CONTENTS

		Page No
List of Figures		III
List of Tables		V
Chapter1:	**INTRODUCTION**	1
	1.1 World's Energy scenario	1
	1.2 Power Scenario of India	1
	1.3 Electrical Grid: An Overview	2
	1.4 Background of the project	4
Chapter2:	**LITERATURE REVIEW**	5
	2.1 Key Drivers of Smart Grid	5
	2.1.1 Unrelenting increase in electricity demand	5
	2.1.2 Global warming	6
	2.1.3 Reliability	6
	2.2 Smart Grid Concept	7
	2.3 Role of information and communication technology in the Smart Grid	8
	2.4 Potential of Smart Grid	11
	2.5 Impact of Smart Grid	11
	2.5.1 Facilities enhanced demand response and load control	11
	2.5.2 Improve operational efficiency	13
	2.5.3 Enhance customer services	14
	2.5.4 Enhanced energy saving by greater integration of renewable energy sources	15
	2.6 Barriers to Smart Grid implementation in India	15
Chapter3:	**OBJECTIVES AND METHODOLOGY**	17
	3.1 Solar Energy Centre: An overview	17
	3.2 Objectives	17
	3.3 Expected Outcomes	17
	3.4 Methodology	18
Chapter4:	**DATA COLLECTIONS AND ANALYSIS**	19
	4.1 Identification of generation points	19
	4.1.1 Configuration of 20kW PV rooftop power plant	20
	4.2 Identification of consumption points	22
	4.3 Preparation of Single line diagram of 11kV substation	22
	4.4 Load calculation of Block A, B, C and D	27
Chapter5:	**INTELLIGENT ENERGY MONITORING UNIT**	38
	5.1 Installation of Intelligent Energy Monitoring Unit (IEMU)	38
	5.2 Real Time Consumption data of Block A and Block B	39
	5.3 Demand Side Management (DSM)	44
	5.4 Installation of Intelligent Home Energy Monitoring Unit (IHEMU)	47

Chapter6:	**RESULTS AND DISCUSSIONS**		52
	6.1	Analysis of existing renewable energy sources	52
		6.1.1 Thin Film PV Plant 2.8 kWp connected across 3.3 kVA Delta Inverter	52
		6.1.2 Thin film PV plant 3.2 kWp connected across 5KVA Delta Inverter	61
		6.1.3 Analysis of Sterling Engine 3X3 kWp	71
	6.2	Economic Analysis	81
Chapter7	**CONCLUSION**		85
	REFERENCES		86

LIST OF FIGURES

Figure No.		Page No.
1.1	World Electricity consumption (Quadrillion Btu)	2
1.2	Electric power system	3
2.1	Example of Smart Grid Map	5
2.2	Comparison of life cycle emission	6
2.3	Two way communication	7
2.4	Smart Grid software Layers	9
2.5	Impact of Smart grid	15
4.1	Block diagram of 10 KW grid interactive PV power plant	20
4.2	Block diagram of 5 KW grid interactive PV power plant	21
4.3	Block diagram of 5 KW standalone PV power plant	22
4.4	Block Diagram of 11 kV sub-station	23
4.5	Block Diagram of Mini Grid With Proposed Positions of Energy Meters	26
5.1	Block Diagram for communication link between inverter and various load priority for DSM	45
5.2	Components used in Smart Micro Grid at SEC	46
5.3	IHEMU device with an open box view	48
5.4	Block diagram of the mini grid at Solar Energy Centre	51
6.1	Energy generation vs. average GHI and average day time temperature for 2.8 kWp thin film PV plant	56
6.2	Energy generated versus rated Peak Power on daily basis for 2.8kwp thin film PV plant	58
6.3	Capacity utilization factor in relation with energy generated and maximum power generated in a day for 2.8 kWp PV plant	60
6.4	Electricity generated (kWh/day) vs average GHI (W/m2) and average day time temperature for 3.2 kWp thin film PV plant	66
6.5	Energy generated (kWh/day) versus rated Peak Power (kWp) and Maximum Generated power (kW) on daily basis for 3.2kWp thin film PV Plant	68
6.6	Capacity utilization factor in relation with energy generated and maximum power achieved in a day for 3.2kWp thin film PV plant	70
6.7	Electricity generated (kWh/day) vs average GHI(W/m2) and average day time temperature for Stirling engine	76

6.8 Energy generated (kWh/day) versus rated Peak Power (kWp) and Maximum Generated power (kW) on daily basis for Stirling engine 78

6.9 Capacity utilization factor in relation with energy generated and maximum power achievedin a day for Stirling Engine 80

LIST OF TABLES

Table No.		Page No.
4.1	List of energy resources	19
4.2	Ratings of all the gadgets/Appliances	27
4.3	Load estimation of block A	28
4.4	Load estimation of block B	31
4.5	Load estimation of block C	35
4.6	Load estimation of block D	36
5.1	*Location of IEMU installed at SEC campus*	39
5.2	Real time consumption of block A and B	40
5.3	List of 36 nonessential load point for DSM	47
5.4	Location of IHEMU installed	50
6.1	Real time generation data of 28kWp Thin film	52
6.2	Real time generation data of 3.2kWp Thin Film	62
6.3	Real time generation data of 3X3 kWp sterling Engine	72
6.4	Energy generation, saving per day for different scenario under smart micro grid project	84