

**Knowledge Management Platform for  
Promoting Sustainable Energy  
Technologies in Rural Thai Communities**

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## DECLARATION

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary educational institution.

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## **ABSTRACT**

Sustainable energy services aim to meet the energy demands and to improve the living standards of rural communities with the utilization of sustainable energy technologies. Such services are becoming increasingly important due to the reduction of traditional energy resources and the ongoing increase in the demands. The demands are mainly due to the growth of population, domestic consumptions and industrial uses. In addition, increasing awareness of issues such as global warming, carbon emission, peak oil and the need for a sustainable environment has kindled keen interests in sustainable energy around the world. Many projects on sustainable energy services have been launched and particularly in developing countries. In most areas, at least one type of sustainable energy resources is available. In the case of Thailand, in addition to resources such as solar and wind, there are other sustainable energy resources in the forms of biomass and waste residue from agricultural products. However, there exist practical problems hindering the success of many sustainable energy projects. Two key reasons are the lack of in depth knowledge regarding the sustainable energy systems among the local users, and the limited budgets for planning, research and development. Therefore, the need to promote better understanding of sustainable energy technologies is necessary in order to gain better utilization of the energy services and acceptance by the community. One possible solution is the use of a Knowledge Management System (KMS). Based on advanced Information and Communication Technology (ICT), the integration of knowledge

management and web technologies has enabled KMS to be developed as an effective tool for the sharing, management and dissemination of valuable knowledge on any particular subject. This combination has the potential to promote the knowledge and initiate relevant activities thereby enabling the acquisition and management of diverse types of information and data. Typical functions and services which could be provided are: checking updated information on sustainable energy resources around a particular area; teaching of sustainable energy systems development and maintenance processes; sharing of best practices and lessons learned...etc. With the availability of the internet, a Web-based KMS will be a valuable channel for the gathering, sharing, extracting and dissemination of knowledge about the sustainable energy services for the Thai communities.

This thesis presents the research and development of a knowledge management (KM) platform for sustainable energy technologies. The system is implemented with web GIS server-side application and it is installed at the School of Renewable Energy Technology, Naresuan University, Phitsanulok, Thailand. To assess the effectiveness of the developed system, surveys in the form of pre-questionnaires and post-questionnaires from the users are used. Such information is used to determine the effectiveness of the system and to measure the improvement of the participants' knowledge on the subject. There are three groups of participants involved in this study: local government administrators, researchers and general users. The overall results of the questionnaires reveal that the participants are satisfied with the performance of the KM platform. The results also indicated that the KM

platform provides adequate knowledge on the subject and it has a high level of user friendliness. It was found that the participants' knowledge is also increased and the increase is in proportion to the time they engaged with the KM platform. A linear regression analysis of the researchers and local government administrators has shown that the increment of the participants' knowledge has a linear relationship with the learning period on the KM platform with statistical significance. Findings from this study can be used as a guideline and for further development on improving the local Thai communities' knowledge on sustainable energy technologies.

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Finally, I dedicate all my work to my parents and family, for their unconditional love, well wishes and steadfast trust in me.

## SUMMARY OF CONTRIBUTIONS

The contributions of this research are summarised as follows:

1. Research and development of a knowledge management platform to promote and enhance knowledge for local government administrators, researchers and community in Thailand. The problem of lack of knowledge on sustainable energy is common in most parts of the world and particularly in the rural communities. In this study, the utilisation of the state-of-the-art technologies such as Web services, GIS and a knowledge management system provide practical benefits to the community. Although the Information and Communication Technology (ICT) infrastructure in the local community is ready, not all the tools and resources are used efficiently. Thus, the proposed KM platform exploits the potential of these technologies and assists the community to realize the potential of the local resources and the usefulness of the tools. In addition, the integration of Web GIS and KMS offers a new means to promote the development the sustainable energy sector. The benefits include sharing and exchanging information of the KMS across the boundaries of computer hardware, software and communication network.
2. The knowledge on the platform will assist the establishment and more efficient use of sustainable energy services which include both traditional and renewable energy resources. This leads to advantages such as:
  - Maintaining efficient use of energy resources including both renewable and traditional energy sources.



- Local community will be able to gain economic value from the agricultural waste residues. The utilization of biomass in local areas will contribute to the solution of agriculture and household waste disposal.
  - Reducing the environmental degradation due to cut back of the use of firewood.
3. The research has provided an education and training platform for the stakeholders. The participants have gained knowledge after engagement with the system. Empirical studies have carried out and quantitative data collected. Results from the analysis have provided insights on the background of the participants and quantitative information on the minimum time that the participants should spend on the system. This could in turn be used as guidelines for future design and development.

## LIST OF PUBLICATIONS

The following list of papers is the collection of journal or conference papers produced during the course of this study. They have reported the results and findings from this research. These papers have either been published or submitted for consideration at the time of writing this thesis.

1. **Payakpate J.**, Fung, C.C. and Nathakaranakule S. (2008), 'Improving Thailand Life Environment with Knowledge on Sustainable Energy', Accepted for presentation in the International Conference on *ICT, Society and Human Beings (ISHB2008)*, Amsterdam, the Netherlands, 22-24 July, 2008.
2. **Payakpate J.**, Fung, C.C., and Nathakaranakule S. (2008), 'A Knowledge Management Platform to Assist E-business in Sustainable Energy Services', Accepted for presentation in *the 7th Wuhan International Conference on E-Business (WHICEB 2008)*, Wuhan, China, May 31 – June 1, 2008.
3. **Payakpate**, J., Fung, C.C., Nathakaranakule S. and Marinova, D. (2008), "Promoting Knowledge on Sustainable Energy in Digital Ecosystem", *Proceedings of the 2<sup>nd</sup> IEEE International Conference on Digital Ecosystem and Technologies (IEEE-DEST 2008)*, 26-29 February, 2008, Phitsanulok, Thailand, ISBN: 1-4244-1490-3, pp 352-357.

4. **Payakpate J.** and Fung C.C. (2007), 'A Knowledge management System on Sustainable Energy Technologies for Thailand', *Proceedings of the Eighth Postgraduate Electrical Engineering and Computing Symposium (PEECS 2007)*, ISBN 1-74067-5673, Perth, Western Australia, pp. 181-184.
  
5. **Payakpate J.**, Fung, C.C., Nathakaranakule S. and Marinova, D., (2007), 'An Integrated Web-GIS Knowledge Management System to Enhance and Promote Knowledge on Sustainable Energy Technologies', *Proceedings of the International Conference on Energy Planning, Energy Saving, Environmental Education (EPESE' 07)*, Arcachon, France, October 14-16, 2007.
  
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10. **Payakpate, J.**, Fung, C.C., Nathakaranakule S. and Marinova, D., (2005), 'Prototype Knowledge Management Platform for Modern Rural Energy Service in Thailand', *Proceedings of The 6<sup>th</sup> European Conference on Knowledge Management (ECKM 2005)*, University of Limerick, Ireland, 8-9 September 2005, ISBN 1-905305-07-9, pp. 398-403.
  
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12. Khor S.W., **Payakpate J.**, Khan S. and Fung C.C. (2004), 'Fuzzy knowledge representation for decision support', *Proceedings of the Fifth International Conference on Knowledge Based Computer Systems (KBCS)*, 2004, pp. 186-195.
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14. **Payakpate J.**, Fung C.C., Nathakaranakule S., Cole P. and Depickere A. (2004), 'A Knowledge Management Platform for the Promotion of Modern Rural Energy Services in ASEAN countries', *Proceedings of the IEEE Region 10 conference (TenCon 2004)*, 21-24 November 2004, Chiang Mai, Thailand, Vol. C, pp. 535-538.

## TABLE OF CONTENTS

<b>DECLARATION</b>	<b>ii</b>
<b>ABSTRACT</b>	<b>iii</b>
<b>ACKNOWLEDGEMENTS</b>	<b>vi</b>
<b>SUMMARY OF CONTRIBUTION</b>	<b>viii</b>
<b>LIST OF PUBLICATIONS</b>	<b>x</b>
<b>TABLE OF CONTENTS</b>	<b>xiv</b>
<b>LIST OF TABLES</b>	<b>xix</b>
<b>LIST OF FIGURES</b>	<b>xxi</b>
<b>ACRONYMS</b>	<b>xxiv</b>
<b>CHAPTER 1: INTRODUCTION</b>	<b>1</b>
1.1 Research Problem	9
1.2 Research Questions and Hypotheses	12
1.3 Research Aims	15
1.4 Organization of the Thesis	15
<b>CHAPTER 2: SUSTAINABLE ENERGY TECHNOLOGIES</b>	<b>18</b>
<b>IN RURAL AREAS</b>	
2.1 The Need for Sustainable Energy Services	18
2.2 Sustainable Energy Services	21
2.2.1 Solar Energy	21
2.2.2 Wind Energy	24
2.2.3 Hydro power	26

2.2.4 Biomass	28
2.2.5 Cook stoves technologies	29
2.3 The Needs for Sustainable Energy Services in Rural Thai Communities	31
2.4 Summary	34
<b>CHAPTER 3: KNOWLEDGE MANAGEMENT SYSTEM (KMS)</b>	<b>36</b>
3.1 Knowledge Management (KM)	36
3.1.1 Definitions of KM	37
3.1.2 KM Activities	39
3.2 Knowledge Management System (KMS)	41
3.2.1 KMS Architecture	41
3.2.2 Functionalities of KMS	44
3.3 KMS on Sustainable Energy Services	45
3.4 Technologies and Tools for KMS on Sustainable Energy Technologies	50
3.4.1 Web Geographic Information System (GIS)	52
3.4.2 Web GIS Client Side Application	56
3.4.3 Web GIS Server Side Application	58
3.5 Summary	59
<b>CHAPTER 4: RESEARCH METHODOLOGY</b>	<b>60</b>
4.1 Research Design	60
4.1.1 Research Approaches	62
4.1.2 Research Phases	64

4.2 Initial Investigation	66
4.2.1 Identify of the Location of Case Study	66
4.2.2 Information Gathering	69
4.3 Evaluation	71
4.3.1 Pre-questionnaire	72
4.3.2 Post-questionnaire	74
4.3.3 Participants in this Study	74
4.4 Summary	75
<b>CHAPTER 5: DESIGN &amp; DEVELOPMENT OF</b>	<b>76</b>
<b>    THE KM PLATFORM</b>	
5.1 Overview of the System	76
5.2 Use Case Diagram	80
5.3 Database Structure	84
5.4 Features of the KM Platform	89
5.5 Summary	96
<b>CHAPTER 6: RESULTS AND ANALYSIS</b>	<b>97</b>
6.1 Results from Pre-questionnaire	98
6.1.1 Comparative Demography between	98
Each Group of Participants	
6.1.2 Internet Infrastructure	99



6.1.3 Participants' Background Experience on Knowledge Management	104
6.1.4 Means Score of Pre-test	107
6.2 Results from Post-questionnaire	108
6.2.1 Participants' Behaviour on Using the KM Platform	108
6.2.2 Participants' Level of Satisfaction with the KM Platform	111
6.2.3 Mean Value of Post-test	115
6.3 Pair T-Test	115
6.4 Linear Regression Analysis	116
6.5 Summary	121
<b>CHAPTER 7: DISCUSSION AND CONCLUSION</b>	<b>123</b>
7.1 Verifying the Research Hypotheses	123
7.2 Answering the Research Questions	125
7.3 Discussion	127
7.4 Further Research	132
7.5 Summary	135
<b>REFERENCES</b>	<b>138</b>

<b>APPENDICES</b>	<b>150</b>
Appendix A – The System Design Diagram	150
Appendix A.1 – Use Cases	150
Appendix A.2 – Use Case Scenarios	151
Appendix A.3 – Sequence Diagrams	154
Appendix B – Graphic User Interfaces (GUIs)	157
Appendix B.1 – The main page	157
Appendix B.2 – Operation: biomass energy	157
Appendix B.3 – Calendar	158
Appendix B.4 – Forum	158
Appendix B.5 – Contact us	159
Appendix B.6 – An Example of Member Page	160
Appendix B.7 – Lessons learned	161
Appendix C – Database Structure	162
Appendix D – Copies of Consent Letter, Pre and Post-questionnaires	
Appendix D.1 – English Version of Consent Letter	165
Appendix D.2 – English Version of Pre-questionnaire	169
Appendix D.3 – English Version of Post-questionnaire	176
Appendix D.4 – Thai Version of Consent Letter	
Appendix D.5 – Thai Version of Pre-questionnaire	
Appendix D.6 – Thai Version of Post-questionnaire	

## LIST OF TABLES

Table 2.1: Examples of sustainable energy services	33
Table 3.1: Examples of existing KM technologies which match with functional architecture	44
Table 5.1: Browsing use case scenario	83
Table 5.2: Access Rights of participants relating to the features of the KM platform	95
Table 6.1: Percentage of how often the participants use the Internet	101
Table 6.2: Participants' opinion on the level of Internet connection	103
Table 6.3: Percentage of places where the participants have used KM	105
Table 6.4: Results on how often the participants use KM platforms	105
Table 6.5: Mean and standard deviations of pre-test	107
Table 6.6: Frequency of access by the participants to the KM platform	110
Table 6.7: The percentage of participants who accessed non-member services on the KM platform	110
Table 6.8: Mean, standard deviation and interpretation of level of general users' satisfaction to the KM platform	112
Table 6.9: Mean, standard deviation and interpretation of level of researchers' satisfaction to the KM platform	113

Table 6.10: Mean, standard deviation and interpretation of level of LGAs' satisfaction to the KM platform	113
Table 6.11: Mean, standard deviation and interpretation of level satisfaction to the KM platform of the member and non-member group	114
Table 6.12: Mean and standard deviation of post-test	115
Table 6.13: Pair T-Test of pre-test and post test	116
Table 6.14: Results of linear regression analysis showing the relationship of <i>all participants'</i> learning periods on the platform and the different value between pre-test and post-test	117
Table 6.15: Correlation value between learning period and the difference value of pre-test and post-test in each group of the participants	118
Table 6.16: Result of linear regression analysis showing the relationship of <i>researchers'</i> engagement period on the platform and the increment between the pre-test and post-test	118
Table 6.17: Result of linear regression analysis showing the relationship of <i>LGAs'</i> learning period on the platform and the different value between pre-test and post-test	120
Table 7.1: Mapping the features of the KM platform with Nonaka model	128

## LIST OF FIGURES

Figure 1.1: GDP and population of Thailand	7
Figure 1.2: Final Energy Demand	8
Figure 1.3: GDP and population of Thailand	8
Figure 2.1: samples of solar dryer - solar cabinet dryers and solar box dryers	22
Figure 2.2: The solar hot water system	23
Figure 2.3: The operation of a solar PV cell	24
Figure 2.4: Windmill	25
Figure 2.5: Water life cycle	27
Figure 2.6: The components of a pico hydro power system	28
Figure 2.7: Process of conversion of biomass to bio-power	29
Figure 2.8: Sawdust briquettes	29
Figure 2.9: Examples of traditional cook stoves	30
Figure 2.10: Jiko - an example of cook stoves technologies	31
Figure 3.1: Model of knowledge creation	39
Figure 3.2: The fundamental of Client/Server (C/S) Architecture	51
Figure 3.3: Architecture of web GIS client-side application	56
Figure 3.4: Architecture of web GIS server-side application	58
Figure 4.1 Research design	62
Figure 4.2 Research Phases	64
Figure 4.3 Phitsanulok Province: the selected area of the study	68
Figure 5.1: An overview of KMS on Sustainable Energy Technologies	76

Figure 5.2: An example of English and Thai interfaces	77
Figure 5.3: An example of the main page of the KM platform	78
Figure 5.4: An example of a member page of the KM platform	79
Figure 5.5: The use case diagram	82
Figure 5.6: Sequence diagram of general user	84
Figure 5.7: The relationship of files on GIS DB	85
Figure 5.8: ER diagram of general user	86
Figure 5.9: ER diagram of member	87
Figure 5.10: ER diagram of administrator	88
Figure 5.11: An example screen shot of biomass operation on the KM platform	90
Figure 5.12: A screen shot from the Calendar on the KM platform	91
Figure 5.13: An example of screen shot of forum on the KM platform	92
Figure 5.14: An example screen shot of lesson learned shown on the KM platform	93
Figure 5.15: An example of screen shot of local energy resources (rice) on the KM platform	94
Figure 5.16: Site map	95
Figure 6.1: Age of participants in each group	98
Figure 6.2: Distribution of the locations where the participants access the Internet	100

Figure 6.3: Percentage of objective of using the Internet	102
Figure 6.4: Participants' background experience on KM platform	104
Figure 6.5: Participants' objectives on access to the KM	106
Figure 6.6: Distribution of participants' engagement period with the KM platform and the duration of time	109

## ACRONYMS

ADSL	Asynchronous Digital Subscriber Line
AJAX	Asynchronous Java and XML
APERC	Asia Pacific Energy Research Centre
ArcIMS	ArcInternet Map Servers
C/S	Client/Server architecture
CASE	International Centre for Application of Solar Energy
CAT	Communication Authority of Thailand
CHP	Combine Heat and Power systems
CO <sub>2</sub>	Carbon dioxide gas
COGEN3	Cogeneration - the generation of electricity from energy sources; COGEN 3 was the third phase of the EC-ASEAN co-operation programme
ECP	Energy Conservation Promotion
EGAT	Electricity Generating Authority of Thailand
EIA	Energy Information Administration
EPPO	Energy Policy & Planning Office
ER	Entity Relationship
ESRI	Environment System Research Institute
GDP	Gross Domestic Product
GHG	Green House Gases
GIS	Geographic Information System
GIS DB	Geographic Information System DataBase
GUIs	Graphical User Interfaces



HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
IE	Internet Explorer
IMS	Internet Map Server
IPP	Independent Power Producers
IRES	Integrated Renewable Energy System
ISP	Internet Service Providers
IT	Information technologies
KM	Knowledge Management
KMS	Knowledge Management System
NEPO	National Energy Policy Office of Thailand
PEA	Provincial Electricity Authority of Thailand
PHP	HyperText Preprocessor
PPA	Power Purchase Agreement
PV	Photo-Voltaic
RDBMS	Relational Data Base Management System
RE	Renewable Energy
RPA	Renewable Portfolio Standard
SERT	School of Renewable Energy Technology at Naresuan University, Phitsanulok, Thailand
SGML	Standard Generalized Markup Language
SPP	Small Power Producers
ThaiREN	Thailand Research and Education Network
TOT	Telephone Organization of Thailand
UNINET	Inter University Network

WECS                      Wind-Electric Conversion System  
XML                        eXtensible Markup Language