Investment Grade Energy Audit in Government Buildings in Kerala

Energy Management Centre-Kerala

Dept. of Power, Govt. of Kerala

Sreekrishna Nagar

Sreekariyam

Thiruvananthapuram 695017

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About the Report

Globally it is understood that the building sector accounts to 40 % of the total energy use today. According to World Business Council of Sustainable Development, energy efficiency in buildings and appliances alone can reduce carbon emission by 715 million tons globally which would be 27 % of the projected increase in GHG emissions to date.

The Situational Analysis conducted by the Bureau of Energy Efficiency indicated a savings potential of 137 MW in the Government Buildings. Further, studies in several office buildings, hotels and hospitals indicated an energy savings potential of 20-50 % in end uses such as lighting, ventilation and cooling, building services operation etc. This represents a vast yet untapped, savings potential attributable mainly to lack of an effective delivery mechanism for energy efficiency with tangible financial benefit to the individual as well as the nation.

Energy Management Center Kerala is contributing its bit to the national as well as global need for better efficiency in building sector.

Twenty Two Buildings were identified to be part of the Investment Grade Energy Audit (IGEA) under the nationwide programme of the Bureau of Energy Efficiency, MoP, Govt. of India. The Energy Audits were conducted during the period 2008-09.

The major savings identified were in lighting, air conditioning and electrical distribution systems. It could be identified that there are several low hanging fruits such as retrofitting with T5 lamps, replacement of incandescent lamps, retrofitting with electronic regulators, providing variable frequency drives, power factor improvement etc…

The total savings to be achieved in all these 22 buildings are nearly 18 % of the present energy consumption and a pay back of less than 1.5 years is envisaged for the energy saving project investment.

Along with the IGEA programme, the Bureau of Energy Efficiency has already started the Star Labeling Programme for commercial buildings. Energy Conservation Building Code is also introduced in the country and various States are implementing the same in their respective States. Kerala is also in the consultative process for the implementation of the same.

The report contains the summary of energy savings identified by the IGEA as well as the highlights of the consultative meeting held on November 14th at Mascot Hotel, Trivandrum

Contents

Sl. No.	Abbreviation	Expansion
1	V	volt
2	A	ampere
3	kW	kilo watt
4	kWh	kilo watt hour
5	P F	Power Factor
6	kVA	kilo volt ampere
7	kVAr	kilo volt ampere reactive
8	EER	Energy Efficiency Ratio
9	THD	Total Harmonic Distortion
10	HT	High Tension
11	LT	Low Tension
12	DSM	Demand Side Management
13	AHU	Air Handling Unit
14	HVAC	Heating, Ventilation & Air-Conditioning
15	FTL	Fluorescent Tubular Lamps
16	CFL	Compact Fluorescent Lamp
17	DG	Diesel Generator
18	ROI	Return On Investment
19	IRR	Internal Rate of Return
20	IGEA	Investment Grade Energy Audit
21	ESCO	Energy Service Company
22	ENCON	Energy Conservation
23	BSNL	Bharat Sanchar Nigam Limited
24	UNIDO	United Nations Industrial Development Organization
25	PWD	Public Works Department
26	BEE	Bureau of Energy Efficiency
27	EMC	Energy Management Centre
28	KSEB	Kerala State Electricity Board
29	SDA	State Designated Agency
30	KSPC	Kerala State Productivity Council
31	FICCI	Federation of Indian Chambers of Commerce & Industry

1. About Energy Management Centre-Kerala

Energy Management Centre-Kerala (EMC) was established in February 1996 as an autonomous organization under the Department of Power, Government of Kerala.EMC has got a functional framework devoted to comprehensive and multi-disciplinary institutional objectives and orientation encompassing all aspects of energy, with a focus on energy-environment-development interactions.

The guiding philosophy and school of thought of EMC is "achieving sustainable development through enhancing total energy efficiency and application of renewable energy and environment friendly energy systems in all sectors of the economy". To realize the above goals, EMC is adopting a multi-faceted institutional and functional strategy.

Established with an aim to remould and instrumentalise energy sector as a catalyst in promoting a development process which is econo-ecologically sustainable, Energy Management Centre has been undertaking its role successfully for the past 14 years.

The Centre is also promoting Small Hydro Power developments in the State. The United Nations Industrial Development Organization (UNIDO) opened its first Regional Centre for Small Hydro Power in Energy Management Centre on 4 April 2003.

Government of Kerala vide notification number, 2450 (S R O No.1212/2003) designated Energy Management Centre to enforce the Energy Conservation Act 2001 in the State. The Bureau of Energy Efficiency (BEE), MoP, Govt. of India was undertaking the implementation of the Energy Conservation Act 2001 in the country and EMC is closely working with BEE in this regards availing support, guidance and assistance.

2. Investment Grade Energy Audit Programme

EMC has taken up Investment Grade Energy audit of twenty two large Government buildings under the aegis of the nationwide programme of "Investment Grade Energy Audit (IGEA) of 500 Government Buildings" of the Bureau of Energy Efficiency, Ministry of Power, Government of India.

EMC has identified 22 buildings which are owned by the Government or Public Undertakings or autonomous bodies or local bodies. The BEE listed Energy Service Companies and Energy Audit Consultants were invited to bid for the IGEA of identified buildings.

The list of buildings and Consultants/ Energy Audit Firms is given below.

Sl No	Building	Audit Firm
1	Kerala Legislature Complex, Thiruvananthapuram	Kerala State Productivity Council, Ernakulam
2	Kerala Secretariat Complex, Thiruvananthapuram	Kerala State Productivity Council, Ernakulam
3	Government Medical College Hospital, Thiruvananthapuram	Energetic Consulting (P) Ltd, Mumbai
4	Regional Cancer Centre, Thiruvananthapuram	Federation of Indian Chamber of Commerce and Industries, New Delhi
5	Mascot Hotel, KTDC, Thiruvananthapuram	Federation of Indian Chamber of Commerce and Industries, New Delhi
6	Vydyuthi Bhawan , Thiruvananthapuram	Federation of Indian Chamber of Commerce and Industries, New Delhi
7	State Bank of Travancore , Thiruvananthapuram	BSNL, Office of Chief Engineer (Electrical), Thiruvananthapuram
8	Shaktan Thampuran Arcade, Thrissur	Federation of Indian Chamber of Commerce and Industries, New Delhi
9	Mail Business Centre, Thiruvananthapuram	Federation of Indian Chamber of Commerce and Industries, New Delhi
10	The Kerala State Planning Board, Thiruvananthapuram	BSNL, Office of Chief Engineer (Electrical), Thiruvananthapuram
11	General Post Office Building, Thiruvananthapuram	BSNL, Office of Chief Engineer (Electrical), Thiruvananthapuram
12	Rajiv Gandhi Centre of Biotechnology, Thiruvananthapuram	Federation of Indian Chamber of Commerce and Industries, New Delhi
13	BSNL–The Panampilly Nagar Telephone Exchange, Ernakulam	BSNL, Office of Chief Engineer (Electrical), Thiruvananthapuram

Sl No	Building Name	Audit Firm
14	Telecom Exchange Building, Medical College, Thiruvananthapuram	BSNL, Office of Chief Engineer (Electrical), Thiruvananthapuram
15	Vikas Bhawan, Thiruvananthapuram	Federation of Indian Chamber of Commerce and Industries, New Delhi
16	Civil Station, Kozhikode	Eaga Energy India Pvt. Ltd., Kolkata
17	Government Medical College, Kozhikode	Eaga Energy India Pvt. Ltd., Kolkata
18	Finance Towers, Kerala Financial Corporation, Ernakulam	Eaga Energy India Pvt. Ltd., Kolkata
19	College of Engineering, Thiruvananthapuram	Eaga Energy India Pvt. Ltd., Kolkata
20	Civil Station, Thrissur	Eaga Energy India Pvt. Ltd., Kolkata
21	Civil Station, Ernakulam	Federation of Indian Chamber of Commerce and Industries, New Delhi
22	High Court Building, Ernakulam	BSNL, Office of Chief Engineer (Electrical), Thiruvananthapuram

3. Scope of Investment Grade Energy Audit

The scope of the work includes a detail study for energy conservation options of various energy sources like Electricity and Fuel oil in the building and recommendation with detailed techno economic and cost benefits.

The broad scope of the study was as per the following.

a) Review of present electricity & fuel consumption and utilization practices and estimation of energy consumption in various load centers like Lighting, Air-Conditioning, Water Pumping and end user applications.

b) Electrical Distribution System

- □ Review of present electrical distribution like Single Line Diagram (SLD), transformer loading, cable loading, normal & emergency loads, electricity distribution in various areas / floors etc.
- □ Study of Reactive Power Management and option for power factor improvement.
- □ Study of power quality issues like Harmonics, current unbalance, voltage unbalance etc,
- □ Exploring the Energy Conservation Opportunities (ENCON)

c) Lighting System

- □ Review of present lighting system, lighting inventories etc.
- □ Estimation of lighting load at various locations like different floors, outside (campus) light, pump house and other important locations.
- □ Detail lux level survey at various locations and comparison with acceptable standards.
- □ Study of present lighting control system and recommend for improvement.
- □ Analysis of lighting performance indices like Lux/m^2, lux/watt, lux/watt/m^2 and comparison with norms of high rise buildings.
- □ Exploring the Energy Conservation Options (ENCON) in lighting system.

d) Heating, Ventilation & Air-Conditioning (HVAC) System

- □ Review of present HVAC system like central AC, window AC, split AC; package AC, Water Coolers, and Air Heaters etc.
- □ Performance assessment of window AC, Split AC and Package AC system.
- □ Performance Assessment of Chillers, Cooling Towers, Air Handling Units (AHUs) and cold insulation system of central AC.
- □ Analysis of HVAC Performance like estimation of Energy Efficiency Ratio (EER i.e. KW/TR), Specific Energy Consumption (SEC) of Chilled Water Pumps, Condenser Water Pumps, AHUs etc and comparison of the operating data with the design data.
- □ Exploring the Energy Conservation Options (ENCON) in HVAC system.

e) Diesel Generator (DG) Sets

- □ Review of DG set operation
- □ Performance Assessment of DG sets in terms of Specific Fuel Consumption (SFC i.e. KWH/Liter).
- □ Exploring the Energy Conservation Options (ENCON) in lighting system.
- □ Exploring the Energy Conservation Options (ENCON) in DG Sets.

f) Water Pumping System

- □ Review of water pumping, storage and distribution systems.
- □ Performance assessment of all major water pumps i.e. power consumption vs. flow delivered, estimation of pump efficiency etc.
- □ Exploring the Energy Conservation Options (ENCON) in Water Pumping System.

g) Thermic Fluid Heaters / Boilers

- □ Performance assessment of hot water generators or thermic fluid heaters like estimation of efficiency etc.
- □ Exploring the ENCON options in this systems

h) Motor Load Survey

- □ Conducting the motor load survey of all drives to estimate the % loading.
- □ Exploring the ENCON options in electric drive system.

i) Energy Monitoring & Accounting System

- □ Detail review of present energy monitoring & accounting system in terms of metering, record keeping, data logging, periodic performance analysis etc. b. Recommend for effective energy monitoring & accounting system.

j) Others

- ➢ Review of present maintenance practice, Replacement policies and building safety practices as applicable to high rising buildings and recommend for improvements.

- □ Cost-Benefit Analysis of each ENCON options indicating simple payback period, return on investment (ROI), internal rate of return (IRR).

- □ Preparation of Detail Project Report and submission of the same to SDA/Building owner/BEE.

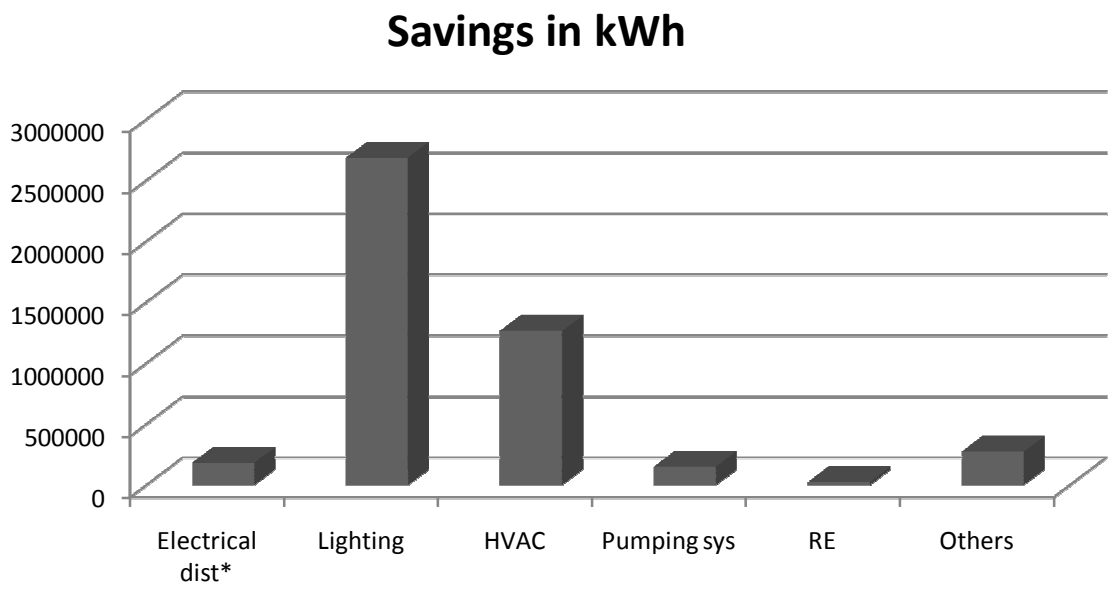
DELIVERABLES IN THE DETAIL PROJECT REPORT (DPR)

- Methodology adopted for the study.
- Present energy scenario of the building.
- Detail analysis of the data obtained through field visits, trial measurements by portable gadgets, discussion with concerned personnel etc.
- Recommendations for energy saving options in all possible areas with cost-benefit analysis.
- Technical Specifications for any retrofit options,
- List of suppliers / manufacturers of energy efficient technologies

4. Consolidated savings data of all the Identified buildings

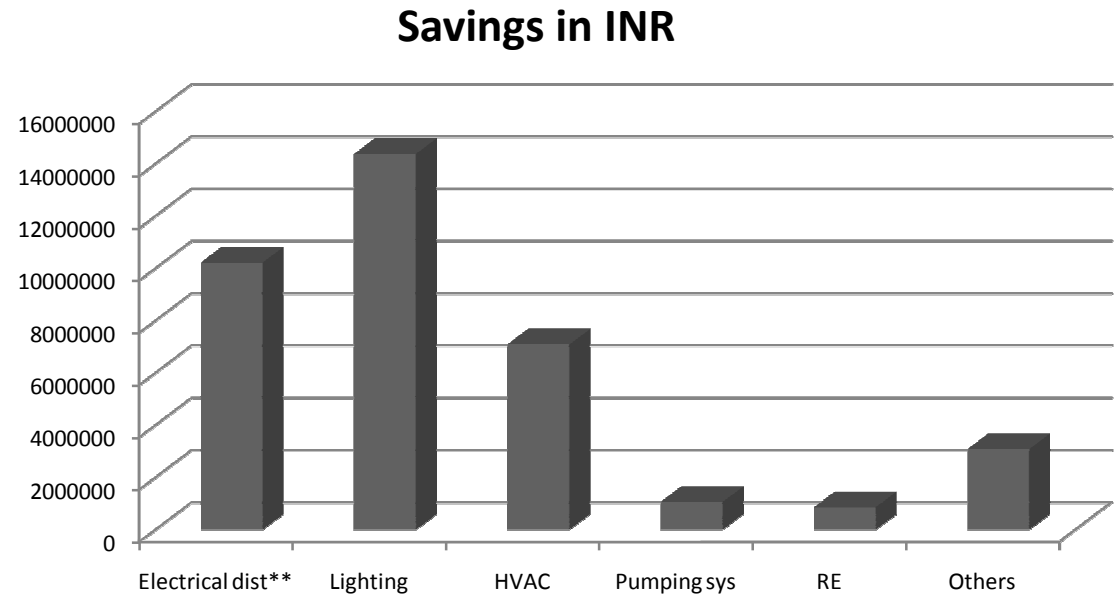
SN	Building	Electrical Energy Consumption kWh/annum	Savings in kWh/annum	Savings in lakh INR/annum	Investment in lakh INR/annum
1	Kerala Legislature Complex, Thiruvananthapuram	2,133,399	3,43,889	49.59	31.49
2	Kerala Secretariat Complex, Thiruvananthapuram	1,661,594	4,44,061	43.64	19.12
3	Government Medical College Hospital, Thiruvananthapuram	3,349,263	7,84,413	39.22	59.69
4	Regional Cancer Centre, Thiruvananthapuram	3,000,000	8,67,000	40.91	59.03
5	Mascot Hotel, KTDC, Thiruvananthapuram	1,656,000	1,86,152	24.92	18.43
6	Vydyuthi Bhawan , Thiruvananthapuram	600,000	1,82,844	9.16	23
7	State Bank of Travancore , Thiruvananthapuram	998,736	85,555	16.02	16.67
8	Shaktan Thampuran Arcade, Thrissur	9,166	9,166		
9	Mail Business Centre, Thiruvananthapuram	93,336	20,183	1.00	1.99
10	The Kerala State Planning Board, Thiruvananthapuram	86,880	49,823	4.26	12.85
11	General Post Office Building , Thiruvananthapuram	173,804	89,108	6.53	10.3
12	Rajiv Gandhi Centre of Biotechnology, Thiruvananthapuram	16,62,000	2,64,130	13.13	13.55
13	BSNL–The Panampilly Nagar Telephone Exchange, Ernakulam	28,40,432	3,14,791	15.11	12.85
14	Telecom Exchange Building, Medical College, Thiruvananthapuram	28,14,491	1,99,051	8.51	10.65
15	Vikas Bhawan, Thiruvananthapuram	240,000	1,39,792	11.07	17.5
16	Civil Station, Kozhikode	459,445	1,40,732	18.18	30.46
17	Government Medical College, Kozhikode	5,264,400	6,36,382	32	28
18	Finance Towers, Kerala Financial Corporation, Ernakulam	848,917	28,096	1.53	2.75
19	College of Engineering, Thiruvananthapuram	781,384	2,21,900	13.81	21.06
20	Civil Station, Thrissur	145,971	40,677	2.24	2.76
21	Civil Station, Ernakulam	322,800	61,512	4.14	8.27
22	High Court Building, Ernakulam	1,607,739	2,28,865	12.59	48.28
	Total	**32,098,587**	**53,38,122**	**367.5**	**449.15**

System Wise Consolidated savings in kWh or Units



*Demand savings not included(Demand savings was calculated as 906kVA).

System Wise Consolidated savings in INR



** Demand savings included.

5. Building Wise

Energy Savings Summary

5.1. Kerala Legislature Complex, Thiruvananthapuram

Audited by: KSPC, Ernakulam

In 1956, the State of Kerala was formed on linguistic basis, merging Travancore, Cochin and Malabar regions. The first general election in the Kerala State was held in February-March, 1957. The first Kerala Legislative Assembly was formed on March 1, 1957. The Assembly had 127 members including a nominated member. Presently the assembly consists of 141 elected members.

The State Assembly is known as Niyama Sabha and is housed in New Legislature Complex. This 10 storied complex is one of the largest complexes in India. The Central Hall is described as most elegant and majestic hall with ornamental TeakWood-Rosewood paneling.

The consolidated statement of power consumption details for the last year is as follows:

YEAR	Average Maximum Demand (kVA)	Power Consumption (kWh)	
		Annual	Monthly Average
2007-08	450	2552900	212742

Executive Summary of Savings Identified

Sl. No	Energy Conservation Opportunities	Annual savings		Investment (in Rupees)	Payback period (Months)
		kVA/kWh/Ltrs.	Value (in Rupees)		
1	Connect 893 kVAR capacitors to improve the average system power factor from 0.75 to unity.	360 kVA	3,060,698	1,071,000	4
2	Distribute the entire load of the complex through a single transformer of 1600 kVA during normal working days.	29386 kWh	162,209	Not Estimated	
3	Provide Variable Frequency Drives for the major AHU's, Chilled Water Pumps and Cooling Tower Fans in the Assembly Hall Complex	52110 kWh	287,647	906,250	38
4	Provide Variable Frequency Drives for the AHU's in the Administration Building	29709 kWh	163,994	312,500	23
5	Replace Ordinary Regulators By Electronic Regulators In Ceiling Fans	17100 kWh	94,392	47,500	6
6	Savings by Avoiding Fluorescent tube fittings or by Converting Double Tube fittings to Single tube fittings at Window Side	67050 kWh	370,116	Nil	
7	Savings By Replacing 250 W Sodium Vapour Lamps with T5 Lamps With Ballasts.	29004 kWh	160,104	129,000	10
8	Install Energy Saver For Yard Lighting at the Assembly Complex	9316 kWh	51,424	75,000	18
9	Replace 40W tubes with ordinary Choke by T5 Lamps	96954 kWh	535,186	577,600	13
10	Saving by Replacing Incandescent Lamps provided in the Assembly Hall Galleries with CFL's	13260 kWh	73,195	30,600	5

11	Provide optimum sized motor with soft starter for the 580 T chillers so that the low loading, high demand rise and the high current due to low pf can be avoided.				
12	Increase the evaporator chilled water temperature setting in the chiller from 6.5^{o}C to 10^{o}C to get a 10% reduction in power consumption in the chiller units.				
13	Provide Two way Valve system in the chilled water line near the AHU's to control the flow of chilled water and thereby reducing the power consumption of chilled water pumping system.				
14	Replace the present motors of the AHU's, Chilled water pumps and Cooling Tower fans with optimum sized Energy Efficient motors to have better power factor as well as better operating efficiency				
15	Provide temperature sensors for the cooling towers to avoid the operation of cooling tower fans after achieving the required temperature of the cooling water.				
16	Ensure proper closing/ Insulation of doors and windows in the air conditioned area to avoid additional heat load to the air conditioner.				
17	Set the air conditioning area temperature within a range of 24^{O}c to 26^{O}c to have better human comfort and hence to save power.				
18	Avoid the usage of lights during daytime where enough natural lighting is available.				
19	Remove the tree branches and the dust particles covering the Street Light fittings to ensure proper distribution of luminous intensity.				
20	It is strongly recommended to switch off lights, fans, A/c's as and when the person leaves the place as well as after office hours				
21	Provide individual controls for lights to avoid operation unwanted of lights.				
22	May Replace the existing CRT monitors of the computers with LCD monitors as the power consumption will be reduced by 70%.				
	Total Savings	3,43,889 kWh	49,58,965	31,49,450	8

A total amount of assured savings of Rs 49, 58,965/- with an estimated investment of Rs 31, 49,450/-. If we consider a simple pay back for the total investment we can understand that it is less than a year.

5.2. Kerala Secretariat Complex, Thiruvananthapuram

Audited by: KSPC, Ernakulam

Executive Summary of Savings Identified

Sl. No.	Energy Conservation Opportunities	Annual savings		Investment (in Rupees)	Payback period Months
		kVA/kWh/Ltrs.	Value (in Rupees)		
1	Repair the faulty capacitors to improve the average system power factor from 0.98 to 0.99.(Consumer No: 29/2973, Old Connection)	21 kVA	1,35,925	99,000	9
2	Add 178 kVAR capacitors to improve the average system power factor from 0.66 to unity.(Consumer No: 6/4470, New Connection)	Nil	4,23,182	99,000	3
3	Add 40 kVAR capacitors to improve the average system power factor from 0.76 to unity (29/3427, Annexe Connection)	Nil	98,984	48,000	6
4	Reduce the contract demand of Consumer No: 6/4470 (New Connection) from 730 kVA to 240 kVA after improving the power factor	364 kVA	13,07,912	Not Estimated	
5	Reduce the contract demand of Consumer No: 29/3427(Annexe Connection) from 200 kVA to 140 kVA after improving the power factor	56 kVA	1,62,069	Not Estimated	
6	Isolate one of the 350 kVA transformer of the Consumer No: 29/2973 (Old Connection)in the HT side itself so that the core loss can be avoided during no Load Periods	4,848 kWh	22,010	Nil	
7	Replace Ordinary Regulators By Electronic Regulators In Ceiling Fans (Consumer No: 29/2973, Old Connection)	36,576 kWh	1,66,055	1,01,600	
8	Replace Ordinary Regulators By Electronic Regulators In Ceiling Fans (Consumer No: 29/3427, Annexe Connection)	11,160 kWh	71,201	31,000	
9	Savings by Avoiding Fluorescent tube fittings or by Converting Double Tube fittings to Single tube fittings at Window Side (Consumer No: 29/2973)	92,928 kWh	4,21,893	Nil	
10	Savings by Avoiding Fluorescent tube fittings or by Converting Double Tube fittings to Single tube fittings at Window Side (Consumer No: 29/3427)	45,804 kWh	2,92,230	Nil	
11	Install Energy Saver For Yard Lighting at the Secretariat Complex (Consumer No: 29/2973).	6,570 kWh	29,828	30,000	
12	Replace 40W tubes with ordinary Choke by T5 Lamps (Consumer No: 29/2973, Old Connection)	1,83,805 kWh	8,34,475	1,123,600	
13	Replace 40W tubes with ordinary Choke by T5 Lamps (Consumer No: 29/3427, Annexe Connection)	62,370 kWh	3,97,921	3,80,000	

14	Rectify the harmonic distortion at the Consumer Number 29/3427 and Connect the capacitors for power factor compensation.				
15	Provide a 20 kVAR capacitor (5% of transformer rating) at the main panel exclusively for transformer compensation (Consumer No: 29/3427) during night/ low load period.				
16	Ensure proper closing/ Insulation of doors and windows in the air conditioned area to avoid additional heat load to the air conditioner.				
17	Set the air conditioning area temperature within a range of 24^{O}c to 26^{O}c to have better human comfort and hence to save power.				
18	Avoid the usage of lights during daytime where enough natural lighting is available.				
19	It is Strongly recommended to switch off lights, fans, A/c's as and when the person leaves the plakhe as well as after office hours				
21	Replace the existing CRT monitors of the computers with LCD monitors as the power consumption will be reduced by 70%.				
	Total Savings	4,44,061 kWh	43,63,685	19,12,200	5.25

A total amount of assured savings of Rs 43, 63,685 /- with an estimated investment of Rs 19, 12,200 /-. If we consider a simple pay back for the total investment we can understand that it is less than a year.

5.3. Government Medical College, Thiruvananthapuram

Audited by: Energetic Consultants, Thane

INTRODUCTION

The Government Medical College was inaugurated by Pandit Jawaharlal Nehru, architect of our nation on 27th November 1951. The inception of the Trivandrum Medical College the first Medical College of the State, a first class teaching hospital with 450 beds was built. The Medical College Hospital was formally inaugurated by the Prime Minister Sri. Jawaharlal Nehru on 8th February 1954. There was already an excellent women and children hospital in the campus built by the Royal family in memory of Prince Sree Avittam Thirunal. Hostels for men and women, Nursing College, Dental College, Pharmacy College, Regional Cancer Centre, Artificial Limb Centre. Sree Chithra Institute and Medical Education residential quarters for the staff etc. were developed in the campus of Trivandrum Medical College. In addition to MBBS course, PG degree and diploma courses in 22 specialties, superspeciality courses in 10 specialties, BSc. Nursing, B.Pharm, B.Sc MLT, Para medical courses, Diploma in Pharmacy course etc. are conducted in this institution.

Energy Audit study was conducted on following buildings from the Hospital campus:

1. Medical college hospital main building
2. Power laundry
3. Sree Avittam Thirunal Hospital building
4. Medical college building
5. Principal office building
6. College of pharmaceutical sciences
7. Priyadarshini Institute of paramedical sciences (PIPMS)
8. Water pump house

Executive Summary of Savings Identified

Reference area	Annual Energy Saving (kWh)	Annual Cost Saving (Rs.)	Capital Investment (Rs.)	Payback Period (months)	ROI (%)	IRR (%)
Cooling tower for package chillers	2,51,870	1,259,351	1,000,000	10	126	126
Cooling load reduction on Blood Bank AC's	27,957	1,39,784	Nil	Immediate	NA	NA
Centralized chiller for SAT hospital OT's	67,181	3,35,903	1,000,000	36	34%	31%
Replacement of V- Belts with Flat belts	2279	11,395	33,000	35	35%	21%
Cooling tower blade Replacement	2440.8	12,204	10,000	10	122	122
Installation of temperature controller on Cooling tower	2928.96	14,645	2,000	2	732	732

Reference area	Annual Energy Saving (kWh)	Annual Cost Saving (Rs.)	Capital Investment (Rs.)	Payback Period (months)	ROI (%)	IRR (%)
Solar hot air generation system for laundry dryers	30,992	1,54,960	8,00,000	62	19	18
Replacement of T12 Tube with T5 tube	2,78,956	1,394,778	1,937,600	17	72	51
Replacement of bulbs with CFL	38,664	1,93,320	26,850	2	720	709
Replacement of existing ceiling fans by energy efficient fans	81,144	4,05,720	11,59,200	34	35	29.5
Total	**7,84,413**	**39,22,060**	**59,68,650**	**18.26**		

5.4. Regional Cancer Centre (RCC), Thiruvananthapuram

Audited by: FICCI, New Delhi

Regional Cancer Centre (RCC), one of the prestigious comprehensive cancer treatment centre of Govt. of Kerala. It is located in the medical college campus of Trivandrum city. The building established in 1981 is a multi-storied building with total of 19 floors in three sub-buildings. About 700 persons are working in this centre. About 1000 patients on an average occupy the centre. The centre operates round the clock in a year. The Engineering department looks after the management of electric supply, water supply, ventilation & air conditioning, lighting system etc. of the entire facility to ensure proper work environment and comfort of its employees. As explained earlier, the energy conservation has become a foremost requirement in any high rising building which has a connected load of 500 kW and more, the RCC is also no exception.

RCC has a connected load of around 992 kW. As per electricity bills, the electrical energy consumption stands at about 2.5 lakh kWh per month i.e. about Rs 10 Lakh Per month.

Executive Summary of Savings Identified

SN	Reference Area	Recommendations	Expected Savings	Approx. Investment (Lakh Rs.)	Simple Pay Back Period (years)
1	Electrical Distribution System	Installation of another 1250 kVA transformer in addition to the existing system	Reliability Improvement of the electrical system considering present load & future load growth		
2	Electrical Distribution System	Enhancing the contract demand up to 800 kVA from 500 kVA	Rs. 4.5 lakh / annum	NIL	
3	Lighting System	Retrofitting the FTLs with 20W CFLs in Non-Essential Areas	0.65765 lakh kWh /annum 2.76 Lakh Rs./annum	0.63	0.23
4	Lighting System	Retrofitting the FTLs with T5 Lamps in essential Areas	5.04 lakh kWh /annum 21.19 Lakh Rs./annum	10.47	0.5
5	Lighting System	Putting timers for Campus Lights	3650 kWh/ annum 0.15 lakh Rs. /annum	0.10	0.67
6	Central AC	Retrofitting 120TR Reciprocating Chiller with 100TR Screw Chiller	1.46 lakh kWh/ annum 6.13 lakh Rs. /annum	35	5.71
7	Central AC	Installation of VFDs in Chilled water pumps	1.04 lakh kWh/ annum 4.37 lakh Rs. /annum	8.43	1.93
8	Central AC	Insulating damaged / bare chilled water line	Prohibiting heat ingress to chilled water	Marginal	
9	Central AC	Installation of Centralized control panel for AHU operation along with installation of LCD monitor for display of temperature of various floors	0.32 lakh kWh/annum 1.31 lakh Rs. /annum	2.5	2

SN	Reference Area	Recommendations	Expected Savings	Approx. Investment (Lakh Rs.)	Simple Pay Back Period (years)
10	Water Pumping System	Installation of Auto ON/OFF actuator switch and water level indicator	12,213 kWh/annum 0.5 lakh Rs./annum	0.5	1
		Installation of a syntax water tank for overflow water from different tanks	Waste minimization	0.2	
		Providing Electronic Energy Meters & Run-Hour Meters for each pump	Better Energy Monitoring & Accounting	0.2	
		Running the pump most of the time during off-peak period	Reduction of about 18kVA from the present maximum demand	Marginal	
11	Boiler	Condensate Recovery in boiler house at laundry	Reduction in Fuel Consumption by 10%	Marginal	
12	Others	Providing Electronic Energy Meters at Strategic Locations	Energy Monitoring & Accounting	1.0	
		TOTAL	8.67 Lakh kWh/annum 40.91 Lakh Rs./ annum	59.03	1.44

5.5. Mascot Hotel, Thiruvananthapuram

Audited by: FICCI, New Delhi

The Mascot Hotel, one of the prestigious hotels under Kerala Tourism Development Corporation Ltd., Govt. of Kerala is located at the heart of the Trivandrum city. The hotel building renovated in 2004 & 2007 is a multistoried building in three sub-buildings. About 250 employees are working in this hotel which operates round the clock. The Project Engineer (Electrical) looks after the management of electric supply, water supply, ventilation & air conditioning, lighting system etc. of the entire building to ensure proper work environment and comfort of its guests & employees.

Mascot Hotel has a connected load of around 728 kW (As per Inventory Survey). As per electricity bills, the electrical energy consumption stands at about 1.38 lakh kWh per month i.e. about 7.5 Lakh Rs. Per month. However, the total energy bill (electricity, water, diesel & LPG) is about 15 Lakh Rs. Per month.

The detail energy audit reveals that various energy conservation and efficiency options can further result in saving of about Rs. 24.92 lakh per annum and reduce the energy consumption by 1.86 lakh units and 4200 liters of fuel oil per annum (About 14% of the total consumption). The summary of the potential savings has been shown in the following table.

Executive Summary of Savings Identified

SN	Area	Recommendations	Expected Benefit/ Saving	Approx. Investment (Lakh Rs.)	Simple Pay Back Period (Years)
1	Electrical Distribution System	Running single transformer by switching ON the bus coupler and keeping the other one hot standby	5,052 kWh/annum 0.25 Lakh Rs./annum	NIL	
2	Electrical Distribution System	Installation of additional 100kVAR capacitor banks at LT main Panel in addition to existing 100 kVAR	PF improvement to 1.0 Reducing the Demand by 20 kVA 0.72 lakh Rs./annum	1.0	1.4
3	Electrical Distribution System	Reducing the Current Unbalance to 10% in all distribution panels	Less Cable Loss Reduction in Safety Hazard	NIL	
4	Lighting System	Retrofitting the T12/T8 FTLs with T5 FTLs	16,000 kWh /annum 0.82 Lakh Rs./annum	0.66	0.8
5	Lighting System	Retrofitting the GLS lamps with 11W CFL Lamps	84,000 kWh /annum 4.10 Lakh Rs./annum	1.87	0.5
6	Central AC	Installation of VFDs for Condenser Water Pumps and improving range in cooling towers	67,000 kWh/ annum 3.33 lakh Rs./annum	4.5	1.35

SN	Area	Recommendations	Expected Benefit/ Saving	Approx. Investment (Lakh Rs.)	Simple Pay Back Period
7	Hot Water System	Rearrangement of hot water distribution system	4,380 kWh/annum 0.22 lakh Rs./annum	0.2	1
8	Hot Water System	Installation of Solar Hot Water system	4,200 liters of fuel 15.0 Lakh Rs./annum	9.6	0.64
9	Others	Insulating the lower portion of the electric press at the laundry	9,720 kWh/annum 0.48 lakh Rs./annum	0.1.	0.2
10	Others	Repairing the damaged portion of the exhaust ducts of kitchen	Better ventilation in kitchen area	Marginal	
11	Others	Providing Electronic Energy Meters at Strategic Locations	Better Energy Monitoring & Accounting	0.50	
	TOTAL		1,86,152 kWh/annum & 4200 ltr of fuel /annum 24.92 Lakh Rs./ annum	18.43	0.74

5.6. Vydyuthi Bhawan, Thiruvananthapuram

Audited by: FICCI, New Delhi

Vydyuthi Bhawan, the headquarters of KSEB is located at heart of the Trivandrum city. The building established in 1985 is a multi-storied building with a total of ten floors. About 1200 employees are working in this office with office hour of 8 hours in week days and Saturday. The Executive Engineer, Civil Division looks after the management of electric supply, water supply, ventilation & air conditioning, lighting system etc. of the entire building to ensure proper work environment and comfort of its employees.

Vydyuthi Bhawan has a connected load of around 475 kW (As per Inventory Survey). As per electricity bills, the electrical energy consumption stands at about 0.5 lakh kWh per month i.e. about 2.5 Lakh Rs. Per month (@Rs. 5/- per Unit).

The detail energy audit reveals that various energy conservation and efficiency options can further result in saving of about Rs. 9.3 lakh per annum and reduce the energy consumption by 1.8 lakh units per annum (About 30% of the total consumption). The summary of the potential savings has been shown in the following table.

Executive Summary of Savings Identified

SN	Area	Recommendations	Expected Benefit	Approx. Investment (Lakh Rs.)	Simple Pay Back Period (Years)
1	Electrical Distribution System	Installation of 100kVAR (4x25) capacitor banks at LT main Panel of VB Feeder	PF improvement to 0.99 Reducing the Demand by 30 kVA	1.0	NA
2	Lighting System	Retrofitting the FTLs with 18W CFLs in Non-Essential Areas	18527 kWh /annum 0.93 Lakh Rs./annum	0.5	0.54
3	Lighting System	Retrofitting the FTLs with T5 Lamps in essential Areas	73,113 kWh /annum 3.66 Lakh Rs./annum	9.14	2.5
4	Comfort AC System (Package AC)	Blocking a portion of the AC duct and providing 1.5TR split AC in one office room in 7th floor		0.2	
		Providing Sun films for entire window glasses which are exposed to sun light in 7th floor	Better cooling effect	1	
		Proper Insulation of Delivery duct of Package AC's	Better cooling effect	0.5	
		Replacing the 10TR#1 & 10TR#2 with one 16.5TR Air Cooled Package AC with Scroll Compressor in 7th Floor	60,855 kWh/annum 3.04 Lakh Rs./annum	6	1.97
		Installation of Electronic Energy Meter for main AC Plant Panel in 7th floor & 10th Floor	Better Energy Monitoring & Accounting	0.2	

	Comfort AC System (Window AC)	Replacing the old units with BEE star rated AC units	23,772 kWh/annum 1.2 Lakh Rs./annum	3.5	1.2
5	Water Pumping System	Installation of Auto ON/OFF actuator switch and water level indicator	6,577 kWh/annum 0.33 Lakh Rs./annum	0.4	1.2
		Installation of a syntax water tank for overflow water from 4th Floor tanks	Waste minimization	0.1	
		Providing Electronic Energy Meters & Run-Hour Meters for each pump	Better Energy Monitoring & Accounting	0.2	
6	Others	Providing Electronic Energy Meters at Strategic Locations	Better Energy Monitoring & Accounting	0.3	
	TOTAL		1,82,844 kWh/annum 9.16 Lakh Rs./ annum	23.0	2.5

5.7. State Bank of Travancore, Thiruvananthapuram

Audited by: BSNL, Thiruvananthapuarm

State Bank of Travancore Complex, set in a quiet residential locality has an imposing Main building having G+7 Floors with 3 smaller buildings spread over the rear side. Constructed in the year 1983, this complex has the following features to make the settings of a vibrant corporate Head Quarters.

Block wise Plinth Area Details of Building

Name of Block	Year of Construction	No. of floors	Plinth Area
Main Bldg.	1983	8	5917 sq.m
Annex Building	1983	3	1511 sq.m
Staff Training Centre	1983	3	2658 sq.m
NAC Branch Bldg.	1982	2	952 sq.m
Total Area			11038 sq.m

Contract Demand : 565kVA
Recorded Maximum Demand (RMD) : 387 kVA (Average)

Fixed Charge & Energy charge : Rs350/kVA&Rs3.70/kWh for HT
Rs170/kVA&Rs8.30/kWh for LT

Annual Electricity Charges : Rs 53, 73,439/- for HT
Rs 9, 78,168/- for LT

Executive Summary of Savings Identified

Sl. No	Energy saving Recommendations	Technical Target	Annual savings (Rs. Lakh)	Capital investment (Rs. Lakh)	Simple pay back period (years)	Return on Investment (%)	Internal Rate of Return (%)
A	**Electrical Distribution System**						
1	Reduction in Contract Demand	Curtailing unnecessary payment	1.11	Nil	NA		
2	Induction of STC LT Load in Existing HT Supply	Deriving HT Tariff Advantage	1.24	0.25	0.20	494.0	514.5
3	Redesigning APFC Panel with fine controls	Ensuring improved power factor and minimizing energy loss during peak & off peak period	6.13	3.00	0.49	180.99	197
B	**Lighting System**						
4	Replacement of 2x40w fluorescent fittings with 2 x 28 w Mirror optic T5 Fittings in office halls	Induction of energy efficient technology	1.15	3.41	3	33.83	25.4

Sl. No	Energy saving Recommendations	Technical Target	Annual Saving (Rs. Lakh)	Capital investment (Rs. Lakh)	Simple pay back period (years)	Return on Investment (%)	Internal Rate of Return (%)
5	Replacement of 40w incandescent lamps with 11 w CFL in Reading Lamps	Induction of energy efficient technology	0.12	0.07	0.6	167.44	167
6	Replacement of 1x40w fluorescent fittings with 1 x 11 w CFL Fittings in Toilets	Induction of energy efficient technology	0.11	0.15	1.3	76.6	76
7	Replacement of resistance type regulators with energy efficient Electronic regulators.	Adopting energy efficient technology to curtail wastage	0.06	0.09	1.6	62.16	62
C	**HVAC System**						
8	Providing inter locks to stop condensers with compressors	Tapping available opportunity to cut energy wastage	0.07	0.05	0.67	148.6	147
9	Replacement of in efficient and life expired WAC/SAC units,	Inducting efficient technology to improve efficiency	1.31	4.19	3.20	31.30	21.9
D	**Pumping System**						
10	Replacement of 1No 10HP centrifugal pump set by energy efficient submersible pump set	Deriving optimum efficiency through better design, where Replacement is already due	0.10	0.35	3.48	28.71	26
11	Replacement of 1No 1.5HP Jet pump set by energy efficient submersible pump set	Enhancing energy efficiency through better design to suit local need	0.24	0.12	0.5	198.15	199
12	Replacement of Lift motors with lower capacity	To reduce energy loss due to over rated motors	0.22	Nil	NA		
E	**Energy Monitoring**						
13	Providing individual Energy meters for Major Loads	Effective Energy monitoring and improved energy management	2.70	2.04	0.75	133.3	193
F	**Renewable Energy Measures**						
14	Bio Gas Plant (20 M^3) for utilization of biomass.	Tapping renewable energy from bio waste	1.00	2.45	2.44	40.91	40
15	Additional Rain water harvesting system for Main Block & Annex Bldg	Enlarging tapping of Bountiful rain water.	0.46	0.50	1.1	107.89	90
TOTAL			16.02	16.67	1.04		

5.8. Shakthan Thampuran Arcade, Thrissur

Audited by: FICCI, New Delhi

Shakthan Thampuran Arcade (STA), one of the shopping complexes in Thrissur City of Kerala is located near to Thrissur Municipality office. Apart from housing various shops, the arcade also houses the office of Kerala Sustainable Urban Development Project (KSUDP). The building established in 2006 is a multi-storied building with total of six floors. Only the first floor and ground floor are occupied (still partially) and rest of the floors is still un-occupied. The KSUDP office is located in the 2nd floor of the arcade. The working hour of the shops is about 11 hours in per day except the KSUDP office which works for about 8 hours per day. The Executive Assistant Engineer (Electrical) of Thrissur Municipality looks after the operation & maintenance of KSUDP office only.

It is seen that the power factor is only 0.8 which is very low. As there is no reactive power compensation through capacitor banks, more kVA (hence more current) is demanded for the same load. The power factor improvement can be done by installation of capacitor banks. But, as there is very little load now and load addition is expected in near future, the size of the capacitor bank could not be calculated. It is suggested to look into this matter by the KSEB authority to ensure PF of 0.99 by installation of suitable capacitor bank. 1.8 The total kVA is recorded as 24.4 kVA. So, the loading of the installed transformer is only 9.76% which is very low. This under loading is leading to poor efficiency as well.

As the lux level is very low, it is suggested to improve the lighting system. It is seen that for this kind of office space CFL could be a better option. It is suggested to install “LEVEL INDICATOR as well as AUTO ON/OFF switch” for the pumps in order to optimize the run hour. Considering the pumping capacity and requirement for consumption, a conservative estimation shows that there would be at least 30%reduction in energy consumption due to water pumps. This can be saved per year in addition to precious water source with marginal investment.

Summary

As out of the total six floors of the building, only first floor and ground floor is occupied that too partially. The list of recommendation that are presentable is limited to the following

- Power Factor improvement from the present value of 0.8
- Presently the transformer loading is only 9.76 %
- The illumination lovel is found to be very low
- Operation of water pumps to be controlled and rationalized

5.9. Mail Business Centre, Thiruvananthapuram

Audited by: FICCI, New Delhi

Mail Business Centre has a connected load of around 30 kW (As per Inventory Survey). As per electricity bills, the electrical energy consumption stands at about 7778 kWh per month. The total energy bill stands at about 1.0 Lakh Rs. Per month which includes electricity, diesel, water & LPG.

The detail energy audit reveals that various energy conservation and efficiency options can further result in saving of about Rs. 1.0 lakh per annum and reduce the energy consumption by 0.21 lakh units per annum (About 22% of the total consumption). The summary of the potential savings has been shown in the following table.

Executive Summary of Savings Identified

SN	Area	Recommendations	Expected Benefit	Approx. Investment (Lakh Rs.)	Simple Pay Back Period (years)
1	Lighting System	Retrofitting the FTLs with 18W CFLs in Non-Essential Areas	8,042 kWh /annum 0.40 Lakh Rs./annum	0.09	0.2
2	Lighting System	Retrofitting the FTLs with T5 Lamps in essential Areas	12,141 kWh /annum	1.2	2
		Providing 'Pull switch' for FTLs at Ground Floor	0.60 Lakh Rs./annum		
3	Others	Providing voltmeter, ammeter for LT main panel, Energy meter, run-hour meter for DG set	Better Energy Monitoring & Accounting	0.2	
		Replacing the existing LT main panel with new one	Improving reliability and reducing electrical safety hazard	0.5	
	TOTAL		20,183 kWh/annum 1.0 Lakh Rs./annum	1.99	2

5.10. The Kerala State Planning Board, Thiruvananthapuram

Audited by: BSNL, Thiruvananthapuarm

The Kerala State Planning Board is a Government body, which supports the State Government to formulate their development plans based on scientific assessment of the resources of the State and the growth priorities. The board is responsible for planning and review of the activities covering all spheres of development of the state of Kerala in line with the Central five-year plans. The Chairman of the State Planning Board is the Chief Minister of the State, presently, Shri. V. S. Achuthanandan. The Planning Board Vice Chairman, Shri. Prabhath Patnaik is a well known economist of international repute and a prominent personality of our country.

The State Planning Board is housed in two blocks, one old block and the other new block. The old block of vintage construction, is set up in sylvan settings of native flora all around. The very settings and the rich tree cover of the old block, makes the ventilation and air conditioning demand of this block very less. On the other hand, the new block (G+6), facing west, when completed will have excess demand of energy due to heat gain through the western and southern wall as well as glass area.

Summary of Energy Saving Recommendations

Sl.No	Energy saving Recommendations at a Glance	Technical Target	Annual Energy Saving (kWh)	Annual Cost Savings (Rs.)	Capital Investment (Rs.)	Simple Pay Back Period	Return on Investment (%)	Internal Rate of Return (%)
I	**Electrical Distribution System**							
1	Load Balancing to reduce the neutral current and cleaning and tightening of terminals	Reducing Wastage of Energy	402	3,000	3,600	14.4 months	83.3	101
2	Use of LED type Indication lamps in LT Panels	Enhancing energy efficiency	237	1,398	450	4 months	311	312
3	Providing APFC Panel for improving the PF	Enhancing energy efficiency		36,192	92,752	2.56 years	39	36
II	**Lighting System**							
4	Use of Energy Efficient FTL with electronic Choke (Retrofit type) in plakhe of conventional FTL with magnetic ballasts	Enhancing energy efficiency	12,528	78,667	2,81,880	43 months	28	22
5	Replacement of GLS Lamps with CFL	Implementation of energy efficiency	3,069	19,856	6,642	4 months	300	297
6	Replacement of HPSV Lamps with Metal halide lamps	Enhancing energy efficiency	3,154	18,606	15,600	10 months	119	118
7	Use of Natural light, Awareness, etc ENCON options 4,5,6 under LIGHTING	Tapping natural resources for sustain-able habitat	840	5,452	0	0	Full	Full

8	Replacement of Resistance type Regulators with Electronic Regulators	Enhancing energy efficiency	7,279	42,946	29,880	8.35 months	144	139
9	Disconnecting the faulty HPSV lamp drawing 16 W power but not glowing	Reducing Wastage of Energy	140	910	0	0	Full	Full
III	**Computers**							
10	Replacement of CRT Monitors with LCD or TFT Monitors	Enhancing energy efficiency	9,500	64,360	2,83,500	4.4 years	22.7	4.38
IV	**Air-Conditioning System**							
11	Cleaning of dirty condenser, evaporator, filters, Replacement of capacitors, topping up R-22etc	Enhancing energy efficiency	4,666	27,529	15,600	7 months	176	160
V	**DG System**							
12	Doing special maintenance to reduce SFC (Already the DG is under AMC)	Enhancing energy efficiency	270 Lts of HSD	8,190	NIL	0	Full	Full
VI	**Energy Monitoring & Targeting**							
13	By energy monitoring and increasing awareness by providing Energy Meters at load centers	Better management Through Energy monitoring and Targeting	1608	12,000	20,000	20 months	60	61
VII	**Tapping Renewable Sources**							
14	Providing Solar Water heaters of 600 Ltrs. Capacity for Canteen	Tapping Solar power under national solar mission	1010 Kg of LPG	42,420	10,5000	2.48 years	40.4	33.26
15	Providing Roof top Rain Water Harvesting	Tapping natural resources for sustainable habitat	900 K. Ltrs of Water	22,500	20,000	11 months	102	111.2
16	Providing Small Wind cum solar Hybrid energy system (3.3KW wind +1.7KW solar) for feeding power to selected load.	Tapping Solar and Wind power under national solar mission	6,400	41,536	4,10,000	9.78 years	10.13	5.15
	TOTAL		49823	425562	1284904	3 years		

Total Electricity Saving : 49,823 kWh Total Diesel Saving : 270 Ltrs
Total Water Saving : 900 Kilo Ltrs Total LPG Saving : 1010 Kg
Total Investment : Rs. 12, 84,904/- Pay Back In The 1st Year Itself: Rs.4, 25,562/-

5.11. General Post Office Building, Thiruvananthapuram

Audited by: BSNL, Thiruvananthapuarm

The GPO building, Thiruvananthapuram is the General Post Office of the city of Thiruvananthapuram, where all postal requirements of a citizen can be fully met. The building is visited by general public in large numbers every day, including evening hours. Being the abode for all kinds of postal activities like selling postal articles, sorting, registering, management of Postal Life Insurance, philatelic bureau etc, this building also accommodate the offices of Director, Postal Accounts Kerala Circle and Postal Division of North Thiruvananthapuram .

Annual Electricity Charges : Rs. 9. 07 Lakh

Annual Diesel Consumption

(DG Set) : 525 Ltrs (Approx)
Annual Fuel (HSD) Charges : Rs. 18,056/-
Annual Water Consumption : 3,308 Kilo Ltrs
Annual Water Charges : Rs. 78168/-
(Will be more next year, since tariff has changed w.e.f. 01.09.2008)

Annual LPG consumption : 3,067 Kg

Summary of Energy Saving Recommendations

Sl. No	Energy saving Recommendations at a Glance	Technical Target	Annual Energy Saving KWH	Annual Cost Savings (Rs.)	Capital Investment (Rs.)	Simple Pay Back period	Return on Investment (%)	Internal Rate of Return (%)
I	**Electrical Distribution System**							
1	Reduction of Contract Demand (125 KVA to 80 KVA)	Rationalization of CD		1,00,000	NIL	NA	NA	NA
2	Load Balancing to reduce the neutral current and cleaning and tightening of terminals	Reducing Wastage of Energy	5,188	27,201	3,600	1.59 Months	756	800
3	Rectification of Earth leakage from SDF unit in LT panel	Reducing wastage of Energy	263	868	NIL	NA	NA	NA
4	Use of LED type Indication lamps in lift M/C room panel	Enhancing energy efficiency	474	1,564	900	6.92 Months	173	177
5	Servicing of APFC Controller and Panel to increase PF from 0.94 to Unity	Reactive Power Management	NA	19,069	4,500	2.83 Months	424	420

Sl. No	Energy saving Recommendations at a Glance	Technical Target	Annual Energy Saving KWH	Annual Cost Savings (Rs.)	Capital Investment (Rs.)	Simple Pay Back period	Return on Investment (%)	Internal Rate of Return (%)
II	**Lighting System**							
6	Use of Energy Efficient FTL with electronic Choke (Retrofit type) in place of conventional FTL with magnetic ballasts	Enhancing Energy Efficiency	18,560	95,448	3,14,766	3.3 Years	30	23
7	Replacement of GLS Lamps with Energy efficient CFL	Enhancing Energy Efficiency	3,863	15,923	2,214	1.67 Months	719	720
8	Use of Natural light, and implementing ENCON options 4,5,6 under Lighting	Tapping natural resources for sustainable habitat	5,986	19,753	NIL	NA	NA	NA
9	Replacement of Resistance type Regulators with Electronic Regulators	Enhancing Energy Efficiency	8,550	41,485	35,100	10.15 Months	118	115
III	**UPS & Computer System**							
10	Replacement of CRT Monitors with LCD or TWT Monitors	Enhancing Energy Efficiency	10,556	1,24,106	2,80,000	5.17 Years	44.32	31
IV	**Air-Conditioning System**							
11	Cleaning of dirty condenser, evaporator, filters, Replacement of capacitors, topping up R-22etc	Improving efficiency thru better maintenance practices	18,374	60,636	12,000	2.37 Months	505	407
V	**DG System**							
12	Doing special maintenance to reduce SFC (Already the DG is under AMC)	Improving efficiency thru better maintenance practices	158 Lts of HSD	5,214	1,000	2.3 Months	521	525

Sl. No	Energy saving Recommendations at a Glance	Technical Target	Annual Energy Saving kWh	Annual Cost Savings (Rs.)	Capital Investment (Rs.)	Simple Pay Back period	Return on Investment (%)	Internal Rate of Return (%)
VI	**Energy Monitoring & Targeting**							
13	Providing Energy Meters floor or section wise for effective monitoring of Energy consumption and creating awareness among staff	Energy monitoring and Targeting	17,294	57,072	26,000	5.47 Months	220	221
VII	**Tapping Renewable Sources**							
14	Providing Solar Water heaters of 600 Lts capacity for Canteen	Tapping natural resources to meet part demand.	1,010 Kg of LPG	23,230	1,05,000	2.48 Years	22.12	20
15	Providing Roof top Rain Water Harvesting	Tapping natural resources to meet part demand.	590 K.Lts of Water	14,761	20,000	16 Months	74	87
16	Bio Gas Plant (15 M^3) for utilization of biomass.	Tapping renewable energy from bio waste	1,496 kg of LPG	46,946	2,25,000	4.79 Years	21	10
	TOTAL		89108	653276	1030080	1.57 Years		

Total Electricity Saving: 89,108 kWh Total Diesel Saving : 158 Ltrs
Total Water Saving : 590 Kilo Ltrs Total LPG Saving : 2,506 Kg
Total Investment : Rs. 10, 300, 80/- Pay Back In The 1st Year Itself: Rs. 6, 53,276/-

The total investment on various items would be paid back within one year and nine months and for the remaining life period of the invested projects; it would definitely yield very good returns or profit Having seen various options, with their individual cost benefit analysis in a nutshell, one can move forward to take a closer look of different systems in the ensuing chapters.

5.12. Rajiv Gandhi Centre of Biotechnology, Thiruvananthapuram

Audited by: FICCI, New Delhi

Rajiv Gandhi Centre of Biotechnology (RGCB) has a connected load of around 591 kW (As per Inventory Survey). As per electricity bills, the electrical energy consumption stands at about 1.385 lakh kWh per month i.e. about 7.5 Lakh Rs. per month.

Executive Summary of Savings Identified

SN	Area	Recommendations	Expected Benefit / Saving	Approx. Investment (Lac Rs.)	Simple Pay Back Period	ROI (%)	IRR (%)
1	Electrical Distribution System	Installation of additional 90KVAR capacitor banks at LT main Panel in addition to existing 160 KVAR	PF improvement to 1.0 Reducing the Demand by 25 KVA Financial benefit to be reflected in the bill as per MD record	0.90		NA	NA
2	Electrical Distribution System	Reducing the Current Unbalance to 10% in all distribution panels	Less Cable Loss Reduction in Safety Hazard	NIL			
3	Lighting System	Retrofitting the FTLs with 20W CFLs in Non-Essential Areas	19000 KWH /Annum 0.96 Lac Rs./Annum	0.3	0.31 years	320	319.99
4	Lighting System	Retrofitting the FTLs with T5 Lamps in essential Areas	108000 KWH /Annum 6 Lac Rs./Annum	6	1 years	100	97.98
5	Lighting System	Replacement of Incandescent lamps with 20W CFL	21000 KWH /annum 1 lac Rs. /annum	1	1 years	100	97.98
6	Lighting System	Putting timers for Campus lights	7300 KWH/ annum 0.4 lac Rs. /annum	0.10	0.26 years	400	399.90
7	Central AC	Setting the Chilled water delivery side temperature at 8.0 ^{0}C during off-peak seasons	54000 KWH/ annum 2.8 lac Rs. /annum	NIL			
8	Central AC	Installation of Centralized control panel for AHU operation along with installation of LCD monitor for display of temperature of various floors	24710 KWH/annum 0.4 lac Rs. /annum	1.5	1.4 years		
9	Comfort AC System (Window AC)	Replacing the old units with BEE star rated AC units	25600 KWH/Annum 1.33 Lac Rs./Annum	2.4	1.8 years	55.42	55.21

10	DG Sets	Putting additional 60-80 KW load on the DG set	About 18 liters of Diesel/hour	NIL			
11	Water Pumping System	Installation of Auto ON/OFF actuator switch and water level indicator	4520 KWH/Annum 0.24 Lac Rs./Annum	0.5	2.0 years		
		Installation of a syntax water tank for overflow water from different tanks	Waste minimization	0.1			
		Providing Electronic Energy Meters & Run-Hour Meters for each pump	Better Energy Monitoring & Accounting	0.2			
12	Others	Providing Electronic Energy Meters at Strategic Locations	Better Energy Monitoring & Accounting	1.0			
	TOTAL		**264130 KWH/Annum** **13.13 Lakh Rs./ Annum**	**14**	**1.06 Years**		

5.13. BSNL-The Panampilly Nagar Telephone Exchange, Ernakulam

Audited by: BSNL, Thiruvananthapuarm

Bharat Sanchar Nigam Ltd., the World's 7th largest Telecommunication Company is providing comprehensive range of Telecom services in India. BSNL has spent Rs.1606 crores in 2007-2008 and Rs.1533 crores in 2006-2007 respectively, towards Energy charges (Electricity and Fuel). The energy cost alone accounts for around 20% of total operating cost of this Public sector undertaking.

The Panampilly Nagar Telephone Exchange, one of the important links in the chain of Telecom Net work of the country, is a very vital Telephone Exchange in Ernakulam. This Telephone Exchange was commissioned in 1992 as E10B exchange. Since then, more switches have been added and at present three major Exchanges viz. E 10B, GSM MSC and Digital Transmission Exchanges are accommodated in the building. Source of energy for the building is KSEB grid supply at 11kV, 3 Phase, which is stepped down to 433V through 2 Nos 750kVA indoor Transformers. There are 2 No.s 500 kVA EA sets to act as standby power source.

Other vital features of the building are,

Area of Land	: 60 Cents
No. of Floors	: Ground + 4
Floor Area	: 3890 Sq.m
Air conditioned Area	: 1758 Sq M
No. of persons working	: 90 Persons
Connected load	: 702 kW
Contract demand	: 500kVA
Recorded Maximum Demand	: 427kVA
Average power Factor	: 0.967
Building operating hours	: 24 Hours
Demand Factor	: 0.55
Tariff	: HT III
Fixed Charge &Energy charge	: 350/kVA & Rs 3.70/kVA
Annual Energy Consumption (Electricity)	:27, 69,960 kWh
Annual Electricity charges	: Rs.1, 36, 30,684
Annual Diesel consumption	: 20,622 Ltrs
Annual Diesel charges	: Rs.7, 21,770
Total Annual Energy cost	: Rs 14,352,454
Major Equipments housed	: GSM-MSC1, GSM-MSC2, E10B and Digital Transmission Equipment

Summary of Energy Saving Recommendations

Sl. No.	Energy Saving Recommendations	Technical Target	Annual Savings (Rs.)	Capital Investment (Rs.)	Simple Pay Back Period, (Months)	Return on Investment (%)	Internal Rate of Return (%)
I	**Electrical Distribution Systems**						
1	Reduction in connected load	Rationalization of CD	1,21,800	NIL	NA	-	-
2	Improvement of Power Factor	Reactive Power Management	95,700	35,000	5	260.57	Above 100
3	Replacement of over loaded cable for supply of AC Plants	Reducing wastage of energy	63,385	32,200	6	196.85	Above 100
II	**Exchange Equipment**						
4	Replacement of conventional type power plant with SMPS Power plant	Adopting energy efficient technology to curtail consumption	2,87,712	5,50,000	23	52.31	47.45
III	**Lighting system**						
5	Replacement of light fittings with energy efficient fittings in corridors and Lobby.	Induction of Energy efficient Technology	1,24,869	49,449	4	277	Above 100
IV	**Heating, Ventilation and Air-conditioning**						
6	Providing ceiling insulation to Motorola and Nortel equipment rooms	Tapping available opportunity to cut Energy wastages.	2,78,603	1,49,061	4	186.91	Above 100
7	Re routing and Rearrangement of AC Plant and Providing partition of AC plant room and correction of Thermostat settings, Condenser stopping	Tapping available opportunity to cut Energy wastages.	2,82,831	2,64,725	11.2	106.8	Above 100
8	Providing Partition to Transmission room at Third Floor	Tapping available opportunity to cut Energy wastages.	30,050	22,800	9	131.7	Above 100
9	Disconnection of life expired Low efficiency AC Units,	Inducting efficient Technology to improve efficiency	1,41,344	58,925	5	239	Above 100

Sl. No.	Energy Saving Recommendations	Technical Target	Annual Savings (Rs.)	Capital Investment (Rs.)	Simple Pay Back Period, (Months)	Return on Investment (%)	Internal Rate of Return (%)
V	**Diesel Generator Sets**						
10	Improving the efficiency of 500 KVA EA set	Improving Efficiency	44,170	55,000	15	80.3	78.49
VI	**Water Pumps**						
11	Replacement of life expired pump and delivery pipe	Enhancing Energy Efficiency	20,967	28,000	16	74.8	72.77
VII	**Renewable Energy sources**						
12	Replacement of heaters with solar water heaters and installation of Bio-Gas Plant	Tapping solar power under National solar Missions	20,004	39,500	30	38.9	31.51
	Total		15,11,435	12,84,660	10.2		

5.14. Telephone Exchange Building, Medical College, Thiruvananthapuram

Audited by: BSNL, Thiruvananthapuarm

The very nature of the operations of a TE building that functions round the clock provides excellent opportunity to conserve energy. A small measure in one Energy intensive system can bring about a large quantity of savings, which make such measures very attractive as well.

Summary of Energy Saving Recommendations

Sl.No	Energy saving Recommendations	Technical Target	Annual savings in Rs (Lakh)	Capital investment in Rs (Lakh)	Simple payback period in (years)	Return on Investment (%)	Internal Rate of return (%)
I	**Electrical Distribution System**						
1	Use of LED type Indication lamps in LT Panels	Enhancing energy efficiency	0.2	0.098	0.43	233.4	233
II	**Lighting System**						
2	Replacement of 2x40w fluorescent fittings with 2 x 28 w Box T5 Fittings	Induction of energy efficient technology	1.9	4.7	2.5	40.4	32
3	Replacement of GLS/Fl. Fittings with 11 WCFL	Induction of energy efficient technology	0.04	0.08	1.9	53.0	39
III	**HVAC System**						
4	Providing inter locks to stop condensers with compressors	Tapping available opportunity to cut energy wastage	0.28	0.20	0.7	139.1	138
5	Replacing of life expired AC units in RRC with reduction in No. of units	Inducting efficient technology to improve efficiency and to reduce energy wastage	1.16	1.40	1.2	83.1	77
6	Replacement of in efficient and life expired WAC/SAC units	Inducting efficient technology to improve efficiency	1.50	2.00	1.3	75.1	70
7	Replacement of resistance type regulators with energy efficient Electronic regulators.	Adopting energy efficient technology to curtail wastage	0.06	0.09	1.6	62.16	55

Sl.No	Energy saving Recommendations	Technical Target	Annual savings in Rs (Lakh)	Capital investment in Rs (Lakh)	Simple payback period in (years)	Return on Investment (%)	Internal Rate of return (%)
IV	**Pumping System**						
8	Replacement of 1No 10HP centrifugal pump set by energy efficient submersible pump set	Deriving optimum efficiency through better design, where Replacement is already due	0.12	0.35	3.0	33.6	27
V	**Energy Monitoring**						
9	Providing individual Energy meters for Major Loads	Effective Energy monitoring and improved energy management	2.82	1.03	0.4	274.1	275
VI	**Renewable Energy Measures**						
10	Providing Solar water heater system to Replace coil heaters & geysers	Tapping Solar power under National solar mission	0.13	0.40	3.0	33.2	26
11	Providing rain water harvesting system	Tapping of bountiful rainwater.	0.30	0.30	1.0	99.4	97
	Total		8.51	10.65	1.25		

5.15. Vikas Bhawan, Thiruvananthapuram

Audited by: FICCI, New Delhi

Vikash Bhawan has a connected load of around 360 kW (As per Inventory Survey). As per electricity bills, the electrical energy consumption stands at about 20000 kWh per month i.e. about 1.35 Lakh Rs. per month 1.1 The detail energy audit reveals that various energy conservation and efficiency options can further result in saving of about Rs. 11 lakh per annum and reduce the energy consumption by 1.4 lakh units per annum (About 58% of the total consumption). The summary of the potential savings has been shown in the following table.

Summary of Potential Saving

SN	Area	Recommendations	Expected Benefit/Saving	Approx. Investment (Lakh Rs.)	Simple Pay Back Period (Years)
1	Electrical Distribution System	Reviewing the tariff structure of Meter # 3584 with KSEB Authority	3.3 Lakh Rs./annum	-	-
2	Electrical Distribution System	Installation of 60 KVAR (3x20) capacitor banks at LT main Panel of CD block & EF block	PF improvement to 0.99 Reducing the Demand by 20 kVA	1.2	NA
3	Lighting System	Replacing main LT panels with New Panels	Reliability in Power Supply Reduction in safety Hazard	4.0	NA
4	Lighting System	Retrofitting the FTLs with 18W CFLs in Non-Essential Areas	16,416 kWh /annum 0.93 Lakh Rs./annum	0.5	0.54
		Retrofitting the FTLs with T5 Lamps in essential Areas	93,607 kWh /annum 5.3 Lakh Rs./annum	7.6	1.4
5	Comfort AC System (Window AC)	Replacing the old units with BEE star rated AC units	23,772 kWh/annum 1.2 Lakh Rs./annum	3.5	1.2
6	Water Pumping System	Installation of Auto ON/OFF actuator switch and water level indicator	3,000 kWh/annum 0.17 Lakh Rs./annum	0.10	1.2
		Replacing the existing 5hp pumps with energy efficient pumps of same capacity	2,997 kWh/annum 0.17 Lakh Rs./annum	0.2	
		Providing Electronic Energy Meters & Run-Hour Meters for each pump	Better Energy Monitoring & Accounting	0.1	
7	Others	Providing Electronic Energy Meters at Strategic Locations	Better Energy Monitoring & Accounting	0.3	
	TOTAL		1,39,792 kWh/annum 11.07 Lakh Rs./annum	17.5	1.58

5.16. Civil Station, Kozhikode

Audited by: BSNL, Thiruvananthapuarm

The Civil Station building is the most important Public Building in Calicut District. This Building Complex houses 35 departmental offices of the state government, including offices of District Collector, District Medical officer, District Labour officer, Principal Agricultural officer, offices of Public Works Department, Excise Dept etc. The Building complex forms the nerve center of District Administration and thousands of people from various parts of Calicut District visit this building complex for satisfying their needs. Hence, the Energy Conservation/Environmental Protection activities launched in this complex will attract large public attention and can act as a catalyst for creating awareness among General Public.

Summary of Energy Saving Recommendations

Sl.No	Energy saving Recommendations	Technical Targets	Annual savings in (Lakh)	Capital investment in (Lakh)	Simple pay back period in Months	Return on Investment (%)	Internal Rate of return (%)
I	**Electrical Distribution System**						
1	Balance of unbalanced load in cables and panels. (Excessive neutral current)	Reducing wastage of Energy	0.01	00	00	100	Full
2	Removal of earth leakage in panels and cables	Reducing wastage of Energy	0.23	00	00	100	Full
3	Providing Automatic power factor correction panel with 150 kVAR capacitor bank to bring the power factor from 0.8 to unity	Enhancing Energy Efficiency	0.97	2.5	31	39	31.36
II	**Lighting System**						
4	Replacement of 417 no's of 2 x 40 w fluorescent fittings and 885 numbers of 1 x 40 w light fittings fluorescent fittings with 1 x 28/2 x 28 w T5 Fittings	Tapping New Technology for Energy efficiency	2.53	10.34	49	25	12.23
5	Replacement of high energy consuming conventional fans with energy efficient fans & energy wasting resistance type regulators with energy efficient electronic regulators.	Tapping New Technology for Energy efficiency	2.34	6.53	34	36	27.82
6	Replacement of incandescent lamp with 11w CFL	Tapping New Technology for Energy efficiency	0.50	0..32	7.6	64	57.1
III	**HVAC System**						

7	Realignment/repositioning 10 numbers of SAC unit condensers at E/E1 block for energy efficient operation of the AC unit	Enhancing Energy Efficiency	0.30	0.30	12	100	98.70
Sl.No	**Energy saving Recommendations**	**Technical Targets**	**Annual savings in (Lakh)**	**Capital investment in (Lakh)**	**Simple pay back period in Months**	**Return on Investment (%)**	**Internal Rate of return (%)**
8	Refrigerant gas topping up for 2 numbers of WAC units, which are inefficient due to shortage of gas.	Enhancing Energy Efficiency	0.062	0.014	3	450	Above 100
9	Replacement of in efficient and life expired WAC units, one each in Treasury Server room and RTO office with energy efficient SAC units	Enhancing Energy Efficiency	0.25	0.44	21	57	52.98
IV	**Pumping System**						
10	Replacement of 1No conventional centrifugal pump set for D block with an energy efficient submersible pump set and repairing of existing bore well pump sets for utilization of existing open/bore wells.	Tapping New technology for Energy efficiency	2.52	0.42	2	600	Above 100
11	Installation of Water Level controller to prevent loss of water and energy due to over flow in tanks	Better management of Water energy	0.079	0.60	91	13.16	3.2
V	**Energy Monitoring and Accounting System**						
12	Installation of separate energy meter for individual departments to avoid penalty for delayed payment and to make departments accountable	Better management of Energy consumption	6.58	4.1	8	160	Above 100
VI	**Other Renewable Energy Conservation Measures**						
13	Providing Bio Gas Plant (25 M^3) for utilization of biomass energy and to arrest environmental degradation.	Environmental protection coupled with Energy efficiency	1.26	3.5	33	36	28.15
14	Solar Water Heater (800 LPD) for canteens to utilize solar power and to reduce carbon dioxide emission by burning of wood	Tapping natural resources for selected Energy needs	0.54	1.38	31	39.25	31.98

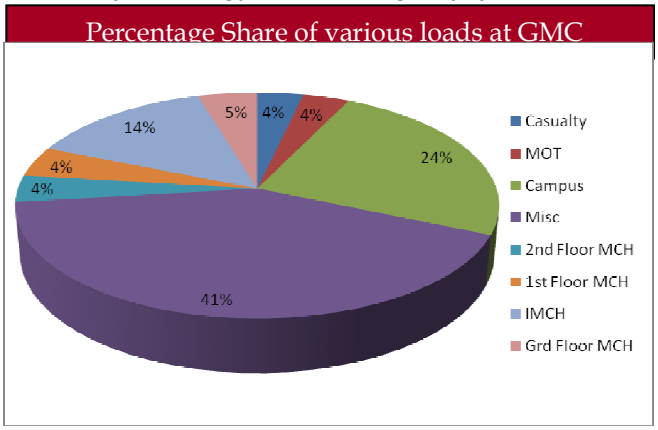
15	Tapping rain water from existing rain water harvesting tanks for daily use	Tapping natural resources for Sustainable habitat	0.012	0.02	20	60	57.30
	TOTAL		18.183	30.464	20		

5.17. Government Medical College Hospital, Kozhikode

Audited by : Eaga Energy Pvt Ltd, Kolkatta

GMC has forty two (42) connections, of which one 11kV HT connection and another six 11 kV deemed HT connection for the medical college, the rest are LT connections. The total electricity consumption from November, 2007 to December, 2008 is 7, 66,024 kWh and the electricity cost during the same period is Rs. 41.96 lakh. The major energy consuming equipments of the complex are:

- Lighting
- Individual AC units
- Ceiling fans
- Pumps
- Street lighting
- Computers and printers



Summary of Energy Saving Recommendations

S. No	Recommendation	Saving potential / Year		Capital investment (Rs Lakh)	Simple payback period (Years)
		kWh	Rs. Lakh		
1	Replacement of conventional FTLs with T 5 lights	2, 54,050	12.7	20	1.6
2	Replacement of GLS lamps by 22 W CFLs	1,14,000	5.7	1.5	0.3
3	Energy improvement in Street lighting	30,782	1.53	0.78	0.5
4	Replacement of existing water pumps by new efficient pumps	98,550	4.9	0.55	0.1
5	Purchase of cleaning blower for air conditioners	24,000	1.2	0.50	0.25
6	New temperature feedback control to Replace the old fittings	65,000	3.25	2.0	0.6
7	Replacement of conventional fan regulators with electronic regulators	50,000	2.5	2.65	1.1
8	**Total**	6, 36,382	32	28	0.9

5.18. Kerala Financial Corporation, Ernakulam

Audited by: Eaga Energy Pvt Ltd, Kolkatta

Kerala Financial Corporation (KFC) incorporated under the State Financial Corporations Act of 1951, is a trend setter and path breaker in the field of long term finance, playing a major role in the development and industrialization of Kerala. It was established as the Travancore Cochin Financial Corporation on 01.12.1953. Consequent to the reorganization of states on linguistic basis in November 1956, Kerala State was formed and the Travancore Cochin Financial Corporation was renamed as Kerala Financial Corporation.

Now KFC has 16 Branch Offices with its Head Quarters at Thiruvananthapuram and Zonal Offices at Kozhikode, Ernakulam and Thiruvananthapuram.

Summary of Energy Saving Recommendations

SL	Recommendations	Saving Potential / Yrs		Capital Investment (Rs)	Simple Payback Period (Years)
		kWh	Rs		
1	Replacement of conventional FTLs with T 5 lights	20,516	1.13	2.23	2
2	Replacement of GLS lamps by 11 W CFLs	2,111	0.11	0.035	0.3
3	Lighting transformer	4,500	0.225	0.45	2
	Total	28,096	1.525	2.746	1.8

GHG emission reduction that will result from energy saving opportunities identified by the study is estimated to be 28 tCO_2e per annum.

5.19. College of Engineering, Thiruvananthapuram

Audited by: Eaga Energy Pvt Ltd, Kolkatta

The College of Engineering, Thiruvananthapuram was established in 1939 as the first Engineering College in the then Travancore State. The institution owes its foundation to the bold and inspired vision of Sree Chithira Thirunal Balarama Varma, the then Maharaja of Travancore. The College was shifted to the present sprawling 45 hectares campus in 1960.

Summary of Energy Saving Recommendations

S. No	Recommendation	Saving potential / Year			Capital investment (Rs. Lakh)	Simple payback period (Years)	ROI (%)	CO_2 emission Reduction/ Year
		kWh	Rs. Lakh	%				
1	Demand side management	NA	1.62	NA	0.50	0.33	314	--
2	Replacement of conventional FTLs with T 5 lights	60,000	3.3	44	13.2	4	5	51 T
3	Replacement of GLS lamps by 11 W CFLs	32,700	1.8	70	1.12	0.62	135.7	27.8 T
4	Replacement of HPMV lamps by MH lamps	30,700	1.69	36	2.24	1.3	50.4	26.1 T
5	Replacement of existing water pumps by new efficient pumps	5,000	0.275	42	0.72	2.62	25.7	4.2 T
6	Purchase of cleaning blower for air conditioners	36,000	2	5	0.50	0.25	375	30.6 T
7	Intelligent control for old stand alone AC	35,000	1.90	10	0.90	0.5	186	29.75 T
8	Replacement of conventional fan regulators with electronic regulators	22,500	1.23	15	1.88	1.5	40.4	19 T
	Total	2,21,900	13.81		21.06	1.53		188.45 T

Classification o+f Investment			
Scale on investment	**Number of items**	**% energy saving in Rs**	**% investment in Rs**
Low investment (< 5 lakh)	7	76	37
Medium investment (<10 lakh)	0	0	0
High investment (>10 lakh)	1	24	63

GHG emission reduction that will result from energy saving opportunities identified by the study is estimated to be 188.45 tCO_2e per annum.

5.20. Civil Station, Thrissur

Audited by: Eaga Energy Pvt Ltd, Kolkatta

The Civil Station in Thrissur houses multiple government offices including the district court, district police head quarter, district collector's office etc.

Summary of Energy Saving Recommendations

SL	Recommendations	Saving Potential / Yrs		Capital Investment (Rs)	Simple Payback Period (Years)
		kWh	Rs		
1	Replacement of conventional FTLs with T 5 lights	8,395	46,172	100,000	2.16
2	Replacement of GLS lamps by 11 W CFLs	11,088	60,984	16,500	0.27
3	Replacement of HPSV lamps by LPSV lamps	4,334	23,837	11,000	0.5
4	Replacement of existing water pumps by new efficient pumps	3,660	20,130	35,000	1.73
5	Timer based controller for air conditioners	7,200	39,600	33,600	0.80
6	Replacement of conventional fan regulators with electronic regulators	6,000	33,000	80,160	2.43
	Total	40,677	2, 23,723	2, 76,260	1.23

5.21. Civil Station, Ernakulam

Audited by: FICCI, New Delhi

Civil Station, the office of the district collector of Ernakulam is located at the outskirts of the Cochin city. The building established about 25 years back is a multi-storied building with total of six floors. About 500 employees are working in this office with office hour of 8 hours in week days and Saturday.

The Assistant Executive Engineer (Electrical) of PWD looks after the management of electric supply, water supply, ventilation & air conditioning, lighting system etc. of the entire building to ensure proper work environment and comfort of its employees. As explained earlier, the energy conservation has become a foremost requirement in any high rising building which has a connected load of 500 kW and more, the Civil Station is also no exception.

Civil Station has a connected load of around 165 kW (As per Inventory Survey). As per electricity bills, the electrical energy consumption stands at about 26900 kWh per month i.e. about 1.82 Lakh Rs. per month.

The detail energy audit reveals that various energy conservation and efficiency options can further result in saving of about Rs.4.14 lakh per annum and reduce the energy consumption by 0.62 lakh units per annum (About 19% of the total consumption). The summary of the potential savings has been shown in the following table.

Summary of Energy Saving Recommendations

SN	Area	Recommendations	Expected Benefit	Approx. Investment (Lakh Rs.)	Simple Pay Back Period (years)
1	Electrical Distribution System	Replacing the LT panel of Switch Room#2	Reliability in Power Supply Reduction in Safety Hazard	1.0	-
2	Electrical Distribution System	Installation of 80 kVAR (4x20) capacitor banks at LT main Panels	PF improvement to 0.99 Reducing the Demand by 30 kVA	0.8	NA
3	Lighting System	Retrofitting the FTLs with 18W CFLs in Non-Essential Areas	12,240 kWh /annum 0.83 Lakh Rs./annum	0.35	0.43
		Retrofitting the FTLs with T5 Lamps in essential Areas and rearrangement of FTL fittings	37,200 kWh/annum 2.52 Lakh Rs./annum	3.22	1.3
		Installation of Solar Powered lights for Campus area	7,300 kWh/annum 0.5 Lakh Rs./annum	2.5	5.0

SN	Area	Recommendations	Expected Benefit	Approx. Investment (Lakh Rs.)	Simple Pay Back Period (years)
4	Water Pumping System	Installation of Auto ON/OFF actuator switch and water level indicator	3,000 kWh/annum 0.17 Lakh Rs./annum	0.10	1.2
		Replacing the existing 7.5 hp pumps with energy efficient pumps of same capacity at A1 side block	1,772 kWh/annum 0.12 Lakh Rs./annum	0.2	
		Providing Electronic Energy Meters & Run-Hour Meters for each pump	Better Energy Monitoring & Accounting	0.1	
	TOTAL		61,512 kWh/annum 4.14 Lakh Rs./annum	8.27	2

5.22. High Court Building, Ernakulam

Audited by: BSNL, Thiruvananthapuarm

On the integration of Travancore - Cochin State after independence on 1st July 1949, it was on the 7th of July 1949 that the High Court of Travancore-Cochin was inaugurated with its seat at Ernakulam. High Court of Kerala came into being from 1st November 1956, with its seat at Ernakulam. The High Court of Kerala has jurisdiction over the Subordinate Courts and the Tribunals in the State of Kerala and the Union Territory of Lakshadweep, where it is the highest judicial forum. The High Court transacts its judicial functions, the Judges sitting in Single, in Division Bench and in specifically referred cases in Full Bench and also in Larger Bench.

The High Court is functioning in the new 8 storied building since 2006. The building is located on the shores of Vembanad Lake, close to Marine Drive. The building is having 11 blocks with a total built up area of 52,280 Sq.m. This massive edifice has many special environmental friendly features, most significant of which is the twin court yard (Quadrangle), around which various blocks are built up. The airy and naturally lighted wide corridors, facing the twin quadrangle, are the life lines of the building. These corridors, by its sheer concept, makes every moment of the occupant of the space fairly comfortable, with least demand on energy. They exude warmth and provide a sense of security and comfort to the occupant, while one is on the move or in waiting for one's work in 30 court halls, 36 Chambers and administrative offices, all of which are housed in a well spread out manner in this building. This building complex also accommodates Advocate General's office, National Informatics Centre, Bank, Post Office, Dispensary etc. There are 1500 employees working in the High Court to take care of the judicial needs of the State's public, through 30 Hon: Justices and 5000 advocates, for who all this wonderful edifice plays host.

Annual Electricity consumption (Av)	: 15, 99,070 kWh
Annual Electricity Charges	: Rs 92.08 Lakh
Annual Diesel Consumption (DG Set)	: 5,196 liters (Approx)
Annual Fuel (HSD) Charges	: Rs. 1, 97,448/-
Annual Water Consumption	: 18,000 Kilo liters
Annual Water Charges	: Rs. 2, 70,000/-
Annual LPG consumption	: 11,520 Kg

Summary of Energy Saving Recommendations

Sl. No	Energy Saving Recommendations at a Glance	Technical target	Annual Energy Saving kWh	Annual Cost Savings (Rs.)	Capital Investment (Rs.)	Simple Pay Back period	ROI (%)	IRR (%)
I	**Electrical Distribution System**							
1	Load Balancing to reduce the neutral current and cleaning and tightening of terminals	Reducing Wastage of Energy	15,991 kWh	42,881	3500	1 month	Full	FULL
2	Servicing of APFC Controller, panel and Replacement of capacitors to increase PF from 0.926 to 0.98	Reactive Power management	NA	1,80,624	71,000	4 months	254	286
II	**Lighting System**							
1	Use of LED lamps for aviation lamp in place of incandescent lamps	Enhancing Energy Efficiency	1,037 kWh	4,044	20,000	5 years	20	8
2	Use of Natural light, and implementing ENCON options 4,5,6 under LIGHTING	Tapping natural resources, sustainable habitat	9,360 kWh	28,080	NIL	NA	NA	NA
III	**Air-Conditioning System**							
1	Cleaning of dirty condenser, evaporator, filters, Replacement of capacitors, topping up R-22etc	Improving efficiency thru better maintenance practices	22,680 kWh	79,380	NIL	NIL	NIL	NIL
2	Providing Door closures in conditioned rooms	Enhancing Energy Efficiency	6,720 kWh	23,250	30,000	1.3 years	78.4	65
3	Providing alternative/ standby AC system to substitute stand-alone operation of existing 50 TR Chiller plant.	Improving Energy efficiency thru better operation practices	65,850 kWh	2,30,475	2,30,000	1 year	100	113
4	Split A/C Units Replacing faulty Starting / Running Capacitors, Topping up of Refrigerant Gas, Cleaning of Fins	Improving efficiency thru better maintenance practices	10,765 kWh	71,294	12,000	2 months	594	628
5	Closure of Chiller piping valves of non operating units, when the respective AHUs are in OFF condition.	Improving Energy efficiency thru better operation practices	3,192 kWh	10,640	NIL	NA	NA	NA
6	Arrest leakages of chilled water through Glands and proper chiller line insulation on damaged portion of chilled water pipe lines	Improving efficiency thru better maintenance practices	19,141 kWh	57,422	5,000	I month	Full	FULL

Sl. No	Energy Saving Recommendations at a Glance	Technical target	Annual Energy Saving kWh	Annual Cost Savings (Rs.)	Capital Investment (Rs.)	Simple Pay Back period	ROI %	IRR %
IV	**Pumping system**							
1	Replacing existing centrifugal Pump with submersible Pump for fresh water arrangement	Improving Energy efficiency	7,854 kWh	30,489	38,000	1.2 years	80	84
2	Replacing existing centrifugal Pump with submersible Pump for Flush water arrangement	Improving Energy efficiency	3,343 kWh	14,701	67,000	4.6 years	22	24
V	**Lift**							
1	Savings on account of switching of one lift in each section, except Judges, during Peak hours	Improving Energy efficiency thru better operation practices	5,513 kWh	16,539	NIL	NA	NA	NA
2	Savings on account of encouraging usage of staircase to travel one or two floors up and down		2,804 kWh	8,412	NIL	NA	NA	NA
VI	**Energy Monitoring & Targeting**							
1	Providing Energy Meters floor or section wise for effective monitoring of Energy consumption and creating awareness among staff	Energy monitoring and Targeting	15,990 kWh	92,000	35,500	5 months	259	259
VII	**Tapping Renewable Sources**							
1	Providing Solar Water heaters of 500 Ltrs capacity for Canteen	Tapping natural resources to meet part demand	1,060 KG LPG	25,683	1, 11,000	4.3 years	23	10.8
2	Bio Gas Plant ((20M^3) for utilization of biomass**.**	Tapping Renewable energy from bio waste	1,470 KG LPG	1,00,240	2,45,000	2.4 years	41	54
	Total		1,90,240 kWh	10,16,154	8,68,000	0.85 years		
VIII	**Optional items**							
1	Replacement of CRT Monitors with LCD or TWT Monitors	Enhancing Energy Efficiency	19,305 kWh	84,034	6,60,000	7.9 years	12.7	11.7
2	Providing Roof top Rain Water Harvesting	Tapping natural resources to meet part demand	6,750 Kilo ltrs	91,125	10, 00,000	11 years	9	10.8
3	Providing 5 KW Solar-Wind Hybrid system to utilize natural resources	Tapping renewable energy from Sun and wind	19,320 kWh	67,620	23,00,000	Very high	LOW	LOW
	Total of Optional Items		38625 kWh	2,42,779	39,60,000	16.3 years		
	Grand Total		2,28,865kWh	12,58,933	48,28,000	3.83 years		

6. IGEA Consultative Meeting- Highlight

An IGEA consultative meeting was held on 13th November 2009 after the receipt of all the Energy Audit reports. Various stakeholders in building energy efficiency and senior officials from the State and Central government as well as financial institutions participated in the meeting. This meeting was convened to discuss on implementation of audit findings and the ESCO mode of Implementation. This was to facilitate the building owners to clarify any queries on the energy audit undertaken.

The meeting provided an interactive platform for the audit firms, the consultants as well as the building owners. All building owners except Shaktan Thampuran Arcade owner participated in the programme. The meeting was attended by all the energy auditors who undertook the IGEA.

A detailed session on ESCO concepts and various modalities of implementation in ESCO route was handled by EMC invited consultant Mr Pradeepkumar, Alliance to Save Energy, Bangalore. He explained the concept of ESCO, the necessity, the implementation methodologies or modes as well as the contract requirement for the same.

The session was inaugurated by Mr L Radhakrishnan, IAS, Principal Secretary (Power). He applauded EMC initiative to start such a dialogue between the building owners and the contractors. He stated that, the implementation of these measures should be taken up on a priority basis so that these government buildings act as demonstrative projects to the other sectors as well as the public to follow. The Principal Secretary mentioned that a similar training programme needs to be initiated with the Public Works Department. He also mentioned during the course of the training that an ESCO model implementation would facilitate the building owners to undertake such projects without allocating funds from their revenue. The process of implementation can be swifter without using the public money. He actively participated in the deliberations.

The Key Note Address by Mr. K M Dharesan Unnithan, Director, EMC covered the salient features in the audits undertaken. The key shortcomings in the audits were also covered in the address. The Presentation on IGEA (Investment Grade Energy Audit) covered the Bureau of Energy Efficiency Programme in Government Buildings. The EMC as an SDA identified 22 Government Buildings and undertook the audit through the BEE listed ESCOs and Consultants. The presentation by Mr A M Narayanan, Head of the Energy Efficiency Division, EMC took the participants/ delegates through the scope of IGEA in an elaborate manner and opened the forum for the presentations by energy audit firms.

The Welcome

A Brief Welcome for the dignitaries on and off the dais was delivered by Shri A M Narayanan, Head Energy Efficiency Division, EMC

The Key Note Address

The Key Note Address by Shri K. M. Dharesan Unnithan, Director, EMC

The Inaugural Address

The Inaugural Address by Shri L.Radhakrishnan, IAS, Principal Secretary Power, EMC

The Audience for Audit Presentations

ESCO Mode of Implementation

Shri Pradeepkumar, Alliance to Save Energy presenting his talk on ESCos

The Key Inferences generated

- The Building owners actively participated in discussions of the audit findings.
- One of the major inferences which were generated during the meeting was at least 50% of the audit undertaken are not compliant to Investment Grade Energy Audit but rather to an extended walk through audit. Some of the building owners passed on their concern on the lack of information on the implementation possibility.
- Enquires were generated on the ESCO mode of Implementation and two building owners are seriously considering this mode of implementation. The meeting was able to generate interest and commitment from the building owners for the implementation of the measures suggested by IGEA.
- Quality enhancement of the IGEA was requested by many of the building owners and the contractors have promised to deliver the same.
- PWD expressed interest in the implementation of the measures in the buildings maintained by them through their own resources.
- High Court Complex expressed interest in ESCO concept.

A brief Outline of general interest expressed by the building owners in implementation of the IGEA findings.

Expressed Interest in ESCO mode of Implementation	**Implementation by own resources**	**Implementation by PWD**
High Court Building, Ernakulam	State Bank of Travancore , Thiruvananthapuram	Government Medical College Hospital, Thiruvananthapuram
Finance Towers, Kerala Financial Corporation, Ernakulam	Mascot Hotel, KTDC, Thiruvananthapuram	Kerala Legislature Complex, Thiruvananthapuram
	The Kerala State Planning Board, Thiruvananthapuram	Kerala Secretariat Complex, Thiruvananthapuram
	General Post Office Building, Thiruvananthapuram	Vikas Bhawan, Thiruvananthapuram
	BSNL–The Panampilly Nagar Telephone Exchange, Ernakulam	Civil Station, Ernakulam
	Telecom Exchange Building, Medical College, Thiruvananthapuram	Government Medical College, Kozhikode
	Regional Cancer Centre, Thiruvananthapuram	Civil Station, Thrissur
	Vydyuthi Bhawan , Thiruvananthapuram	Civil Station, Kozhikode
	Rajiv Gandhi Centre of Biotechnology, Thiruvananthapuram	College of Engineering, Thiruvananthapuram
	Mail Business Centre, Thiruvananthapuram	

7. Conclusion

A multitude of actions are necessary to aggressively reduce energy consumption in new and existing buildings. The Investment Grade Energy Audit is the first step towards the government's commitment of establishing energy efficiency norms for all its buildings.

Energy Management Centre is working towards engaging the various departments who are directly or indirectly involved in the implementation of the IGEA findings as well as the construction of new buildings in the state. The consultants who have undertaken IGEA are also expected and are willing to provide implementation support to the building owners. The IGEA Implementation Consultative Meeting on November 13th 2010 bought together all the stakeholders in the IGEA process and EMC is following up with all the buildings on the implementation process.