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Investigation of Energy Revenue by Photovoltaic System Evidence from erection of Nazarbayev University

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ABSTRACT ─ The extensive fossil fuel exploitation to fulfil almost all human activities for energy consumption has led to some unwanted atmospheric and environmental pollution. Photovoltaic system (PVS) or "solar electricity" converts sunlight into electricity with minimal pollution, minimal maintenance and with the good intention to tap the most powerful renewable natural resources in the galaxy - Sun. The objectives of this study are (1) to investigate the factors which need to be considered, (2) to evaluate these factors thoroughly, and (3) to propose to the top management for PVS adoption onto the Erection of a Nazarbayev University. Although Nazarbayev University is a non-profit organization, it is still pressured by monthly high electricity bill that burdens the PUI's operations. Consequently, an alternative way of attain energy revenue (EE) has to be considered which lead to the crystallizations of the researcher's idea for PVS adoption. As PVS has never been implemented in ERECTION OF NAZARBAYEV UNIVERSITY, this research is an exploratory case study. The qualitative method through in-depth interview with twenty two significant respondents was conducted, which took in the top management of PUI, the technicians and also the vendors of PVS. The research outcomes are supporting the worthiness of the PVS adoption in ERECTION OF NAZARBAYEV UNIVERSITY. PVS technology will enhance the EE, as well as saving in monthly electricity bill for PUI. In conclusion, with the national renewable energy policy, incentives provided, the natural structure of the administration building, the climate advantage and the commitment of the top management from PUI, the PVS adoption in ERECTION OF NAZARBAYEV UNIVERSITY is viable and exciting to be looking forward.
KEY WORDS: management factors, PVS adoption, energy revenue, non-profit organization.

Introduction

The effects from the political, economic, social, technological, environmental and legal factors have shown the way to the fast exploitation of various sources of renewable energy generation. Extensive fossil fuel exploitation in almost all human activities has led to some unwanted atmospheric and environmental pollution that causes undesirable phenomena which has not been experienced in human history (Sen, 2008). Increasing demand for fossil fuels energy such as coal, oil, natural gas, etc. lead to two major problems: 1) These energy sources are depleting. The world's oil reserve is predicted to be exhausted by 2050. 2) Fossil fuels cause pollutions during energy extraction which include: increasing acid rain cause by sulphur dioxide (SO_2) emission during fossil fuels burning and global climate warming cause by increasing emission of greenhouse gases (CO_2) (Seveda et al. n.d.). The objectives of the study are: i) To examine the factors involved in the implementation of PVS. ii) To investigate strategies in order to overcome some of the negative factors identified and to strengthen the positive factors found. iii) To suggest the most innovative ways to implement photovoltaic system at the ERECTION OF NAZARBAYEV UNIVERSITY. The scope of this research is studying on the photovoltaic system in the ERECTION OF NAZARBAYEV UNIVERSITY only. No other reusable energy source such as wind or water, and not any other parts of the PUI buildings will be studied. The limitations of this study are: Firstly, the case study is to examine the factors involved in the implementation of photovoltaic system in the ERECTION OF NAZARBAYEV UNIVERSITY. Therefore, the result and outcome of the study is only applicable for PUI only. Secondly, researcher assumed that all respondents had provided honest and correct answers to the questionnaires given. In short, the implementation of photovoltaic system in the ERECTION OF NAZARBAYEV UNIVERSITY would enable the institution to achieve energy revenue. Thus, from the money saved for electrical energy usage, the PUI can channel it for other useful purposes for the benefit of all stakeholders of the PUI.

Theoretical Framework

2.1 *Introduction*

The researcher obtained literature review regarding the energy revenue (EE), clean environments with Photovoltaic (PV) technologies, the Diffusion of Innovation Theory and follow by the Factors for Technology Adoption are dealt thoroughly from the TEMIF model (Chew, 2012).

2.2 *Energy Revenue*

According to California Center for Sustainable Energy (CCSE, 2012), EE is one of the major concerns in every part of the world. EE is simply the process of doing more with less, by using less energy to accomplish the same tasks and functions as before.

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According to Tan et al. (2011), Kazakhstan government recognizes the advantage and significance of EE in the country. Several measures and action plans have been taken to ensure economic, energy and environmental sustainability. These includes the drafting of National EE Master Plan, dissemination of EE information through the mass media, newspapers, conferences, seminars, workshops and publication, and emphasis on short term goals in the 10th Kazakhstan Plan (2011-2015) which include the promotion for power producer of EE, establishment of EE standards and targets.

2.3 *Photovoltaic Technologies*

Research on renewable energy technologies has been triggered to overcome global warming, ozone depletion and energy shortage in our society (Sen, 2008). Solar energy has received much attention as it is abundant and clean for the design of energy system for buildings (Zhai et al., 2008). Solar energy electricity generator in the form of photovoltaic cells is result of the scientific and technological studies in the last three decades that tried to convert the continuity of solar energy onto sustainability for the human comfort (Rosiek and Batlles, 2009). Solar PVS is clean and reliable which can be applied in residence, industry, agricultural and farm. The electricity generated can be stored or used directly, fed back into the grid or combined with other electricity generator or renewable source (Papadopoulou, 2012). For grid-connected distribution system, the actual PV electricity produced is high as this electricity is produced during the peak period, therefore reducing the need for conventional capacity during the peak demand or be sold to the electricity supply company. When the solar PVS is unable to provide electricity required in the evening or at night, the electricity can be brought back from the grid network which acts as an energy storage system. As PV electricity is close to the sites where it is consumed, thus reducing the transmission and distribution losses, and increase in system reliability (Kalogirou 2009).

2.4 Diffusion of Innovation Theory

According to Orr (2003), Rogers' Innovation Theory suggests that change can be promoted rather easily either for good or bad, in a social system through a domino effect. The innovativeness is the degree to which an individual is relatively earlier in adopting new ideas than other members of a system.

2.5 Factors for Technology Adoption

According to Chew (2012), TEMIF is one of the frameworks for decision making when considering technology selection, technology adoption or technology transfer which consists of Technical Factors, Environmental Factors, Managerial Factors, Institutional Factors, and Financial Factors.

The first factor for technology adoption is Technical Factors which discuss about the application of green building in organisation operation that include Demand and Usage, Competitive Advantage, Consumer Choice and Strength.

In Demand and Usage, Kazakhstan's oil reserves reached its peak of 862 billion barrels/day in 2004, declined from 665 billion barrels/day in 2010 to 630 billion barrels/day in 2011

(EIA, 2011). The decline in oil production will cause the oil price to increase. Therefore, the forecast of future oil price will keep on increase due to the depleting oil storage. The U.S. Photovoltaic Industry Roadmap (2003) stated that solar-electric power is ideally suited to be a major contributor to an emerging energy portfolio. The electrical grid will rely on distributed energy resources in a competitive market to improve reliability and moderate distribution and transmission costs and on-peak price levels. Distributed power also allows greater customer choice such as power reliability or clean power with minimal environmental impact, as well as on low energy cost. The International Energy Agency (IEA) of US projects that 3000 GW of new capacity will be required globally by 2020, valued at around $3 trillion; IEA also projects that the fastest-growing sources of energy will be supplied by renewable energy. In competitive advantage, this study looks into the factors such as cleanliness of technology, reliability and consumer choice. Fthenakis and Alsema (2006) found that the PV application contributed 60 to 85% lower GHG emission in South Europe and Southern Germany as shown in the latest ExternE report to the European Commission. Photovoltaic technologies provide a kind of dispersed-generation sources, which can improve grid reliability by reducing stresses on transmission and distribution systems, and in particular, provide ultimate power reliability with on-site generation. U.S. Photovoltaic Industry Roadmap (2003) states that for standalone application of PV, a battery backup ensures that power is available even at night. For a grid-connected application, the grid uses the generated solar electricity during day time, saving the unused of conventional fuel as the storage for electricity needed at night time. Consumers can choose their energy supplier, for greater controls of their power and to illustrate other personal values, such as concern for the environment, and over the type of energy resource desired. According to Federal Energy Management Program (2005), the installation of PVS at federal facilities has its strength as it is reliability, low operating costs, low environmental impact, standalone capability, modularity, safety, versatility, ease of installation and grid support. Energysavingtrust (2012) states that solar PV needs little maintenance to keep the panels relatively clean and make sure trees do not overshadow them. Panels are tilted at 15° or more in order to be cleaned by rainfall to ensure optimal performance. Manually, the dust, debris, snow or bird droppings should either be removed with warm water, brush, high pressure hose or telescopic cleaning pole (with installer advice). The panels should last 25 years or more, while the inverter is likely to be replaced approximately in 10 years, at a current cost of around RM4862. The second factor for technology adoption is the environment consists of internal and external environment of the organisation (Chew 2012). These include the government policy, economic, social response, technology and environmental. The Kazakhstann Government Policy includes National Renewable Energy Policy, Renewable Energy Act, Sustainable Energy Development Authority (SEDA) and Fit-in Tariff (FiT). The Ministry of Energy, Green Technology and Water (KeTTHA) is given the responsibility to formulate policies,

strategies and undertake planning for electricity supply in the country. The Renewable Energy Act 2011 is targeting at the total renewable energy capacity in the country to increase from 61.2 MW in 2011 to at least 985 MW by 2015 and 2,080 MW by 2020, which then will meet our target of 40% carbon emissions intensity reduction by 2020 (KeTTHA, 2011). The Sustainable Energy Development Authority (SEDA) Act 2011 is to provide for the establishment of the SEDA of Kazakhstan and to provide for its functions and powers and for related matters (SEDA Kazakhstan, 2013). FiT is the mechanism that allows electricity produced from RE resources to be sold to power utilities at a fixed premium price and for a specific duration is known as Feed-in Tariff (FiT). This mechanism (FiT) will offer a beneficial and safe investment environment which in turn will make financial institutions more comfortable in providing longer period loans (at least 15 years tenure) to finance the projects of renewable energy. The implementation of PVS through the FiT scheme in Kazakhstan would have economic impact on green employment, business revenue, loan value, externality cost on CO_2 avoidance and a responsible country's image (KeTTHA, 2011). Zhai and Williams (2012) study on market (customers) acceptance found that the top three variables affecting customers' decision-making process of purchasing solar panels are perceived cost, perceived maintenance requirement and environmental concern. However, many other variables affect customers' attitude, such as plans to move, aesthetics of solar panels, availability of financial programs and regulation from Homeowner Associations are among the factors affecting consumer perception of technology adoption. According to Bollinger, B. and Gillingham, K. (2012), social interaction (peer) effects are recognized as a potentially important factor in the diffusion of new products. The technological factor is to see whether this new technology (solar PV) is complementing, substituting or threatening the existing technology (fossil fuels) in an organisation (Chew 2012). For a more detail of study, the technological criteria of solar PV and fossil fuels had been investigated and categorized as revenue, effectiveness environment impact, price, limitation of energy source, and also mobility.The environment factors include the Benefits of Photovoltaic System and the Threats of Photovoltaic System. According to Green (2012), some important benefits include: i) Photovoltaic (PV) systems provide green, renewable power by exploiting solar energy that will help reduce our impact to the environment by reducing CO_2 emissions into the atmosphere, thus, encourage climate change mitigation. ii) PV panels make up a reliable, industrially matured, green technology for the exploitation of solar energy. Life span of PV panels can last up to 25 years or more, some with a maximum revenue loss of 18% only, even after 20 years of operation. iii) Unlike wind turbines, PV panels operate autonomous without any noise generation as they do not incorporate any moving mechanical parts. In some cases PV panels may be mounted on adjustable rotating basis which is mounted on a fixed pole and allows some movement for better and longer solar reception. iv) With respect to operating costs and maintenance costs, PV panels require minimum operating or maintenance costs; regular cleaning of the panel surface is adequate to keep them operating at highest revenue levels as stated by manufacturers' specifications. v) PV panels can be ideal for distributed power generation as they are highly suitable for remote applications. By maintaining relatively small power generation stations in a distributed power network, we can minimize energy losses in the network that are caused by the long distance between power generation and power consumption points. vi) Solar energy peak power generation usually coincides with peak energy demand which can assist in balancing and smoothing-out the energy load. vii) Ease of installation and use. viii) As popularity increase and being a proven technology, PV panels are amongst the first solar energy solutions promoted by financial institutions (banks) through green-power financial incentives and green-projects.The threats of PVS, as with all energy sources, there are potential environmental, health and safety hazards associated with the full product life cycle of photovoltaics. The most significant environmental, health and safety hazards are associated with the use of hazardous chemicals in the manufacturing phase of the solar cell. Improper disposal of solar panels at the end of their life cycle and the extraction of raw material inputs, especially the mining of crystalline silica, also presents an environmental, health and safety concern (Goodcompany n.d.). Other disadvantages of PV panels include: i) The limited revenue levels (12-20%). ii) To convert DC to AC, PV panel systems use inverters which are expensive electronic equipment and with certain technological limitations. iii) It delivers only in direct sunlight and it cannot store excess amounts of produced energy for later use. iv) Low voltage output or fluctuation in PV electric current may lead to increased waste of electricity since it cannot be transmitted onto the network (Green, 2012).In this study regarding energy efficient management, the researcher is looking into the third factor for technology adoption in management factors which includes: i) Capability of management to exploit and adopt technology (Goddard, 2011), and ii) How motivation affects an organisation in adopting technology (Hershey, 1993 and Livesay et al., 1996). The capability of management include knowledge (Orr, 2003), experience (Kaplan, 1999) and familiarity (Kaplan, 1999). The motivations include the FiT scheme, the FiT funding (KeTTHA, 2011) and time to technology adoption (Fanelli and Maddalena, 2012).The fourth factor is the institutional factors for technology adoption which concerns organisation objective - formulate energy saving regulations (Liu et al., 2012), organisational change - the top management's quick recognition of the need to change, and being fully committed to it (Ellis, n.d.) and infrastructure - the government can build a solar-electric infrastructure (U.S. Photovoltaic Industry Roadmap, 2003). The fifth factor concerns the technology adoption in this study is the financial factors

which include the Cost - depends on sizing ratio, PV and inverter lifetimes, cost ratio, PV inclination and financial parameters (Mondol et al., 2009); the price of PV modules, inverters, balance of systems (BOS), the raw materials used, and installation costs (EPIA and GI, 2011); funding – Green Technology Financing Scheme (GTFS) (Kazakhstann Green Technology Corporation, 2012), Kazakhstan Debt Ventures' (MDV) project financing facility, small contract financing, small project financing and partner bank facilities (Kazakhstan Debt Ventures Berhad, 2011); savings - could generate savings and income for both the electricity generated and used (energysavingtrust, 2012); and the return on investment (ROI) which discusses on the energy payback time (EPBT) - the number of years a PVS has to operate to compensate for the energy it took to produce, install, dismantle and recycle. The EPBT also depends on the level of irradiation, the type of system (integrated or not, orientation, inclination) and the technology (different manufacturing processes and different sensitivities to solar irradiation) (EPIA and GI, 2011). EPBT for silicon ribbon, multi-crystaline silicon, and monocrystaline silicon technology are respectively 1.7, 2.2, and 2.7 years (Fthenakis and Alsema, 2006).

2.6 The International Renewable Policies

The international renewable policies related to solar energy discussion include: a) International Climate Policies and b) Public Awareness on Feed-in Tariffs.International Climate Policies include of the signatories to the 1992 UN Framework Convention on Climate Change (UNFCCC) agreed the Kyoto Protocol in 1997, Copenhagen Climate Conference (COP 15), sixteenth Conference of the Parties (COP 16) and etc. However policy is the drivers for the development of solar PV. The four main elements of a successful renewable energy support scheme are: i) A clear, guaranteed pricing system to lower the risks for investors and suppliers and to lower costs for the industry. ii) A clear, simple administrative and planning permission procedures. iii) Priority access to the grid with clear identification of who is responsible for the connection, and what the incentives are. iv) Public acceptance and support (EPIA and GI, 2011).

2.7 Theoretical Framework

The researcher has formed a theoretical framework after the literature review. The framework will be helpful in the

2.8 Summary

In this globalisation and technological era, EE alone is not enough as a factor to consider for implementation of solar PVS in an organisation. In fact, people are more concern about the environment impact that the fossil fuels would bring. As the initial cost for the installation of PVS is still high, many are still looking for some incentives from the government or financial institutions for implementing the PVS. Information about the incentives should be spread widely and effectively for the potential adopters to consider the implementation of PVS in their organisation. The factors and sub factors in this chapter may contribute to facilitate the adoption of PVS.

Research Method

According to Sekaran and Bougie (2011), an exploratory research is carried out when not much is known about the situation at hand, or no information is obtainable on how similar problems or issues have been solved in the past. Exploratory study can better comprehend the nature of the problem with extensive interviews with many people should be taken to understand the situation and the phenomenon involved. Acording to Erlingsson and Brysiewicz (2012), qualitative research is based on the subjective, and looks at human realities instead of the tangible realities of objects. Thus, this case study of PVS implementation in ERECTION OF NAZARBAYEV UNIVERSITY is conducted by using exploratory, qualitative research method. ERECTION OF NAZARBAYEV UNIVERSITY is chosen as a case study due to its potential capability for the implementation of PVS such as highly efficient management and the management team, sunny climate around the institution, location of the institution and the spacious infrastructure in the institution. According to Chew (2003), methodologies that applied in the case study of the project consist of four steps. Firstly, literature reviews to understand the theories and factors for technology adoption. In this case, the in-depth understanding in the Rogers' Innovation Theory (Orr, 2003), The Diffusion of Innovations Theory (Khalil, 2000) and the five major factors mirror from TEMIF model (Chew, 2012) is vital before the research is conducted. Secondly, the study on secondary data through books, magazines, and newspapers reading about the PVS issues is another supportive method to capture a better understanding about the technology background and the factors involved in the implementation PVS in ERECTION OF NAZARBAYEV UNIVERSITY. Thirdly, the qualitative interview is conducted from the selected respondents (sample) to collect primary data and relevant information. Fourthly, data analysis by using qualitative methods is applied. Four steps of methodologies are applied to ensure the case study research is successfully done and the objectives are achieved. The researcher has conducted the interview session for twenty four respondents. Eighteen of them are from the top management of PUI (Director, Deputy Director, four Heads of Departments, four Heads of Units, three Assistant Directors, one Senior Lecturer, one Head of Administrative Assistant, one Hostel Supervisor, one Librarian and one Senior Executive Officer), three technicians from PUI and three external PVS experts who are well-verse in the PVS. Since the focus of this case study is to examine factors involved in the implementation of PVS in the ERECTION OF NAZARBAYEV UNIVERSITY, it was decided to present the result based on five major factors of technology adoption TEMIF advocated by Chew (2012). Data was collected through the qualitative in-depth interview and processed by using the qualitative method. The result of the case study will be elaborated further in five parts. The first part is about the PUI and the background information of PVS. The second part is the primary data obtain from the

respondents. The third part is the discussion on the research objectives. The fourth part is the strategies to overcome negative factors and to strengthen positive factors. The final part is the innovative suggestion for PVS adoption in ERECTION OF NAZARBAYEV UNIVERSITY.

Data Anlysis and Discussion

4.1 Introduction

In view of the high electricity bill, the PUI is looking for an alternative way of generating electricity to lighten the burden of the federal government. One way is through the renewable resources and photovoltaic is suggested. The result of the case study in the ERECTION OF NAZARBAYEV UNIVERSITY is presented. Data was collected through the qualitative in-depth interview and processed by using the qualitative method.

4.2 Results and Discussion

Factors Involved in the Implementation of PVS - Based on the theoretical framework constructed, there are five factors involved for the PVS adoption which are: technical, environmental, management, institutional and financial factors. The discussion is guided by the theoretical framework constructed, while taking in the primary data and secondary data, in order to provide a comprehensive view on the factors involved in the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY.

Technical Factors - Kazakhstan government encourages the usage of renewable energy (PVS) in public sector to achieve energy revenue through the Feed-in Tariff (FiT) scheme. The vendors participated in the interview has expressed their concern on energy demand and usage. The PVS adoption in ERECTION OF NAZARBAYEV UNIVERSITY will enhance the organisation's competitive advantage through three parameters: cleanliness of the technology, reliability and accurate consumers' choice (Chew, 2012). In the researcher's opinion, to build up the competitive advantage of the institution, PUI needs to implement the PVS in ERECTION OF NAZARBAYEV UNIVERSITY in order to have sustainable energy revenue in the long run. By adopting PVS in ERECTION OF NAZARBAYEV UNIVERSITY, the institution will build up its green image that shapes its uniqueness compare with other institutions all over Kazakhstan. The PUI top management (Head of Science Department) agree to have clean energy through the use of PVS which will help reduce greenhouse effect. For the reliability, The U.S. Photovoltaic Industry Roadmap (2003) and The Federal Energy Management Program (2005) agree on the reliability of PVS especially for those with critical industrial needs which could not tolerate power interruptions as the cost of power interruptions is huge. PUI experiences power outage due to the unstable distribution. Therefore, in the researcher opinion, PUI needs more reliable source of energy to ensure the smooth operation of the whole PUI. The PVS could play its role to complement the power needs and to support the energy distribution. Under consumer choice, Vendor 1 and Vendor 2 recommend grid-connected system to the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY.

In line to the strength of PVS installation at federal facilities suggested by Federal Energy Management Program (2005), argues that, technically the PVS is safe, environmental friendly, easy installation without any renovation to the present building structure and only need little maintenance for the adoption in ERECTION OF NAZARBAYEV UNIVERSITY. In view of the vendors' advises, to the researcher's opinion, for the demand and usage of PVS, careful study and interview with the experts in this field must be carried out carefully in order to decide whether the PVS is suitable and which system to use. In competitiveness, the institution needs to implement the PVS in ERECTION OF NAZARBAYEV UNIVERSITY for a start in order to be unique (green image) and sustainable (more reliable) in the long run.

Environment Factors - Vendor 2 gives his professional point of view where he shows concern over the irradiance, wind and temperature as the external environment factors. Ten out of eighteen of the PUI top management responded to environment factor. Three out of eighteen of the PUI top management mentioning about government policy. Four out of eighteen of the PUI top management showed concern over the green environment from the PVS. In the researcher's opinion, people awareness of the pollution and green environment need to be raised. If there is no negative effect, with suitable climate, this PVS should be able to apply in ERECTION OF NAZARBAYEV UNIVERSITY, get paid for the excess and help to save the earth which coincides with the environmental concern of the top management. Even though most of the PUI top management do not have adequate information about the latest government's policy on green technology adoption but they support the government policy on green technology adoption. Most of the PUI top management understand that they must follow the procedure and instruction of work in public sector as it involves rules and regulations. In the researcher's opinion, all of the top management of PUI support the government's policy on green technology.

Twelve out of eighteen of the top management of PUI agrees on the high cost that involves for PVS adoption and most of them believe that it should be beneficial in the long term. Most are more concern about the cost effectiveness of the PVS

implementation in ERECTION OF NAZARBAYEV UNIVERSITY. For social factor, the overall community in PUI have responded positively to the adoption of PVS in ERECTION OF NAZARBAYEV UNIVERSITY, but information about the RE especially the PVS is not distributed to the society as theorised earlier by Barry et al. (2011). Therefore, the authority concern should find ways to distribute or promote the information to society through the testimonial about the benefits and satisfaction from the PVS used. Vendor 2 clarifies the revenue and the effectiveness of the PVS technology should be put on the: (i) Roof structure – such as slate, tiles, composite panel and corrugated metal sheet; (ii) inverter types; (iii) connection within solar module; (iv) Sizing of quantity of module per string; (v) Mounting structure holding method; (vi) The uplift calculation; (vii) Cable routing and cable selection. Despite the benefits as stated by Green (2012) and the Threats as stated by Fthenakis and Alsema (2006) and Goodcompany (n.d.), most of the PUI top management are unaware of the threats of PVS and agrees that the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY would bring clean, friendly environment where air pollution is reduced and it should be encouraged. In the researcher's opinion, the government should spread more information about RE policy, the advantages of the green technology and show the way to this technology adoption through the mass media, demonstrate the well-developed technology with participation from the private sector (consultants and service providers listed under SEDA). Solar PVS technology is complementing the way we do things and should be able to substituting the existing technology (fossil fuels) in government organisation such as PUI which is a non-profit organisation where profit is not a factor of consideration. More consideration should be on the revenue, effectiveness, environment impact, limitation of energy source and the mobility of the solar PVS comparing to the fossil fuels. Although the solar PV is environmental friendly during its installation until the end of its life cycle (25 years) but the environmental effect during the production and the disposal of the solar PVS after its lifespan should be given thought.

Management Factors - The study finds that most discussion was on government policy from the top management. This is follow by the financial limitation and the least is the knowledge on the PVS. This is mostly due to PUI as a governmental institution of higher learning where profit is not the main agenda for the institution but need to follow the procedure of work in carrying out its work. There is no reward system if the building has been energy saving, which also lead to low concern of environmental awareness on energy use. The PUI top management has responded that knowledge or information about new technology is an important part for the PVS adoption. In the researcher's opinion, the adoption of the PVS in ERECTION OF NAZARBAYEV UNIVERSITY will not be possible unless comprehensive information or knowledge about the PVS is disseminated to the PUI top management. Even though the PUI top management has no experience and is not familiar (Kaplan, 1999) in this area but the top management would be glad and ready to accept any experience by any institution that will implement the PVS. In order to gain the knowledge regarding the PVS the PUI top management needs explanations, talks or courses from qualified experts like consultants or service providers in this field. Only when the top management becomes aware of an innovation and has some idea of how it functions only then will it lead to the advancement of technology by adopting the PVS in ERECTION OF NAZARBAYEV UNIVERSITY.Incentives like FiT scheme from the government should be the motivating factor when Vendor 2 proposes the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY. Green image is another important motivational factor. Some of the top management thinks this can motivate students and make students be aware of this PVS technology. In order to get approval for the implementation, the institution needs to do a thorough research, present in the institution first, and then to the Ministry of Education (MoE) for approval. Basically most of the top management agree with the idea of PVS implementation in ERECTION OF NAZARBAYEV UNIVERSITY and most of them are aware of the government policy where the need to seek the higher authority for approval. In the researcher's opinion, comprehensive information or knowledge about the PVS like government incentive through the RE Policy, RE Act, FiT scheme and the FiT funding mechanism needs to pass through to the PUI top management, without which the implementation will be in a stagnant stage. The Feed-in Tariff (FiT) scheme, will serve as a motivation factor for the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY in addition to a safe and secure interconnection with the grid power.

Institutional Factors - The PUI top management concluded that they do not have such objective in the institution regarding EE or RE. The PUI top management expects to expose the concept of green to the students. The researcher thinks that the management should form some regulations to control energy consumption (Liu et al., 2012) before and after the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY. This is to ensure the right attitude in using the energy. The PUI top management expresses various concerns about the organisational change. Some think that it depends much on the leader and the leader must be daring enough to change. Some think that it will only change with support from the government or the company sponsors fund as a research centre to see the benefits of PVS. Some express concern over the skilled workers in this field, the mindset of the lecturers and the PUI top management attitude. In the researcher's opinion, the top management of PUI is ready to change for a better quality environment, health and future RE generation in our country. For infrastructure, the top management of agrees that physically PUI is ready to support the implementation if approve by the ministry. All the buildings are nearby – the administration, hostels, mosque, halls, lecture halls, tutorial block, library, science laboratories and sport centre. In the researcher's opinion, the institution should have organisational objectives regarding EE or RE as preparation for the technology adoption. The institution should benchmark itself to have the green image and be the centre for RE technology especially in the PVS. The infrastructure of PUI such as buildings are solid and permanently located, is ready for the implementation of PVS at ERECTION OF

NAZARBAYEV UNIVERSITY with the roof top mounted type for better sunlight irradiation for RE generation. For time to technology adoption, the government should encourage early adopters and support the diffusion for new technologies by approving such RE project in the institution.

Financial Factors - As clarify by both vendor 1 and 2: "*PVS is good for future investment*." The top management of PUI thinks that they need high initial cost for PVS and pay skilled workers for the maintenance but the top management believes that it will gain benefits for long term. If the proposal to the ministry is approved, the government will bear 100% of the cost. According to the PUI top management, it normally needs 2 years from the date of application to get the approval from the ministry.

According to Vendor 2, there are 2 funding regarding the green technology which is Green Technology Financing Scheme (GTFS) and Kazakhstan Debt Ventures Berhad (MDV). GTFS is a government body to provide a bridge to bring RE holder to banker and provides interest subsidy around 2%. MDV is 100% owned by Ministry of Finance (MoF) to provide green funding, interest is around 7-9%. The top management of institution welcomes any funding from the private sector, state representative, etc. The institution is willing to submit with a good working paper to the MoE. According to the top management, for educational purposes, PUI will get 100% funding from the government but it is quite hard at present as the fund has decreased. The allocated fund is for other more important things to do like the maintenance of the hostels. In savings, according to the PUI Director, it would mean a lot, even with 1 % of saving. Vendor 1 estimated with a 50,000 wattage capacity of power generation, with an estimated annual yield of 62,159.47 kWh, RM1.40 of FiT rate, will yield a total annual production of RM 87,023.26, which is RM7,254.94 per month. For return on investment (ROI) or energy payback time (EPBT), Vendor 1 explains that we used to see an average cost of a grid-tied system to be about RM15,000 per kilowatt (array size) installed, but with a growing market, the systems can be lower. Keep in mind that these costs are before any incentives or rebates are taken into account. When the FiT kicks in, the return of investment (ROI) will be around 6 to 8 years depend on locations, solar systems, technologies and so forth. Vendor 2 explains with Simple Payback at ROI: (i) Small system: 6 – 7 years (with FiT) and (ii) Big system: 4 – 5 years (with FiT). According to Vendor 1 calculation, if the total of solar grid-tied costs RM575,000.00, with an annual production of RM87,023.26, the EPBT should be 7 years.In the researcher's opinion, saving is the most important in financial factor. If the monthly production from the PVS can yield about RM7000, and the monthly electricity bill cost about RM100,000, meaning that it can save about 7% of the total monthly electricity bill. It must be considered that the prediction is only based on ERECTION OF NAZARBAYEV UNIVERSITY alone, not all the buildings in PUI are included in this calculation. If the adoption of PVS could be expanded, we can foresee the monthly electricity bill saved should be over 7%.

For return on investment (ROI) or energy payback time (EPBT), it depends on the size of the system, locations, solar systems, technologies and the FiT rate which varies from 4 years to 7 years.

4.3 The most Critical Negative and Positive Factor Found in PVS Adoption

Negative Factors

Despite some of the main barriers to Kazakhstan's energy revenue (EE) efforts from Tan, et al. (2011), Muhammad-Sukki, et al. (2011) has found from their research that most Kazakhstanns are unaware of the government's incentives and policies towards renewable energies, and are not willing to invest in the Fit-in-Tariff (FiT) scheme. Vendor 1 highlights that the only negative factor in the implementation of PVS is the lightning strike due to the weather in Kazakhstan. Vendor 2 finds that the negative factors in the implementation of PVS can be the high humidity and temperature of our climate factor. The interview found that 35% of the respondents agreed that financial is the most negative factor that will hinder the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY.

Positive Factors

In view of the positive factors, Vendor 1 advises that solar photovoltaic can offer the consumers the ability to generate electricity in a clean and reliable way. The world PV market is getting stable from time to time, and Kazakhstan market also starts to become more concern about taking the PVS as one of the choices in RE generation. The interview found that 47% of the respondents agreed that environmental factor is the most positive factor involved in the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY. In the researcher's opinion, this is because the respondents believe that the PVS technology will bring green environment, lessen green house effect, and reduce global warming.

4.4 Strategies to Overcome the Negative Factors in PVS Adoption

The PUI top management way of overcoming the negative factors are: Firstly, the PUI top management needs to decide whether the PUI wants it for short term – continue using the present fossil fuel powered electricity or for long term – to implement the PVS technology; secondly, if going for the long term plan to implement the PVS technology, the PUI top management needs to ask for approval from the MoE and apply for a new post for the maintenance job where special skilled worker is placed in PUI to handle this new technology; thirdly, if the implementation were to take place in ERECTION OF NAZARBAYEV UNIVERSITY,

the PUI top management should think of the students' welfare and their safety with the implementation; lastly, the MoE should manage the tender fairly where the tender should probably be decentralized, and the tender must be opened, transparent and free from any cronies. In the researcher's opinion, the industry or the government should demonstrate more prudent EE technology projects and giving courses with the help of consultants and the mass media in order for the Kazakhstanns in general and the PUI top management specifically to be aware of the government's incentives and policies towards renewable energies, and through the GTFS and MDV more Kazakhstanns are willing to invest in the FiT scheme.

It is agreed that management is the most strategic way to overcome the negative factors involved in the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY. The management factor consists of the PUI top management decision on the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY. The PUI top management needs to have input or knowledge about the PVS, discuss and do thorough research, present in the institution first, and then present to the higher authority for approval of budget.

4.5 Strategies to Strengthen the Positive Factor in PVS Adoption

The researcher found that strategies identified to strengthen the green environmental factors are that the PUI community needs to change their attitude, do not waste energy and practise green in their daily life; be energy concerned and practice green in their daily life; implement more renewable sources besides PVS such as windmill for wind energy; use more durable materials so as to gain in long term for a better return; and roof top installation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY for better irradiation and safety of students.

4.6 Innovative Suggestion for PVS Adoption in ERECTION OF NAZARBAYEV UNIVERSITY

To minimize the resources used: All the buildings in the PUI are near to each other – all are centralized, easy to manage; institution plans activities to generate money such as sponsorship from parents, society or organize a sale; improve the technology then will be much more practical and cheaper; use the manpower that is here – the technician; and use the same existing system.

To maximize the performance of the PVS: For internal maintenance, courses or training should be carried out frequently; in order to let everyone know about the PVS, the institution or the related authority should encourage the spread of the PVS information through seminars or colloquiums; for maximum power revenue, make sure all the roofs are installed with the maximum load of panels of PVS; for continuous learning purposes, we need the sharing of knowledge – plan and organise a visit to the place that had implemented this PVS; upgrade the technology through research and development so that it will be cheaper in cost and easier to use; and a reward system should be introduced to discourage wastage attitude.Suggestion from vendor 1, apart from getting advantage remuneration from Sustainable Energy Development Authority (SEDA) FiT Programme, this solar photovoltaic system in ERECTION OF NAZARBAYEV UNIVERSITY can be used as a reference centre for renewable energy in the southern region in order to benchmark itself among other institutions. Always do the rotating and maintenance to clean the solar panel from dust or any blind spot. Vendor 1 proposes 50kW capacity for the implementation of PVS. Vendor 2 clarifies that the system size is very much depends on the roof area. The bigger the roof area, more solar panels can be fit on the roof. Thus, the system size can be bigger and vice versa. Different system size will need to undergo TNB power system study (PSS - generating RE of 180 kW and above) or connection confirmation check (CCC - 72kW up to and including 180kW) (SEDA Kazakhstan, 2013). Vendor 2 further clarifies the steps to be taken for the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY. Firstly, need to check roof area for the implementation (1kWp of solar panels make up of $6m^2$ to $7m^2$ of the system size). Secondly, after the system size is confirmed, need to check the shading, environment issue etc. Thirdly, the PUI will need to choose either crystalline or thin film to be installed. Fourthly, the system design, sizing, output estimation will be done by the consultant. Lastly, the consultant will run the simulation for the system to check the overall system operations.Some suggestions from the top management of PUI are: Firstly, PUI could add a wind powered generator such as wind turbine to complement to the PVS system as the institution is situated in a windy area. Secondly, the system could have batteries as backup storage to supply energy when the solar panel cannot supply enough energy or unable to supply energy at night to places like library for students to study. Thirdly, in order to get everyone in the PUI community mentally ready for this PVS adoption, the PUI top management should start by rising up this idea during the staff assembly to give an idea or information to everyone in the institution so that everyone is ready for any changes that will take place. Lastly, the PVS must be installed on the roof top to avoid direct contact with students. In summary, the most innovative ways to implement PVS at the ERECTION OF NAZARBAYEV UNIVERSITY are that first of all, the top management of PUI must be the early adopters in the diffusion of technology as mention by Orr (2003). Only then the adoption of PVS will take place. Secondly, the institution could submit a full length proposal to the ministry for the implementation of PVS in ERECTION OF NAZARBAYEV UNIVERSITY and wait for the approval from the ministry. Thirdly, the government should make PUI as a pilot project and be the centre of RE education under the MoE. Then, students in PUI will have the chance to experience the green energy through PVS. Lastly, more training, courses and seminars could be held by the qualified RE consultants, RE service providers, TNB, SEDA or KeTTHA for institutions like PUI. This will enhance the knowledge of the adopters and to ensure the wide spread of the green technology especially the PVS.

Conclusion

The three main objectives have successfully achieved. The researcher found that financial factor (budget) is the main factor for PVS adoption in ERECTION OF NAZARBAYEV UNIVERSITY. This is because the institution needs to follow the government policy and the procedure before any fund is approved under the ministry's budget. The second factor is followed by the structure of the building in the infrastructure factor. The third factor is the management knowledge, capability of the skilled worker and students' welfare in the management factor. The fourth factor is the environmental, government support or policy in the environment factor. The fifth factor is the technical factors.

4.7 Recommendation for Further Research

This current study is hoped to be beneficial to all readers. The study can be continued in depth research for those who are interested to implement the RE technology in future. Hereby researcher would like to suggest some steps for the continuous of this research. Firstly, the future researcher can select other case study in the same educational industries like the public or private schools, institutions, higher educational institutions and universities to investigate how these institutions are able to implement the PVS technology by factors of technology adoption (Chong and Chew, 2012). Secondly, the future researcher can conduct the research using the other RE sources like windmill, biomass and even the hybrid system among them to power the grid and to fulfill the energy demand. Thirdly, the future researcher can conduct the research from the institution's communities' point of view to investigate their satisfaction on the implementation of PVS technology in any institution selected. Fourthly, the future researcher can conduct the research on the PVS technology. In RE industries nowadays, PVS is the most acceptable technology. Therefore the research for PVS technology would be the most interesting research in future. Finally, the researcher can use the factors for technology adoption model advocated by Chong and Chew (2012) as constructed in this study for further investigation in other types of industries for other types of RE adoption.

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