



TABLE OF CONTENTS

COVER	i
ANTI-PLAGIARISM STATEMENT	ii
APPROVAL FORM	iii
PROJECT FORM.....	iv
DEDICATION AND QUOTE	v
ACKNOWLEDGMENT	vii
TABLE OF CONTENTS	viii
LIST OF TABLES	x
LIST OF FIGURES.....	xi
NOMENCLATURE.....	xii
ABSTRACT	xvii
CHAPTER I INTRODUCTION	1
I.1. Background	1
I.2. Problem Statement.....	2
I.2.1. Scope and Limitation	2
I.3. Objectives	3
I.4. Benefits	3
CHAPTER II LITERATURE REVIEW	4
CHAPTER III THEORETICAL BACKGROUND.....	9
III.1. Solar Radiation.....	9
III.2. Hot Water Demand Calculation	15
III.3. Solar Water Heating System	17
III.3.1. Type of Solar Water Heating System.....	17
III.3.2. System Component	21
III.4. F-Chard Method.....	28
III.5. Carbon Emission Savings	30
III.6. Economical Viability	31
III.6.1. Net Present Value.....	33
III.6.2. Simple Payback Period	34



CHAPTER IV RESEARCH METHODOLOGY	35
IV.1. Tools and Data	35
IV.2. Research Flowchart.....	36
IV.2.1. User Survey.....	36
IV.2.2. Software Simulation.....	37
IV.2.3. Economic Viability Calculation.....	42
IV.2.4. Analysis of Variation	43
IV.2.5. Carbon Emission Savings Calculation.....	44
IV.3. Result Analysis	44
CHAPTER V RESULT AND DISCUSSION	45
V.1. Solar Resource Assessment.....	45
V.2. Hot Water Consumption.....	46
V.3. System Assessment	47
V.3.1. Component Selection	48
V.3.2. Energy Performance and Economic Viability.....	48
V.4. Analysis of Variation for Collectors Number and Tank Volume	52
CHAPTER VI CONCLUSION AND RECOMMENDATION	57
VI.1. Conclusion	57
VI.2. Recommendation	57
BIBLIOGRAPHY	58
APPENDICES.....	61
APPENDIX A	62
APPENDIX B	63
APPENDIX C	64



LIST OF TABLES

Table 4.1. Tools used in the research.....	35
Table 4.2. Spesific pump power recommendation from RETScreen Handbook..	42
Table 5.1. Main component of SWHS for software simulation.....	48
Table 5.2. Investment cost of SWHS	50
Table 5.3. Operational cost of SWHS	51
Table 5.4. Maintenance cost of SWHS	51
Table 5.5. Energy performance parameters and economic viability indicators of the proposed SWHS	55
Table 5.6. Energy performance and economic viability comparison of proposed system with system from literature review	56



LIST OF FIGURES

Figure 3.1. Diffused radiation component	10
Figure 3.2. Geometric relationship of sun, earth, and solar devices	11
Figure 3.3. Angular position of the sun in respect to the equator (declination) ...	12
Figure 3.4. Direct-active SWHS	18
Figure 3.5. Indirect-active SWHS	19
Figure 3.6. Integrated collector storage SWHS	20
Figure 3.7. Thermosiphon	21
Figure 3.8. Standar configuration of liquid heating system	30
Figure 4.1. Research flowchart	36
Figure 4.2. Display of meteorological data on RETScreen Expert	37
Figure 4.3. Heating load calculation for hot water production on RETScreen Expert	38
Figure 4.4. Solar resources assessment for solar collector on RETScreen Expert	39
Figure 4.5. Solar collector selection on RETScreen Expert	40
Figure 4.6. Storage tank size selection, heat exchanger selection, and miscellaneous losses on RETScreen Expert	41
Figure 5.1. Effect of slope variation to HT	45
Figure 5.2. The amount of hot water needed at 60 °C	47
Figure 5.3. Effect of collectors number on solar fraction and NPV	52
Figure 5.4. Effect of tank volume on solar fraction and NPV	53
Figure 5.5. Energy consumption comparison before and after SWHS utilization	54