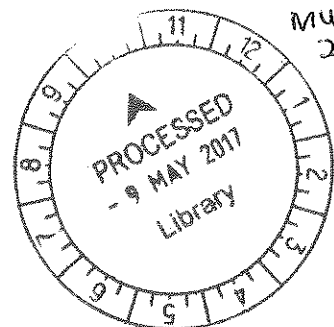


INTI INTERNATIONAL UNIVERSITY
MASTER OF BUSINESS
ADMINISTRATION

**Exploring the Implementation of
Solar Energy in Higher Education
Institutions in Malaysia.**

AUTHOR	MAYIBONGWE TAFARA MUDZENGI
STUDENT ID	I11008879
ETHICS NUMBER	CBUS/PGT/CP/02696
SUPERVISOR	Assoc. Prof. Dr. Lee Kar Ling
SUBMISSION DATE	16 DECEMBER 2016
FINAL WORD COUNT	14873



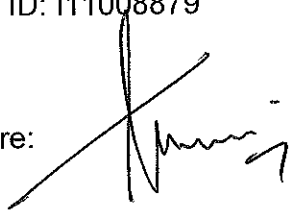
Declaration

I hereby declare that this thesis is my own work and effort and that it has not been submitted anywhere for any award. Where other sources of information have been used, they have been duly acknowledged.

Name: Mayibongwe Tafara Mudzengi

Student ID: I11008879

Signature:

A handwritten signature in black ink, appearing to be 'Mayibongwe Tafara Mudzengi', written over a horizontal line.

Date: 14TH DECEMBER 2016

Research Abstract

The area of research aims, to explore the implementation of solar energy in Higher Educational Institutes (HEIs) in Malaysia, to evaluate the prospectus usage of solar energy and Government policies, incentives and increasing the implementation of renewable energy solutions as well research into institutions currently using Solar Energy, determining how the educational institutions and community could benefit from a solar array.

Renewable energy is the key to a better world which needs to be adopted and embraced with uncluttered mindset were the need of adoption of solar energy in Higher Educational Institutions (HEIs) in Malaysia and the present-day precipitous rise, global adoption of solar energy is well documented. Various types of institutions will be included in the research, Private, Government, Semi Government to attain a broad spectrum on the energy needs in the Malaysia educational system.

The research will adopt qualitative research methods as qualitative research methods will enable the researchers to understand people better based on what they say and what they do (Myers, 2013), which will have analyzed and cross tabulation of the groups. The adoption study of a solar energy in HEIs could be substantially beneficial for all parties involved, administration, students, research and creating green environment, a comprehensive feasible analysis, recommendation with the developing some propositions, hence the adopting the focus group method as the research designs for the study to be rationale (Jennings 2009).

A qualitative approach to the research involved 7 interviewees from two groups, the HEIs and professional expertise in solar energy. Based on the findings, solar energy is a favorable energy alternative to implement for HEIs in Malaysia. Establishing a good energy saving culture is the advocator of application of solar energy in HEIs in Malaysia

Key words: Solar, HEIs, Case Study

ACKNOWLEDGEMENTS

First and foremost, I would like to thank Almighty God for his unconditional mercies and guidance throughout my research. On the very outset of my research, I would like to extend my sincere & heartfelt obligation towards all the personages who have enabled me in this endeavor. Without their active guidance, help, cooperation & encouragement, I would not have made headway in this dissertation.

I am ineffably indebted to Associate Professor Dr. Lee Kar Ling for her conscientious guidance and encouragement to accomplish this research. I am extremely thankful for the support she provided throughout my research, with her patience and knowledge whilst allowing me the room to work in my own way. I could not have imagined having a better advisor for my project. Thank you to my second examiner Dr. Mun Geet Ow Yong for his valuable guidance and support on completion of this research.

I also acknowledge with a deep sense of reverence, my gratitude towards my family, who has always supported me morally and in prayer. I extend my gratitude to INTI International University & Faculty for giving me this opportunity to enhance and enrich my educational development to world cutting edge.

Next, I would also like to show my gratitude towards the selected organizations and the interviewees that have participated in the interview and shown their support to my research.

Lastly would like to thank all of my friends, classmates who directly or indirectly helped me to complete this research, any omission in this brief acknowledgement does not mean lack of gratitude.

Contents

Declaration	i
Research Abstract	ii
ACKNOWLEDGEMENTS	iii
Chapter 1.....	6
Introduction	6
1.1 Overview	6
1.2 Background of the Study	7
1.3 Problem Statement	8
1.4 Research Objectives	9
1.5 Grounded Theory	10
1.6 Research Questions	11
1.7 Propositions	11
1.8 Significance of Study	12
1.9 Scope of the Research.....	13
1.10 Limitations of Study	13
1.11 Operation Definition	14
1.12 Organization of Study.....	15
1.13 Conclusion	16
Chapter 2.....	17
LITERATURE REVIEW	17
2.1 Overview	17
2.2 History of Solar Energy.....	18
2.3 Malaysia Current Energy	19
2.4 Types of Solar Panels.....	27
2.5 Existing Solar Installation Solar Energy in Educational Institution.....	31
2.6 Malaysia Energy Policies	33
2.7 Grounded Theory	37
2.8 Research Gaps	38
2.9 Conceptual Framework.....	39
2.10 Propositions	40

2.11 Conclusion	40
Chapter 3.....	41
3.1 Overview	41
3.2 Research Design	41
3.3 Purpose of the study	42
3.4 Group Differences	42
3.5 Focus Group Approach.....	42
3.6 Research Framework	43
3.7 Cross sectional	44
3.8 Unit of Analysis	44
3.9 Sampling Selection and Techniques.....	44
3.10 Proposed Interview Questions.....	45
3.11 Description of the Case Study Groups	47
3.12 Higher Educational Institutions' Profiles.....	47
3.13 Chapter Conclusion	49
3.14 Ethical Considerations.....	50
3.15 Gantt chart	50
Chapter 4.....	51
4.1 Overview	51
4.2 Demographic data of interviewees.....	51
4.3 Profile of the interviewees.....	52
4.4 Propositions Testing.....	55
4.5 Key Findings and Discussion.....	59
4.6 Conclusion	64
Chapter 5.....	64
5.1 Overview	64
5.2 General Conclusion	64
5.2.1 Discussion and Conclusion of Proposition Testing.....	65
5.3 Contribution to the literature	67
5.4 Contribution to Industry	67
5.5 Limitation of the research.....	68
5.6 Recommendation.....	69

5.7 Future Research Direction	69
5.8 Personal Reflection	70
5.9 Conclusion	70
6.0 References.....	72
7.0 Appendixes.....	77
APPENDIX A: INTERVIEW QUESTIONS.....	77
APPENDIX B : INITIAL RESEARCH PROPOSAL	143
APPENDIX C : MBA Rubric	192
APPENDIX D: TURNITIN RESULTS	193
APPENDIX E: UH ETHICS CONFIRMATION AND NOTIFICATION	194
APPENDIX F: MASTER PROPOSAL DEFENSE	195
APPENDIX G: MBA PROJECT LOG	196

Figures

Figure 1: Suruhanjaya Tenaga (Energy Commission)	24
Figure 2 Suruhanjaya Tenaga (Energy Commission)	25
Figure 3 Annual average value per square metre of solar cell.....	27
Figure 4: Solar system: source: National Renewable Energy Laboratory (NREL).....	27
Figure 5 : Solar system: source: National Renewable Energy Laboratory (NREL).....	28
Figure 6: Solar system: source: National Renewable Energy Laboratory (NREL).....	28
Figure 7 : Solar system: source: National Renewable Energy Laboratory (NREL).....	29
Figure 8 : Solar system: source: National Renewable Energy Laboratory (NREL).....	30
Figure 9: Solar system: source: National Renewable Energy Laboratory (NREL).....	30
Figure 10: 325kW solar canopy system in the parking of Whole Foods in Brooklyn, NY.....	31
Figure 11 Total cost of project for Monash University PV installation	32
Figure 12 Monash University PV installation.....	32
Figure 13 Limitation of Renewable in Malaysia.....	33
Figure 14 Renewable energy estimated capacity	34
Figure 15 National Renewable Energy Goals	34
Figure 16 Potential photovoltaic.....	35
Figure 17 Malaysian Photovoltaic Technology Entities	36
Figure 18 Gantt Chart	50
Figure 19: Suruhanjaya Tenaga (Energy Commission)	165
Figure 20 Suruhanjaya Tenaga (Energy Commission)	166
Figure 21 (Malaysia Radiance Mekhilefa , 2012	166
Figure 22 Annual average value per square metre of solar cell.....	168

Figure 23: Solar system: source: National Renewable Energy Laboratory (NREL).....	167
Figure 24 : Solar system: source: National Renewable Energy Laboratory (NREL).....	169
Figure 25: Solar system: source: National Renewable Energy Laboratory (NREL).....	169
Figure 26 : Solar system: source: National Renewable Energy Laboratory (NREL).....	170
Figure 27 : Solar system: source: National Renewable Energy Laboratory (NREL).....	171
Figure 28: Solar system: source: National Renewable Energy Laboratory (NRE).....	171
Figure 29: 325kW solar canopy system in the parking of Whole Foods in Brooklyn, N	173
Figure 30 Total cost of project for Monash University PV installation.....	174
Figure 31 Monash University PV installation.....	174
Figure 32 Limitation of Renewable in Malaysia.....	176
Figure 33 Renewable energy estimated capacity	176
Figure 34 National Renewable Energy Goals	177
Figure 35 Potential photovoltaic.....	178
Figure 36 Malaysian Photovoltaic Technology Entities.....	179
Figure 37. Theoretical framework of Technological Acceptance Model (TAM).....	181

Tables

Table 1: Profile by the Respondents	53
Table 2: Preliminary Analysis Result showing the Understanding of the Research	54
Table 3 Proposition Testing Results.....	59
Table 4 : Interviewees Findings.....	62

Nomenclature

PV: photovoltaic

RE: renewable energy

FDP: Fuel Diversification Policy

TNB: Tenaga Nasional Berhad

TNR: Tenaga Nasional Research

BIPV: Building Integrated Photovoltaic

ISE: Institute of Solar Energy

MBIPV: Malaysian Building Integrated Photovoltaic

MP: Malaysia Plan

NDPC: National Development Planning Committee

MP: Malaysia Plan

MEWC: Ministry of Energy, Water and Communication

EC: Energy Commission

R&D: Research and Development

MoE: Ministry of Education

EIA: Environmental Impact Assessment

FiTs: feed-in tariffs

RM: Ringgit Malaysia

USD: United States Dollar

GWh: gig watt hour

Chapter 1

Introduction

1.1 Overview

This research paper entails an analysis of various types of solar technology in buildings around Malaysia (Safari 2011).

The period of creating electric force in expansive steam-controlled focal stations appears to have finished. The expanded attentiveness toward ecological effects of ordinary fossil powers, in particular those identified with environmental revolution, has been the principle component driving the move towards efficient power energy and era of force most positively from renew able energy sources that is free (Mekhilef, and Saidur 2011).

The chapter will cover, further research into the background of study, problem statement, research objectives, research questions, significance, scope of study, limitations of study with operational definitions and highlight of organization of this research to end the chapter. The area of research aims to exploring the implementation of solar energy in HEIs in Malaysia, existing HEIs with solar systems implemented into the infrastructure, energy policies and future prospects.

Renewable energy is the key to a better world which needs to be adopted and embraced with uncluttered mindset were the need of adoption of solar energy in Higher Educational Institutions (HEIs) in Malaysia and the present-day precipitous rise, global adoption of solar energy is well documented in this chapter. Various types of institutions will be included in the research, Private, Government, Semi Government and Private to attain a broad spectrum on the needs of the main sectors in Malaysia educational system (Bodger, 2009).

The HEIs by 2011 were about 28.3 million with a multi-ethnic population, with a breakdown of 20 public, 53 private and six foreign university branch campuses;

Solar energy is a clean and readily available source across the earth the extra-terrestrial is radiation emitted by the sun at a constant 1367W/m^2 , with intensity which varies all through year, as the distance of travel increases (Nakkela 2016).

1.2 Background of the Study

About 1.6 billion people are deprived to the access to electricity, being plunged into darkness the world has pledged to convene and tackle the energy crisis in sight of the forthcoming depletion of fossil fuels (ElBaradei, 2008). The world consumption is estimated, 10 terawatts (TW) per year, by 2050 estimated to rise to 30 TW on the other hand estimated 20TW non-co₂ is needed to stabilize the atmospheric conditions faced today (Zweibel 2005).

Green energy reduces the carbon footprint which have low negative impact to the environment, were solar energy is classified under compared to the natural fossil fuels which have contributed to the depletion of the ozone layer, which emits rays which have led to the increase of global warming, which has caused environmental unrest, the use of solar energy is on an rapid growth in the market which began in the 1980s as multi megawatt photovoltaic plants produced power (Maycock 2010).

Malaysia being located along the equatorial space has an average radiation of 4500kWh per square meter, 4,5 to 8 hours of sunshine per day, enabling Malaysia to be a potential solar hub (Sriram, Frost and Sullivan (2006, 2011). Promotion of renewable energy has commenced in Malaysia, due various reasons, increase of oil imports, price and environmental awareness, global investments piloted in the Tenth Malaysia Plan has enticed RM9.8 billion to renewable energy, which is estimated 20% of electronic industries (Adinoyi and Said 2013).

Educational awareness of solar around the world is a common phenomenon vital on the creation of sustainable supply, parallel coordinated action on energy matters, poverty, climate change among many other issues were heads of state need a mutual solution (ElBaradei 2008).

In 1998 July, the first PV technology was installed on a university roof which gave Malaysia insight as the first practical experience of grid-connected PV though it was basic very experience at the time but still functioning today (Ruoss 2007). The University Malaysia Perlis UniMAP is the first public university in Malaysia to install 1.0 megawatt (MW) capacity solar system (Suruhanjaya Tenaga 2010).

A Private, Semi Private and Government institutes will be analyzed to ascertain the feasibility of implementation of solar energy in their campus.

1.3 Problem Statement

The area of research, exploring the effective Implementation of Solar Energy in Higher Educational Institutes (HEIs) in Malaysia, existing HEIs with solar systems implemented into the infrastructure, energy policies and future prospects. Renewable energy is the key to a better world which needs to be adopted and embraced with uncluttered mindset were the need of adoption of solar energy in Higher Educational Institutions (HEIs) in Malaysia and the present-day precipitous rise, global adoption of solar energy is well documented in this chapter. Various types of institutions will be included in the research, Private, Government, Semi Government and Private to attain a broad spectrum on the needs of the main sectors in Malaysia educational system.

Green environment will inspire, teach younger generation educational to contribute to making the global citizens in the wake of rise of global warming and unrest around the world (Pinto 2013). The chapter presents the current usage of solar energy in the Malaysian market, also abroad with anticipation of the public and private financial sectors providing financial incentives in solar technology and adoption (Ching,2016). The private sector, Malaysia has anticipated the encouragement of sustainable development in the application of solar technology in infrastructure (Nohuddin, Sharip, Radzi ,2016.)

The research gap falls between scholar research which has extensive research on solar system globally, lack of module design for HEIs implementation (particularly), basic need of solar utilization. On the other hand, HEIs' in Malaysia have low implementation of solar systems, end user perception, government initiatives (Zarim, 2016).

During the World Future Energy Summit (WFES) January 2016, in the United Arab Emirates, Professor Dr. Kornelis Blok stated there is a need for broad-based education, which is actually lagging behind the momentum for renewable energy in society, were the need to educate students who can work in future renewable energy areas, but we need to train already established professionals in how to use the new technologies (McKenzie, 2013).

The power usage in HEIs has been gradually surging along with the growing student population in Malaysia directly influencing the rise the cost of energy supplied to HEIs. Alternatives energy source to ease the usage and cost of energy consumed (Chua, (2012).

1.4 Research Objectives

The adoption and implementation of solar energy in Higher Educational Institutes (HEIs) in Malaysia today have the following objections:

- 1 To explore if implementation of solar energy as an alternative energy source is feasible in Higher Educational Institutes (HEIs) in Malaysia.
- 2 Explore the current energy utilized by HEIs.
- 3 To explore the usage of solar energy and Government incentives related to the implementation of solar energy solutions in HEIs.
- 4 Determining the educational benefits for the institutions and community at large would benefit from solar array.

1.5 Grounded Theory

Technological Acceptance Model (TAM) has been widely used to explain the acceptance of an information system and numerous literature reviews are available in this area (Surendran, 2012). Many researchers Adams, Nelson and Todd (1992), Chin and Todd (1995), Mathieson, Peacock and Chin (2001) and Moon and Kim (2001) of information system have confirmed that the TAM has two main concepts; perceived usefulness and the perceived ease of use in estimating the acceptance of information system by the individuals. In this framework of TAM, system quality, and the quality information are two main aspects that affect the use and the user's satisfaction (Roca, Chiu, and Martínez, 2006). Kettinger and Lee (1994) re-examined the model and mentioned that one more important aspect is defined in this model is quality service to user's satisfaction.

According to Yousafzai, Foxall and Pallister (2010), the theory of Reasoned Action was the foundation of TAM theory by (Fishbein and Aizen, 1975) that helped Davis (1989) to come up with the TAM model. TAM focus on the external factors that affect the actual use and the intention through moderated effect on the perceived ease of use and the perceived usefulness (Park, 2009).

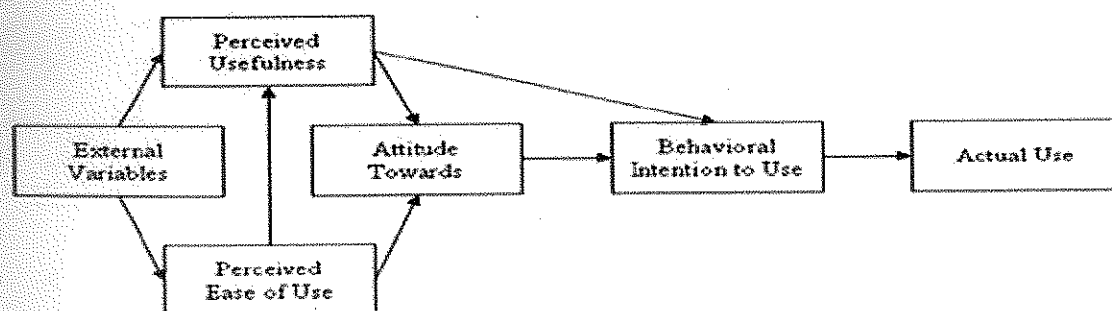


Figure 5. Theoretical framework of Technological Acceptance Model (TAM) Source: Park (2009)

1.6 Research Questions

This research focuses on exploring the use of relevant approaches in implementation of solar energy in private higher educational institutions. The following are the main issues and concerns in this research:

1. What are the key factors to consider when accessing the implementation of solar system in HEIs'?
2. How can the implementation of solar energy in educational institutions become a future trend in HEIs?
3. What are the challenges and limitations in Malaysian energy policies directed to solar energy for HEIs?
4. What the pros and cons in the adoption and usage of solar energy HEIs'?

1.7 Propositions

1. P1: Higher Educational Institutes (HEIs) in Malaysia, are able to use solar energy as an alternative source of energy.
2. P2: The Government energy incentives support the usage in of solar in Higher Educational Institutes (HEIs).
3. P3: Solar energy has become a potential and future Renewable Energy in HEIs' Malaysia.
4. P4: Solar energy has educational benefits for HEIs and Malaysian community