barriers in order to adopt BIPV into their project. Their concerns on BIPV’s technology reliability, adoption readiness and financial implications have hindered them.

However, there are also drivers that industry stakeholders think are attractive enough to assist them in implementing BIPV into their projects. Therefore, this research carries a paramount importance for the reference of developers towards BIPV implementation. On the other hand, the other relevant stakeholders like the government needs to form more cooperative actions with the developers in order to succeed the implementation of BIPV in Malaysia.

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