Solar City Master Plan

for Shimla

Final Report

Supported by

Ministry of New and Renewable Energy

Government of India, New Delhi

Deloitte Touche Tohmatsu India Private Limited

Acknowledgement

This Master Plan is an outcome of the Ministry of New and Renewable Energy's (MNRE) Solar City Programme as part of the 11th Five Year Plan. Under this programme Deloitte Touche Tohmatsu India Private Limited (DTTIPL) was entrusted with the assignment of preparing the Master Plan for Shimla. DTTIPL expresses its gratitude to HIMURJA and Shimla Municipal Corporation for the extensive support and assistance they have provided for the entire period of development of this master plan. We would like to thank officials and other staff members from HIMURJA and Shimla Municipal Corporation of for their consistent support in preparing and finalizing the report.

The report benefited enormously from a peer review process by a gamut of experts from DTTIPL, Himurja, SMC and different stakeholders of Shimla Solar City programme. We acknowledge their contributions and suggestions which streamlined the structure and composition of the master plan.

The report would have not been possible without the generous support of the Ministry of New & Renewable Energy, Government of India. We extend our gratitude to the officials of MNRE for their valuable advice and guidance during the preparation of this report.

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LIST OF ABBREVIATIONS

BEE	Bureau of Energy Efficiency
BEMS	Building Energy Management Systems
BAU	Business as Usual Scenario
CDM	Clean Development Mechanism
CFL	Compact Fluorescent Light
CAGR	Compound Annual Growth Rate
CER	Certified Emission Reduction
CUM	Cubic Meter
EE	Energy Efficiency
ESCO	Energy Services Company
ECBC	Energy Conservation Building Code
EPC	Engineering, Procurement, and Construction
ETC	Evacuated Tube Collector
EPI	Energy Performance Index
FTL	Fluorescent Tube Lights
GHG	Greenhouse Gas
GoHP	Government of Himachal Pradesh
GRIHA	Green Rating for Integrated Habitat Assessment
HPSEB	Himachal Pradesh State Electricity Board
HIMURJA	Himachal Pradesh Energy Development Agency
HIMUDA	Himachal Pradesh Urban Development Authority
I &PH	Irrigation and Public Health Department
JNNSM	Jawaharlal Nehru National Solar Mission
LED	Light Emitting Diode
MNRE	Ministry of New & Renewable Energy
MSW	Municipal Solid Waste
NGO	Non-governmental Organization
PWD	Public Works Department
RE	Renewable Energy
SLNA	State Level Nodal Agency
RDF	Refuse Derived Fuel
SCS	Solar City Scenario
SMC	Shimla Municipal Corporation
STP	Sewage Treatment Plant
SPA	Shimla Planning Area
ULB	Urban Local Bodies

LIST OF UNITS

GWh	Gigawatt hour
kV	Kilovolts
kW	Kilowatt
kWh	Kilowatt hour
ktOe	Kilo Ton of Oil Equivalent
MW	Megawatt
MWh	Megawatt hour
MLD	Million Liters per Day
MU	Million Units
tCO2e	Tone of Carbon Dioxide Equivalent

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EXECUTIVE SUMMARY

I. Introduction

India is one of the fastest growing economies in the world. With increasing economic growth there has been an unprecedented upsurge in India's urban sector. Rapid urbanization is laying pressure on existing infrastructure and natural resources. There is sharp increase in requirement of energy from various sectors supporting each of the urban epicenters. Urban areas currently use 67 percent of world's energy and account for over 71 percent of global Green House Gas emissions which are expected to rise to 73 and 76 percent respectively by 2030 *(International Energy Agency-IEA 2008).*

Energy infrastructure of most of the Indian cities is not very good as compared to developed or developing countries counterparts. It is still well below satisfactory in urban governance parameters. Many of the Indian cities are still running short of power due to inadequate demand and supply scenario. The major reasons for this are inefficiently managed energy system and lack of innovation in harnessing the potential of renewable energy resources.

With such a rapid expansion, there is a need to shift in energy resources and to develop a framework that will encourage and assist cities in assessing their present energy consumption status, setting clear targets and preparing action plans for generating energy through renewable energy sources and in conserving energy utilized in conducting urban services

In order to overcome this situation and make the Indian cities energy-sustainable & self-reliant, Ministry of New and Renewable Energy launched a program namely "Development of Solar Cities"

The mission aims at short term and long term development of energy infrastructure, capacity building, awareness generation and active participation of citizen and community. Shimla is one of the 60 eligible cities under "Development of Solar Cities Program"

II. Solar City Concept and Development of Master Plan

"Solar City" is a concept to strategically manage the long term energy supply and demand considering an urban conglomerate/town/city as a unit. It is an inclusive approach of assessment and implementation of possible Renewable Energy and Energy Efficiency options across various sectors within urban boundaries. Development of master plan is the first step towards the making a city as solar city

III. Key Sectors

Following five sectors have been considered for the analysis according to the MNRE guideline for development of master plan.

- Residential: It comprises of occupied or unoccupied, owned or rented, single-family or multifamily, housing units and mobile homes within the city boundary. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting,

refrigeration, cooking, and running a variety of other appliances.

- Commercial: This sector consists of service-providing facilities and equipment of: businesses, State, Local governments and other private and public organizations, such as Hotels, Restaurants, Shopping complexes and Shops. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a wide variety of other equipment.

- Industrial: This is goods-producing segment. Common uses of energy associated with this sector include manufacturing process, water heating, air conditioning, refrigeration etc.

- Institutional: This sector consist non-financial corporations such as Schools, Colleges, Research Institute, Hospitals, Government office Buildings, Religious Buildings and Heritage Buildings. Common uses of energy associated with this sector include space heating, water heating, air conditioning, cooking and lighting.

- Municipal: This sector provides the basic facilities like water supply, sanitation, parking, waste management etc. within the city boundary. Common uses of energy associated with this sector include Street Lighting System, Water treatment & pumping, Sewage Pumping/ Treatment and energy consumed by the office buildings of corporation.

IV. Baseline Energy Assessment and Demand Forecasting

Goss energy consumption for all sectors under the scope of solar city project has been assessed on the basis of primary and secondary data received form the various sources like State & District statistical department, Food & Civil Supply Department, Municipal Corporation, Department of Energy, District industrial Center and Electricity Board. Forecasting has been done for next seven years using the Compound Annual Growth Rate (CAGR) method. Baselines as well as forecasted data are given below in the table.

Energy Consumption and Demand Forecasting (ktOe)

Year/Energy Type	2008-09	2009-10	2010-11	2013-14	2018-19
Electricity	23.61	25.39	23.82	27.26	34.14
LPG	5.26	5.31	5.85	6.87	8.96
Kerosene	1.29	1.16	0.98	0.64	0.32
Gross	30.16	31.86	30.65	34.8	43.4

V. Resource Assessment and Energy Planning

Various option of generating energy from renewable energy resources such as biomass, solar, wind and municipal waste, has been assessed by conducting the field survey across the city boundary. It has been found that in the present scenario solar energy is the most feasible option while some amount of energy can also be generated by vegetable waste based biogas plant and from existing sewage treatment plant by recovering the methane gas produced by anaerobic digestion process. Also, significant amount of energy can be saved by enhancing the efficiency of existing system across various sectors.

Based on the resource assessment and field contacts conducted across different energy consuming sectors, various energy saving and renewable energy generation measures have been proposed.

VI. Year Wise Goal for Energy Saving

Gross target for next 7 years is approximately 50491MWh (50MU) which is 10% of the total projected demand. Based on the assessment of potential for demand side management and supply side interventions through renewable energy technologies, the following targets are proposed to achieve this reduction target in order to develop Shimla as a Solar City. .

City	Reduction (MWh)	Intervention	Year wise Cumulative Energy Saving Goal in MWh							% of Goal to Meet	GHG Reduction (tCO2e)
			1st Year (2012-13)	2nd Year (2013-14)	3rd Year (2014-15)	4th Year (2015-16)	5th Year (2016-17)	6th Year (2017-18)	7th Year (2018-19)		
Year -Wise Percentage Saving			5%	8%	12%	15%	15%	20%	25%		
Shimla	50491	EE(MWh)	712	1140	1710	2137	2137	2850	3562	27.00	12112
		Cumulative EE(MWh)	712	1852	3562	5700	7837	10687	14249		
		Municipal	29	46	69	86	86	115	144		
		Residential	459	735	1102	1378	1378	1837	2296		
		Commercial	116	186	280	349	349	466	582		
		Industrial	23	37	56	69	69	93	116		
		Institutional	85	136	203	254	254	339	424		
		RE(MWh)	1830	2927	4391	5489	5489	7319	9148	73.00	31104
		Cumulative RE(MWh)	1830	4757	9148	14637	20126	27444	36593		
		Municipal	355.0	568	852	1065	1065	1420	1775		
		Residential	470.0	752	1128	1410	1410	1880	2350		
		Commercial	352.5	564	846	1058	1058	1410	1763		
		Industrial	176.3	282	423	529	529	705	881		
		Institutional	475.9	761	1142	1428	1428	1904	2379		
		Cumulative EE & EE(MWh)	**2542**	**6609**	**12710**	**20337**	**27963**	**38131**	**50842**	**100**	**43215**

VII. Budget Estimation

Based on the sector wise proposed project activity to improve the present and projected energy consumption scenario of the city, quantum of investment required for various sectors is estimated for Solar City Development Plan over a specified time frame to achieve the mission goals. Gross investment need is approximately 272.50 Crores for the next seven years. The costing provided for the projects is a rough cost estimation based on similar kind of projects and vendor interaction with suitable escalation factors in each sector during the implementing period.

Sector	Gross Value (Crores)	MNRE/HIMURJA Subsidy(Crores)	Users Contribution (Crores)
Residential	99.84	31.40	68.44
Commercial	62.85	19.48	43.36
Industrial	15.51	4.80	10.71
Institutional	85.97	26.83	59.14
Municipal	8.33	3.63	4.70
Gross Investment	272.50	86.15	186.35

1 INTRODUCTION

1.1 Background

"Development of Solar city" is one of the most ambitious programs launched by Ministry of New and Renewable Energy (MNRE).The program assists Urban Local Bodies in:

- Preparation of a master plan for increasing energy efficiency and renewable energy supply in the city.
- Setting-up institutional arrangements for the implementation of the master plan.
- Awareness generation and capacity building activities.

The main focus of the programme is to reduce the increasing energy as well as power demand across different sectors in the fast urbanizing cities in the country.
The program aims at *minimum 10% reduction* in projected demand of conventional energy at the end of five years, which can be achieved through a combination of energy efficiency measures and enhancing supply from renewable energy sources.

1.2 Goal & Objective of the Solar City Program

The Goal of the program is to promote the use of Renewable Energy in urban areas by providing support to the Municipal Corporations/ULBs for preparation of a *road map* to develop their cities as Solar Cities. The main objectives of the programme are:

- Enable/empower Urban Local Governments to address energy challenges at City - level.
- To provide a framework and support to prepare a Master Plan including assessment of current energy situation, future demand and action plans.
- To build capacity in the Urban Local Bodies and create awareness among all sections of civil society.
- To involve various stakeholders in the planning process.
- To oversee the implementation of sustainable energy options through public - private partnerships.

1.3 Scope of Work

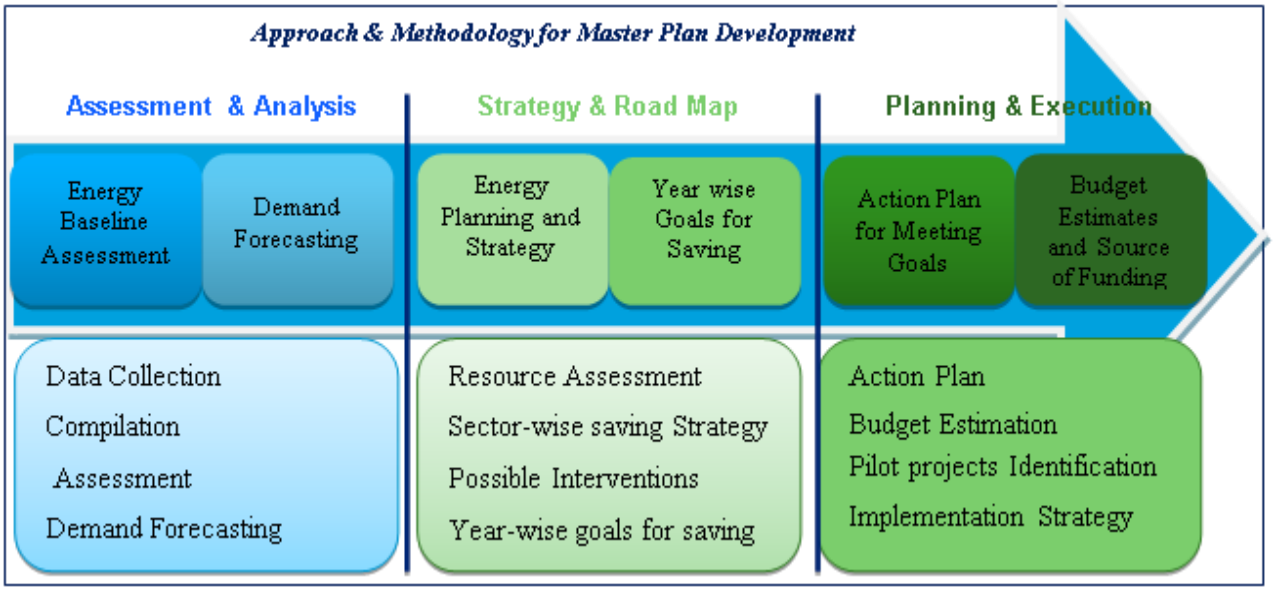
The "Solar City Master Plan" for Shimla outlines the strategy to achieve vision within the context of the solar city scheme launched by MNRE. The scope of work is to.

(a) Establish the overall and sector-wise energy baseline of the city assuming 2008-09 as base year.
(b) To forecast the medium term (2013) and long term (2018) energy demand on the basis of previous data.

(c) Assessment of various renewable energy resources and quantifying the energy conservation potential across various sectors.
(d) Overall energy planning for the city and Sector-wise strategy for energy saving and renewable energy interventions.
(e) Estimation of the budget and identifying the possible source of funding for the implementation of the formulated strategy for various sectors.
(f) Identification of the few implementable pilot projects.

1.4 Approach & Methodology

The preparation of Solar City Master Plan for Shimla has been carried out in 3 distinct phases with 6 sub-activities.1st phase comprised of energy baseline assessment with sub-activities like primary & secondary data collection from various government/private departments and demand projection based on past year's energy consumption trend. 2nd phase comprised of strategies & roadmap with sub-activities like resource assessment and setting year-wise goal for energy saving. 3rd phase comprised of planning & execution with sub activities like identification of pilot projects, cost estimation, identification of sources for revenue generation to fund the identified projects and implementation strategy. A pictorial presentation is given below.



1.5 Consultation Process

Stakeholders Consultation is an integral part of this project. As a part of the consultative process, first and second stakeholder meeting for "Shimla Solar City Project" was held at Rotary Club Hall, the Mall Shimla on 17th June 2011 and 6th January 2012 respectively involving Shimla Municipal Corporation, State level nodal agency for renewable energy promotion(HIMURJA) and various other stakeholders including Electricity Distribution Company(City Division & Division-1),Waste Management Company, Urban Development Authority(HIMUDA),Public Work Department(PWD), Department of Science & Technology, Pollution Control Board(HPSEB), District Industrial Centre, Traders Associations ,Hotelier association, Academic/Research Institutions, Councilors and NGOs.

The discussions revolved around the city's future energy planning, sustainable development, GHGs mitigation strategy, Energy efficiency measures and Renewable energy intervention like applications of SWHS ,Solar Street Lighting, Solar Cooking Options and Grid -connected as well as Off-grid application of SPV system across various sector within the city boundary.

Picture 1: First Stakeholder Meeting at Rotary Club Hall, the Mall Shimla on 17th June 2011.

The issues and suggestion provided by the stakeholders have been assessed and incorporated while preparing the Master Plan.

Picture 2: Second Stakeholders Meeting at Rotary Club Hall, the Mall Shimla on 6th January 2011

1.6 Structure of the Report

The Report contains nine (8) Chapters.

Chapter-1: It presents the background, objectives, approach & methodology and process of Solar City Master Plan development.

Chapter-2: It contains city profile, evolution of the city, climate, geographical setting and demography which includes trend of population growth.

Chapter-3: It addresses the overall energy baseline assessment, demand projection for next five & ten years based on the previous year data and estimation of Green House Gas Emission(GHG) in the baseline scenario.

Chapter-4: It illustrates energy planning, overall assessment of renewable energy resources and sector-wise strategy for energy saving and renewable energy interventions.

Chapter-5: It explains year-wise goal of energy saving through demand side management (Energy Efficiency) and supply side interventions (Renewable energy).

Chapter-6: It explains the action-plan for achieving the set goals, capacity building and awareness generation strategy.

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Chapter-7: It provides informaton about the estimated budget for project implementataion.

Chapter-8: It provides the overview of Pilot Projects identified for each sectors and implementation strategy.

2 CITY PROFILE

2.1 Evolution

Shimla was first explored by British during colonial period in the first half of 19th century. It is situated on the last traverse spur of the central Himalayas and a well-known tourist destination in India. The Ridge, located at the center is a commanding site of the city with scandal point in the west, Lakkar Bazar, Library and Christ Church in the East, along with Town Hall and Goofa on the Southern side.

Municipal Committee came into existence in 1851 and was responsible for establishment of Town Hall and Gaiety Theatre. The city is famous for its buildings style and neo-gothic architecture dating from the colonial era. British established many architectural masterpieces such as Vice Regal Lodge, Gorton Castle, Railway Board Building, Gaiety Theatre, Town Hall, Auckland House, Ellerglie, Barnes Court etc.

In 1871, the Government of Punjab also decided to use Shimla as its summer capital. In 1904, the Kalka-Shimla railway line was commissioned. After Partition in 1947, offices of Punjab Government were shifted from Lahore in Pakistan to Shimla. In 1966, with reorganization of territory into Punjab, Haryana and Himachal Pradesh, Shimla became the capital of Himachal Pradesh and also the head quarter of Shimla District.

The city is named after the goddess Shyamala Devi, an incarnation of the Hindu Goddess Kali.

2.2 Key Features

This beautiful hill station lies between 31° 6’ North Latitude to 77° 11' East Longitude at an average altitude of 2310 meters above mean sea level. The highest point in Shimla is at 2454 meters is the Jakhoo hill. Shimla comes in Zone -IV (High Damage Risk Zone) as per the earthquake hazard zoning of India (IS-1893)

According to 2011 Census, the urban population of Shimla district is 201500 and has shown a decadal growth of 20.49%. The total population within Shimla Municipal Corporation is 169758. The total area under the Municipal limit is approximately 20 Sq.km.

Shimla is connected to the city of Kalka by one of the longest narrow gauge railway. It is approximately 100 km from Panchkula, the nearest major city, and 365 km from New Delhi.

Table 1: Salient Features of Shimla

City	**Shimla**
District	Shimla
State	Himachal Pradesh
Area	20 Sq.km. (MC)35.34 Sq.km.(U.A)
Number of Wards	25
Average Altitude	2,310 meters
Latitude & Longitude	31° 6' North to 77° 10' East
Population(Census-2011)	Urban: 201500 Rural: 611884 Total: 813384 Municipal Corporation:169758

2.3 Climate

According to a recent code of Bureau of Indian Standards, there are five major climatic zones in India.

- **Hot & Dry**: Mean monthly temperature >30 & relative humidity <55%
- **Warm & Humid**: Mean monthly temperature >25-30 & relative humidity >55-75%
- **Temperate:** Mean monthly temperature 25-30 & relative humidity <75%
- **Cold (Cloudy/ Sunny):** Mean monthly temperature <25 & relative humidity – all values
- **Composite:** When six months or more do not fall within any of the other categories

Shimla comes under Cold Zone or more precisely in Cold & Cloudy Zone. Chilly winds from the upper Himalayas make winters in Shimla cold. Around Christmas or last week of December Shimla gets snowfall. The average annual rainfall in the region is 900mm and temperature varies from 15 ~25ºC in summers and in winters it's in the range 0~13ºC. Relative humidity varies in between 39(March) to 93(August).

2.4 Geographical Setting

Shimla town is situated on the rocks of Jutogh Group and Shimla Group. Jutogh group occupies main Shimla area and extends from Annadale-Chura Bazaar-Prospect Hill-Jakhoo-US Club and highland area. Shimla Group comprising of earlier Chail Formation and Shimla Series represented by shale, slate, quartzite greywacke and local conglomerate is well exposed in Sanjauli-Dhalli area.

The existing town resembles an irregular crescent with a 9.2 km extension from one end to the other, covering a total area of approximately twenty-two sq.km. The eastern portion of the town is Chotta Shimla while the extreme western side is called Boileauganj. An outlying northern spur running at right angles to the main ridge is Elysium Hill. Five and half kilometers from the western end of the station are outlying hills of Jutogh.

The whole town is spread over seven hill spurs namely Jakhoo Hill, Elysium Hill, Museum Hill, Prospect Hill, Observatory Hill, Summer Hill and Potters Hill. These spurs are interconnected by roads. The important character of the road network circumscribing these hills is that it is connected to the Mall road from Boileauganj to Chotta Shimla.

Land available to the city is used for various purposes like buildings, roads, vehicle parking, parks and open spaces. A detail of land use in the urban area as well as in the Shimla planning area is given below in the chart and table.

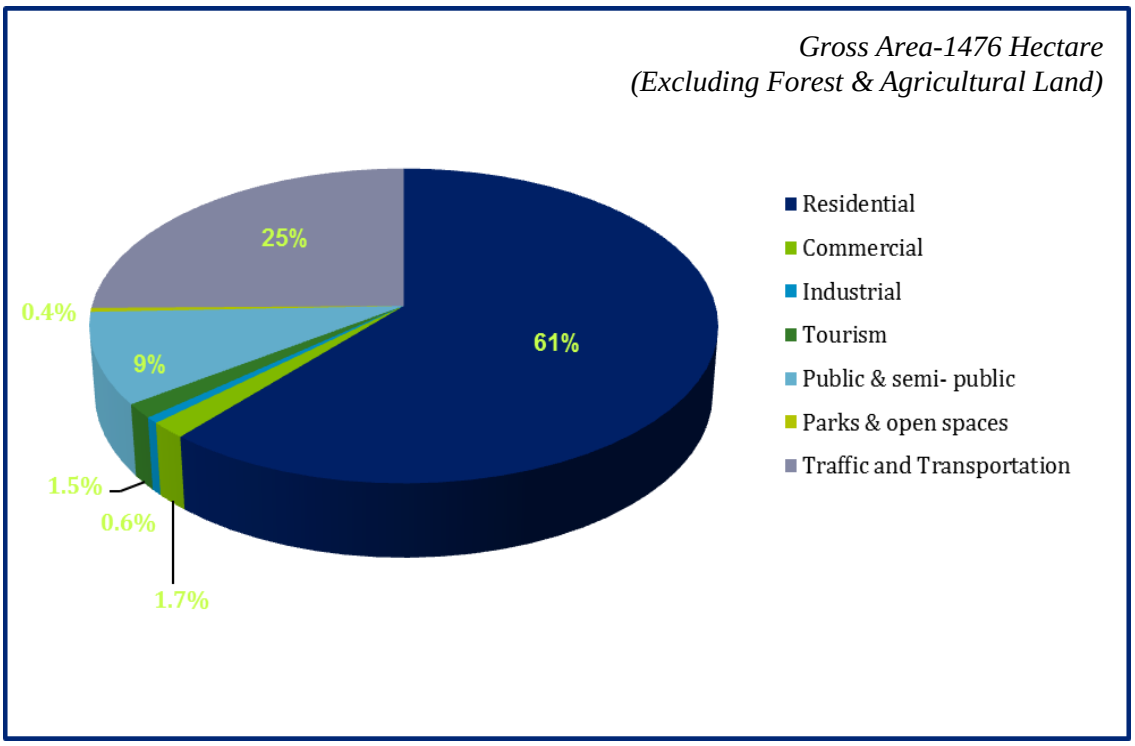


Chart 1: Land Use of Shimla Urban Area

(Source: Shimla Municipal Corporation)

2.5 Demography

2.5.1 Population

Development of any city is directly linked with population & its long term growth rate. Requirement of energy, infrastructure and other basic amenities is directly proportional to the population of the city.

Shimla is the only Class-I city in Himachal Pradesh. According to the Census 2011 it has an urban population of 201500 person and population of Shimla Planning Area(SPA) is 245732 persons. Total number of households in the Urban area of Shimla is 37,756.. Annual growth rate of population is 2.50%. The growth rate of the city is faster than the corresponding state average growth rate. The detail of the population of Shimla Urban as well as Shimla Planning area is given below in the Chart.

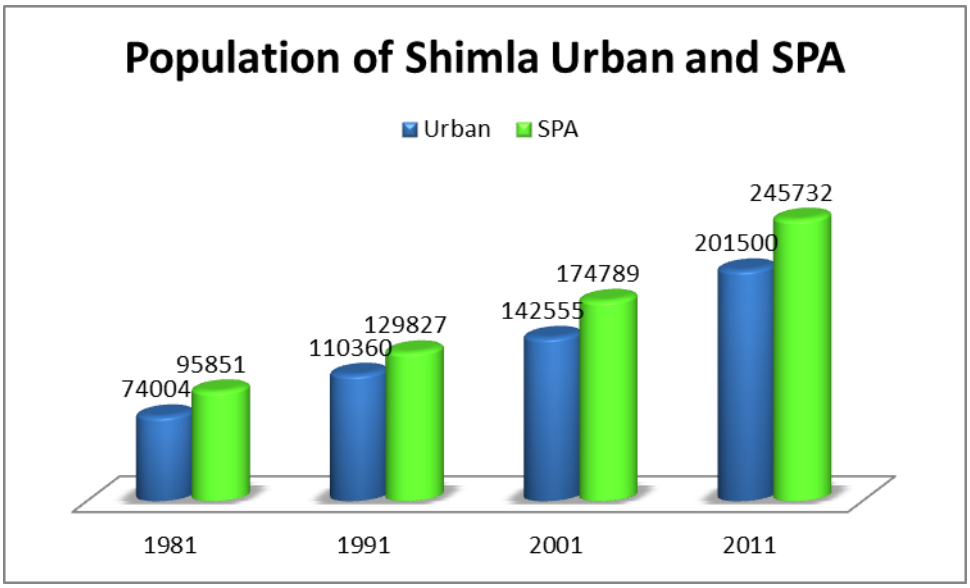


Chart 2: Population of Shimla Urban & SPA in the Past Three Decades.

(Source: District Statistical Report & Census-2011)

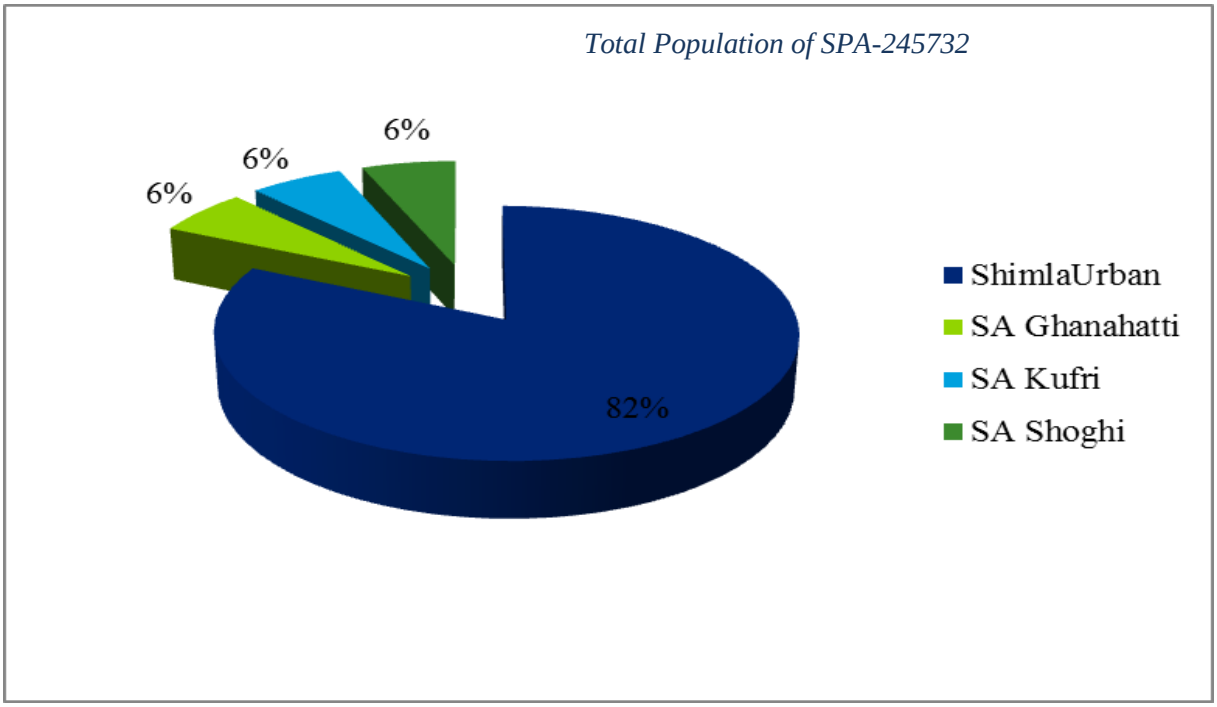


Chart 3: Arrangement of Population within the Shimla Planning Area

(Source: City Development plan-JNNURM)

2.5.2 Floating Population in Shimla

Shimla is a very famous tourist destination in the country for both domestic as well as foreign tourists. Population of the city keeps fluctuation throughout the year. As per the state government estimate more

than two lakh tourists visit the city during the year. 70% of this tourist population visit during summers from April to September.. Thus during the peak season, the existing city infrastructure, municipal, water and energy need to support the population almost double from that of its base population.

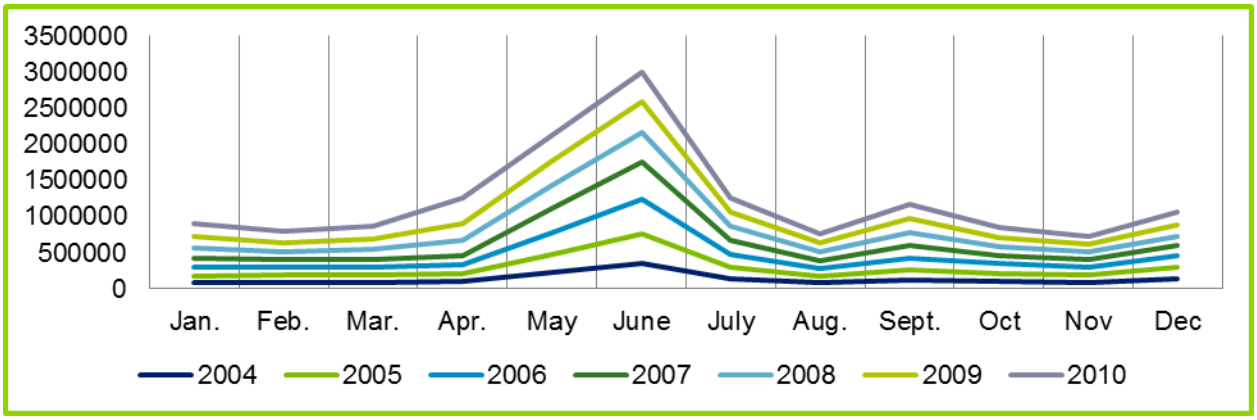


Chart 4: Floating Population in Shimla

(Source: http://himachaltourism.gov.in)

2.6 Defining the Master Plan Area

An important step in the development of "Solar City Master Plan" is defining its geographical boundary or limits. The spatial limits considered for developing the Master Plan fall within the Shimla Municipal Boundary. The Programme region is the core urban area of Shimla which comprise of Municipal Corporation including New Shimla, Dhalli and Tutu. However some of the interventions may extend beyond the Municipal boundary to achieve the programme objectives.

In order to ensure planned and regulated growth, GoHP constituted Shimla Planning Area through notification in November 1977. Shimla Planning Area (SPA) comprise of following:

- Shimla Municipal Corporation
- Recently merged Special Areas of Dhalli, New Shimla, and Tutu
- Special Areas of Kufri, Shoghi and Ghanahatti

The geographical spread of SPA is roughly 100 Sq.km in which approximately 22 Sq.km falls under the municipal limit including newly added area New Shimla, Dhalli and Tutu.

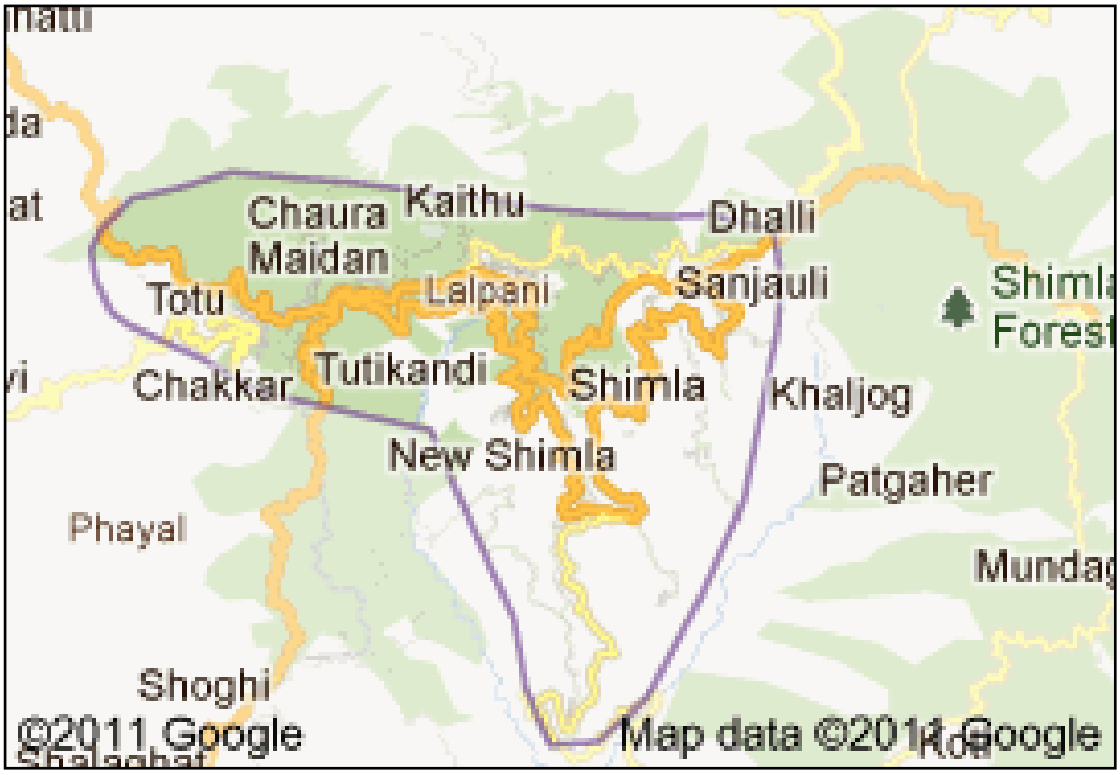


Chart 5: Map of Shimla Municipal Boundary

Chart and figure below explains percentage distribution of these planning areas, and the administrative limits.

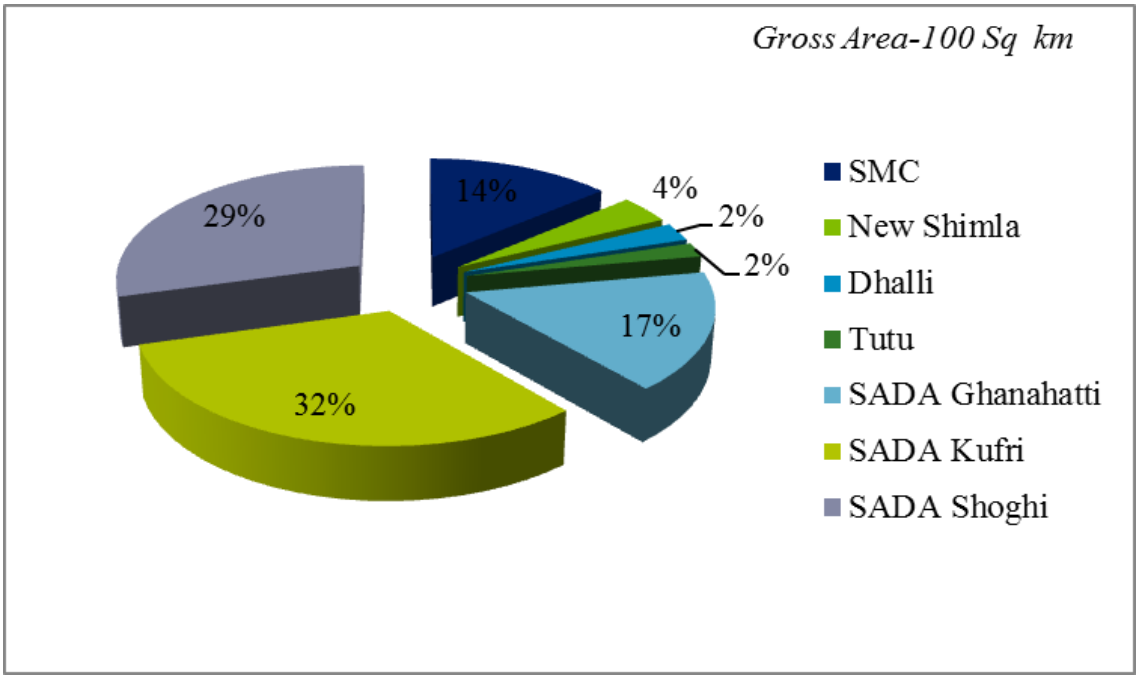


Chart 6: Percentage Distribution of Land within Shimla Planning Area

3 ENERGY BASELINE ASSESSMENT & DEMAND PROJECTION

The term energy baseline means "the amount of energy that would be consumed annually without implementation of energy conservation measures based on historical metered data. This chapter focuses on the present scenario of energy consumption in Residential, Commercial, Industrial, Municipal and Institutional sectors of Shimla City.

3.1 Gross Energy Consumption

Gross Energy Consumption of Shimla city for the baseline year 2008-2009 was 30.16 ktOe and is growing with overall annual growth rate[1] of 9.09 % while the population of the city is growing with CAGR of 3.3%. It is evident that energy consumption is growing almost three times faster than the growth in population which indicates that residents of the city are moving towards more energy intensive life style.

The projected consumption in the year 2013-14 and 2018-19 is 34.80 ktOe and 43.40 ktOe respectively. Summary of the energy consumption in the baseline year and its projection in the Business As Usual (BAU) scenario is given below in the table and the corresponding charts.

Table 2: Year-wise Gross Energy Consumption in Shimla

Year/ Energy Type	Year-wise Gross Consumption in Shimla (ktOe)							Growth Rate (CAGR)
	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	%
Electricity	18.18	19.24	21.74	23.53	23.61	25.39	23.82	4.96
LPG	-	-	-	-	5.26	5.31	5.85	5.46
Kerosene	-	-	-	-	1.29	1.16	0.98	-12.95
Gross	18.18	19.24	21.74	23.53	30.16	31.86	30.65	9.09

(Data Source: HPSEB, District Food Civil & Supply Department)

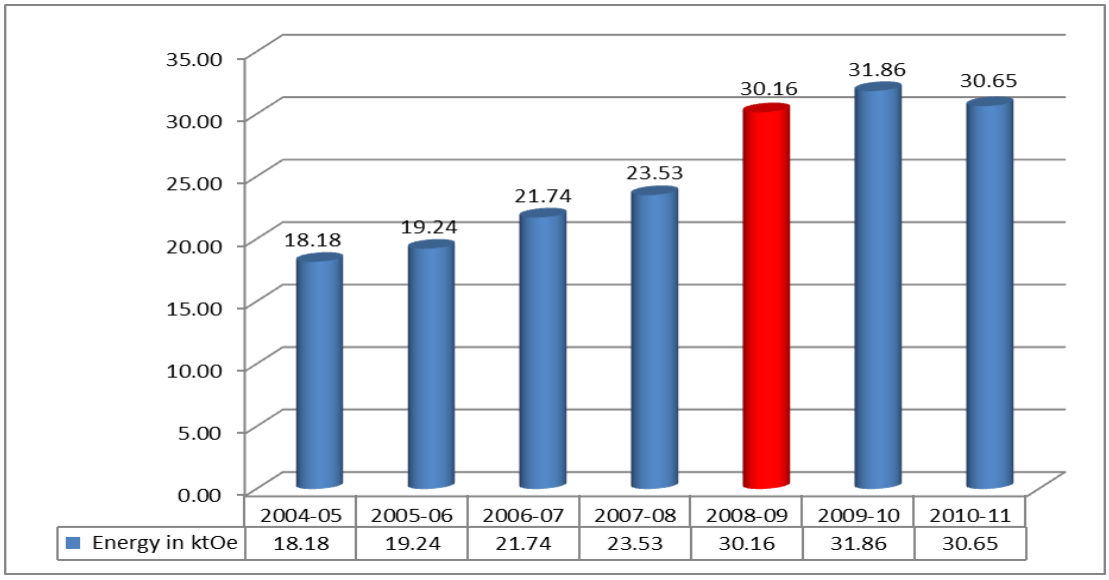


Chart 7 : Year –wise Gross Energy Consumption in Shimla

[1] Growth Rate: Compound Annual Growth Rate(CAGR)

Table 3 : Year-wise Projected Demand

Year/ Energy Type	Year-wise Projected Demand (ktOe)							
	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**
Electricity	24.92	26.06	27.26	28.52	29.83	31.20	32.64	34.14
LPG	6.17	6.51	6.87	7.24	7.64	8.05	8.49	8.96
Kerosene	0.85	0.74	0.64	0.56	0.49	0.42	0.37	0.32
Gross	31.9	33.3	34.8	36.3	38.0	39.7	41.5	43.4

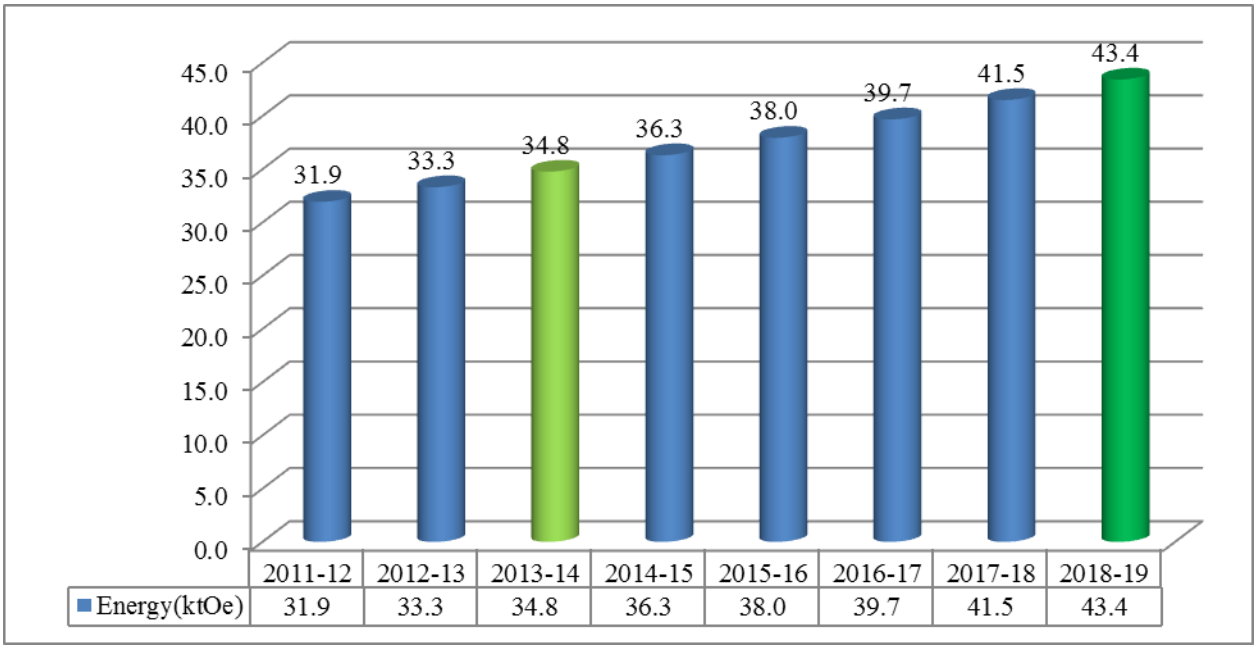


Chart 8: Year–wise Projected Energy Demand in Shimla

Although all forms of energy such as Electricity, LPG, Kerosene, Diesel, Petrol and Coal are in use within the city boundary but electricity use is dominant with a share of 78% of the total consumption. There is no contribution of renewable energy within the city boundary as most of the small and micro hydel power projects are located outside the city boundary.

The percentage contribution from three main source of energy namely Electricity, LPG and Kerosene is 78%, 18% and 4% respectively and their corresponding growth rates are 4.96%, 5.46% and -12.95% respectively. Negative growth rate of kerosene clearly indicates that the city population is moving towards cleaner fuel. Percentage contribution of each energy source to the gross consumption is given below in the table and chart.

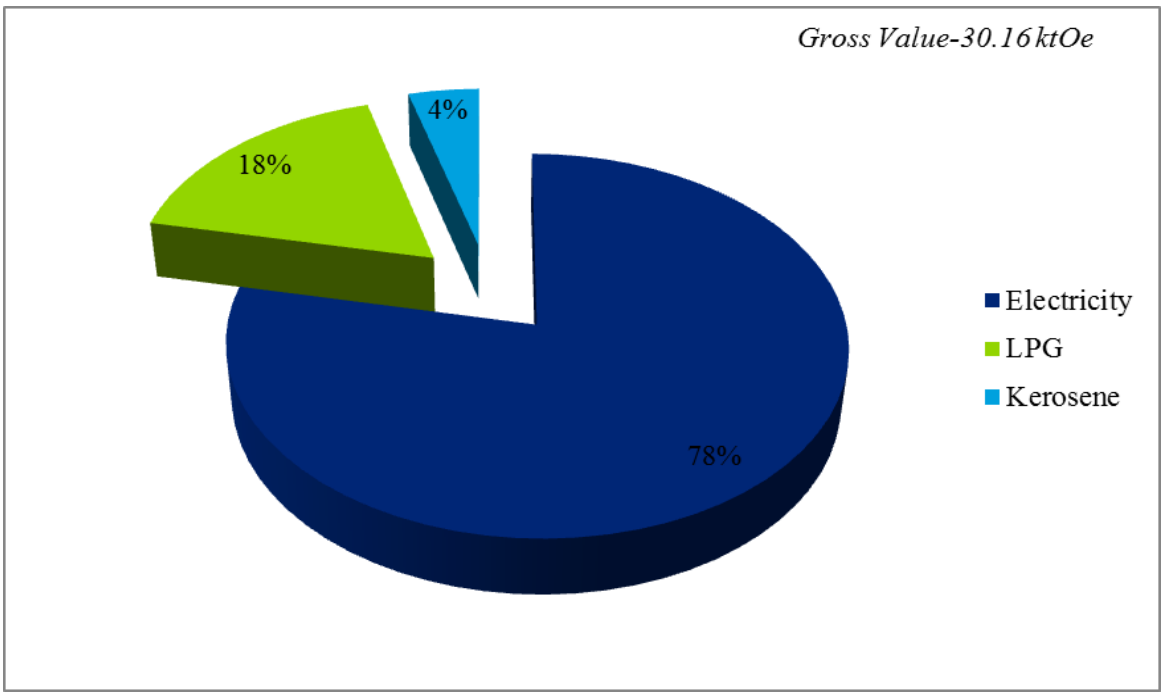


Chart 9: Percentage Contribution of Different Source of Energy in Baseline Year 2008-09

Among five sectors residential sector is the largest consumer of energy.. It consumes about 61% of the gross consumption followed by the commercial and institutional sectors which is 25 % and 10 % respectively. Percentage contribution by each sector which comes under the scope of the master plan is given below in the chart.

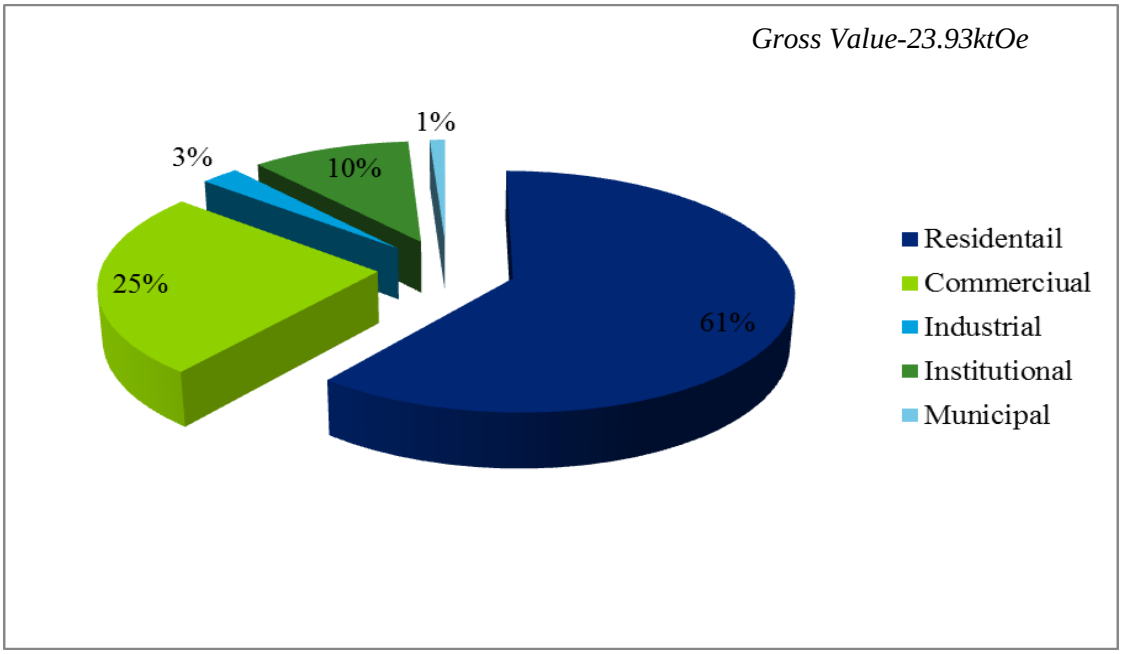


Chart 10: Percentage Sectoral Energy Consumption in Baseline Year 2008-2009

Per capita gross energy consumption in the city is continiously growing with a simple average growth rate of 4.5% per year. In the baseline year per capita energy consumption was 2.06 MWh/person. The projected consumption in the year 2013-14 and 2018-19 is 2.25 MWh/Person and 3.25 MWh/person respectively. Per capita energy consumption is given the chart below.

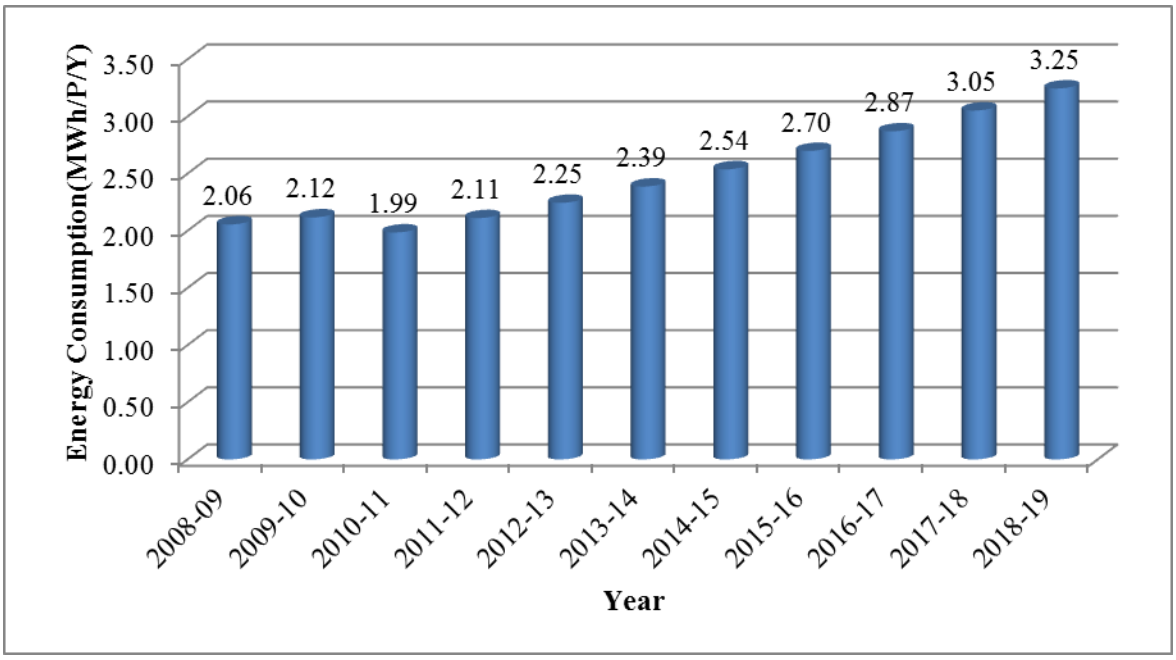
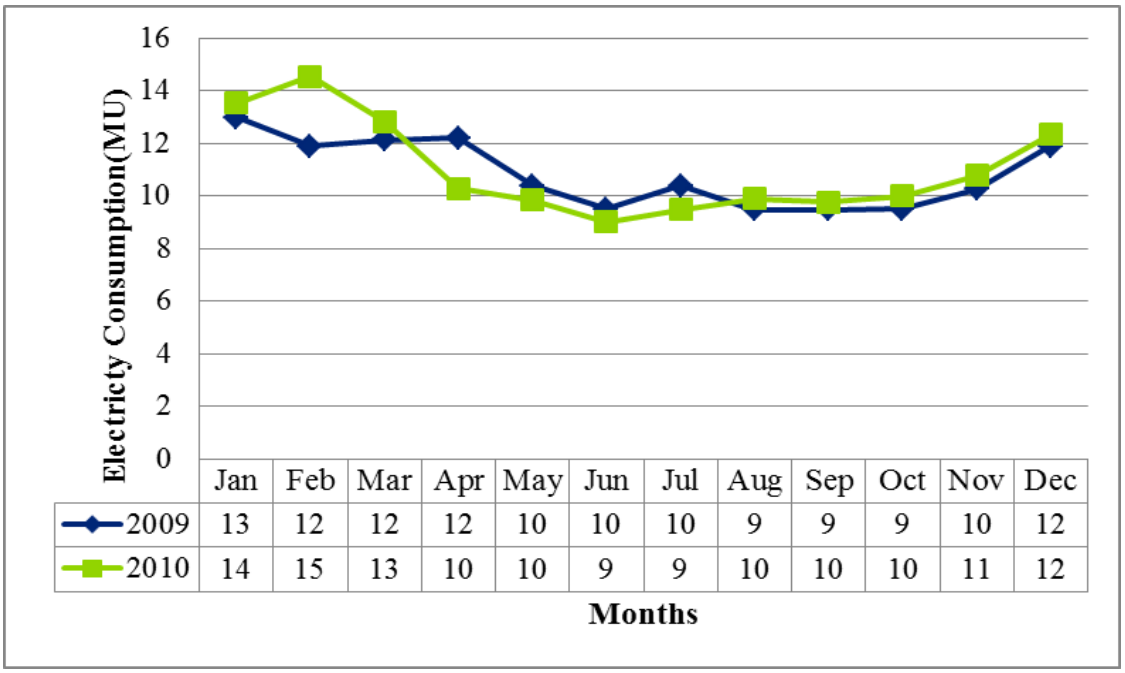


Chart 11: Year-wise Per-capita Energy Consumption (MWh/Person/Year) in Shimla

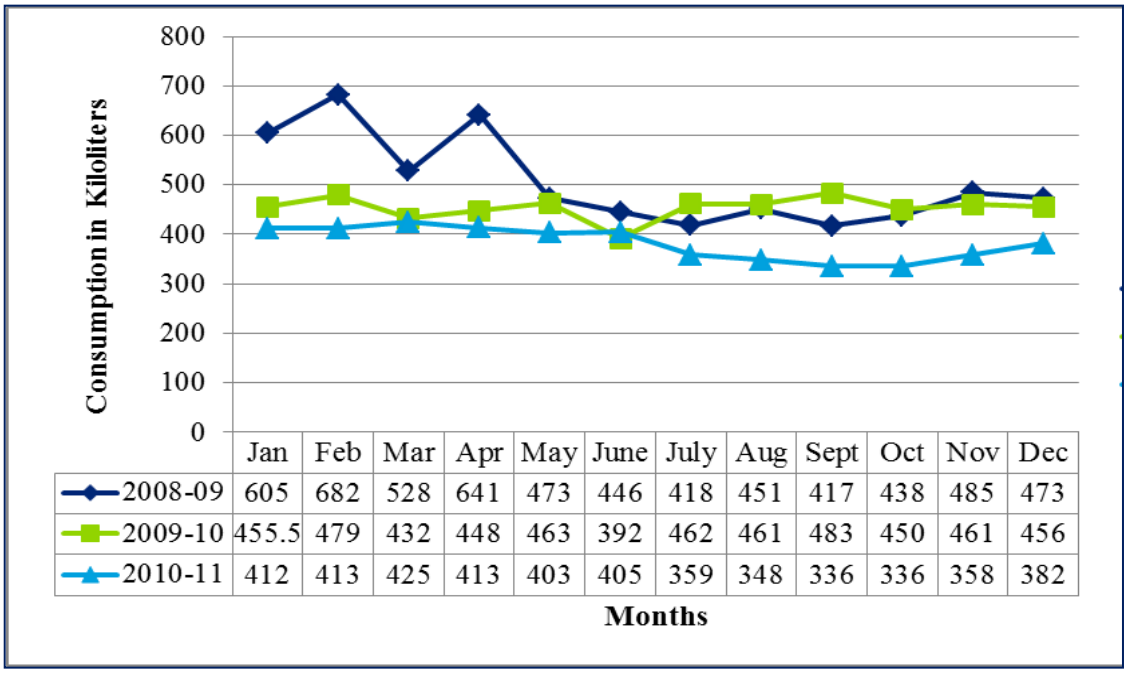
After analyzing the monthly electricity and kerosene consumption data of past two and three year respectively it was observed that the consumption of electricity as well as kerosene in the city increases during the winter season. It has been concluded on the basis of field contacts that consumption of electricity and other source of energy increases because space and water heating demand drastically increase during the winter season (Nov - April). Monthly variation in electricity and kerosene consumption for past two and three years respectively is given below in the chart.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2009	13	12	12	12	10	10	10	9	9	9	10	12
2010	14	15	13	10	10	9	9	10	10	10	11	12

Chart 12: Monthly Variation in Electricity Consumption in the Shimla

(Source: HPSEB, District Food Civil & Supply Department)



	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2008-09	605	682	528	641	473	446	418	451	417	438	485	473
2009-10	455.5	479	432	448	463	392	462	461	483	450	461	456
2010-11	412	413	425	413	403	405	359	348	336	336	358	382

Chart 13 : Monthly Variation in Kerosene Consumption in the Shimla

(Source: District Food Civil & Supply Department)

3.2 Residential Sector

The gross energy consumption in the residential sector in the baseline year 2008-2009 was14.54 ktOe. The projected consumption in the year 1013-14 and 1018-19 would be approximately 18.92 ktOe and 25.59 ktOe which include electricity as well as other fuels.

Table 4: Year-wise Gross Energy Consumption in Residential Sector

Year/ Energy Type	Gross Energy Consumption in Residential Sector(ktOe)							Growth Rate (CAGR)
	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	%
Electricity	6.22	6.60	7.20	8.43	8.24	10.94	9.44	7.20
LPG	-	-	-	-	5.01	5.08	5.61	5.77
Kerosene	-	-	-	-	1.29	1.16	0.98	-12.95
Gross	6.22	6.60	7.20	8.43	14.54	17.18	16.03	-

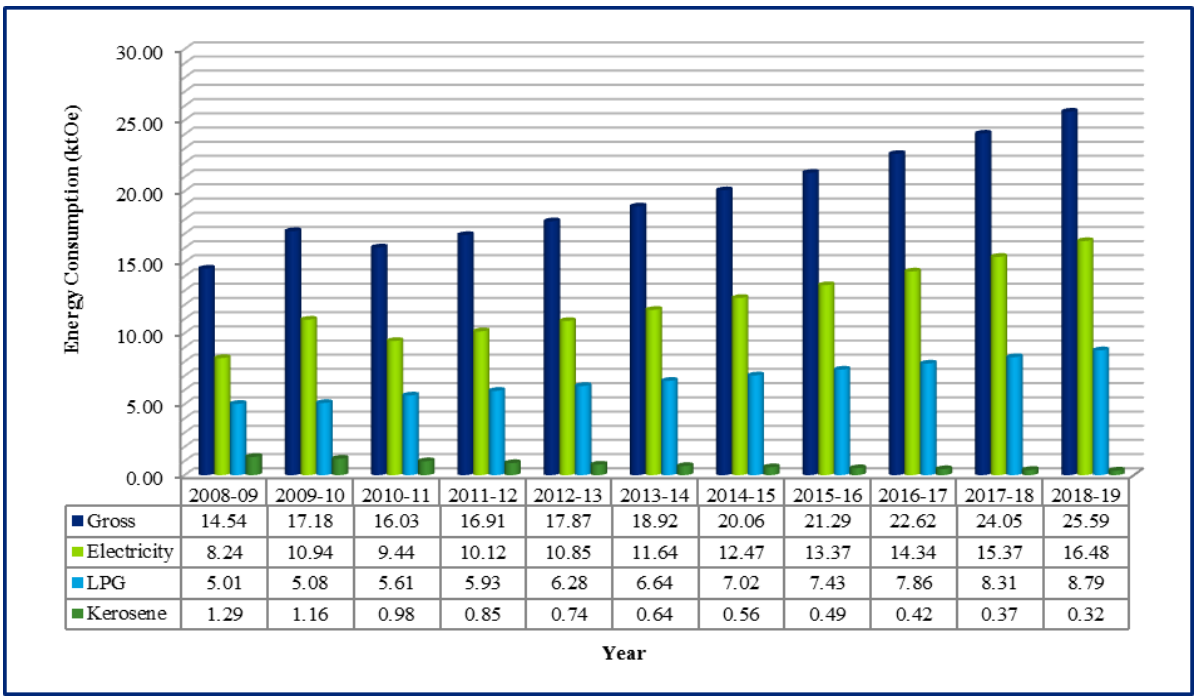
(Source: HPSEB City Division and Division-1, Shimla)

The main sources of energy in this sector are Electricity, LPG and Kerosene which are growing with an annual growth rate of 7.20%, 5.77% and -12.95% respectively.

Table 5: Year –wise Projected Demand for Residential Sector

Year/ Energy Type	Year-wise Projected Demand for Residential Sector(ktOe)							
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Electricity	10.12	10.85	11.64	12.47	13.37	14.34	15.37	16.48
LPG	5.93	6.28	6.64	7.02	7.43	7.86	8.31	8.79
Kerosene	0.85	0.74	0.64	0.56	0.49	0.42	0.37	0.32
Gross	16.91	17.87	18.92	20.06	21.29	22.62	24.05	25.59

Consumption and demand trend given below in the chart show that demand of electricity as well as LPG is growing while consumption of kerosene will decrease in the future.



	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Gross	14.54	17.18	16.03	16.91	17.87	18.92	20.06	21.29	22.62	24.05	25.59
Electricity	8.24	10.94	9.44	10.12	10.85	11.64	12.47	13.37	14.34	15.37	16.48
LPG	5.01	5.08	5.61	5.93	6.28	6.64	7.02	7.43	7.86	8.31	8.79
Kerosene	1.29	1.16	0.98	0.85	0.74	0.64	0.56	0.49	0.42	0.37	0.32

Chart 14 : Year wise Energy Consumption and Demand Trend in Residential Sector

Main end uses of energy in the residential sector are lighting, cooking, space heating, water heating, and energy consumption by home appliances such as washing machine, TV, Refrigerator etc. For cooking, most of the residents are using LPG while few low income group people are still using kerosene and wood to some extent.

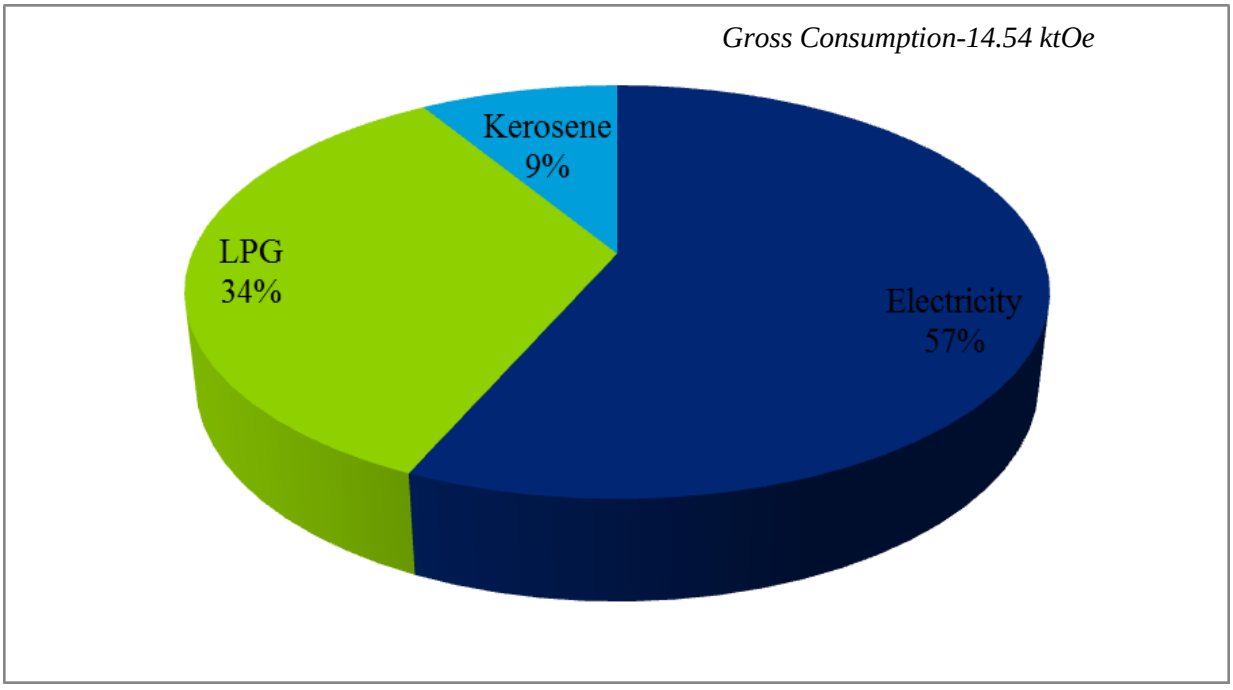


Chart 15 : Percentage Contribution by Energy Type in the Residential Sector (2008-09)

3.3 Commercial Sector

Commercial sector is the second largest consumer of energy in the city. The total consumption in the baseline year 2008-09 was 6.03 ktOe. Projected demand in the year 2013-14 and 2018-19 is 6.37 ktOe and 6.70 ktOe respectively in BAU scenario.

Energy consumption in this sector is directly linked with the tourism and hotel industry. Various end use of energy in this sector are lighting, cooking, water heating, and space heating. Year wise energy consumption and growth rate for the commercial sector is given below in the table.

Table 6:Year-wise Gross Energy Consumption for Commercial Sector

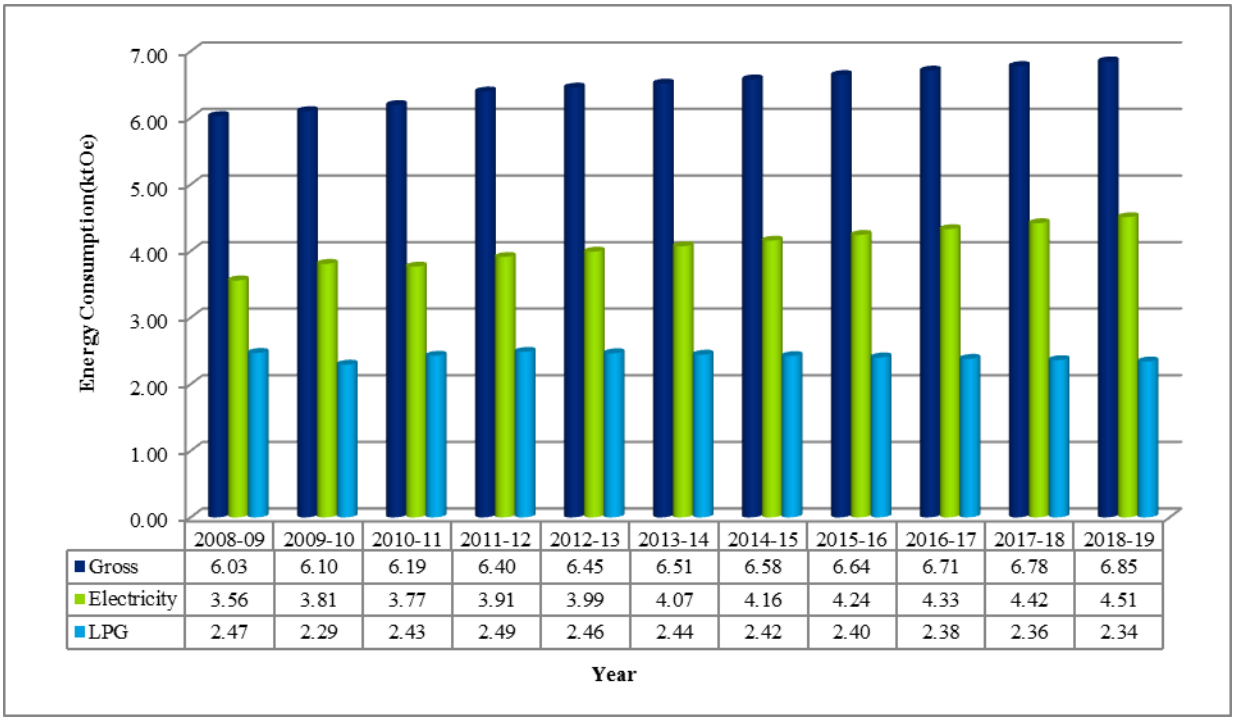
Year/ Energy Type	Gross Energy Consumption in Commercial Sector(ktOe)						Growth Rate (CAGR)
	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	%
Electricity	3.40	2.96	3.12	3.56	3.81	3.77	2.05
LPG	-	-	-	2.47	2.29	2.43	-0.86
Gross	3.40	2.96	3.12	6.03	6.10	6.19	-

(Source: HPSEB City Division and Division-1, Shimla)

Consumption of electricity and LPG in the commercial sector in the baseline year 2008-09 was 3.56 ktOe and 2.47 ktOe respectively. Consumption of electricity is growing with an annual growth rate of 2.05 % while consumption of LPG is decreasing with an annual rate of -0.86, with this growth rate demand for electricity and LPG in the year 2013-14 would be 4.00 ktOe & 2.36 ktOe and in 2018-19 it would be 4.43 ktOe and 2.27 ktOe respectively.

Table 7: Year-wise Projected Demand in Commercial Sector

Year/ Energy Type	Year-wise Projected Demand for Commercial Sector(ktOe)							
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Electricity	3.84	3.92	4.00	4.08	4.17	4.25	4.34	4.43
LPG	2.41	2.39	2.36	2.34	2.32	2.30	2.29	2.27
Gross	6.25	6.31	6.37	6.43	6.49	6.56	6.63	6.70



	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Gross	6.03	6.10	6.19	6.40	6.45	6.51	6.58	6.64	6.71	6.78	6.85
Electricity	3.56	3.81	3.77	3.91	3.99	4.07	4.16	4.24	4.33	4.42	4.51
LPG	2.47	2.29	2.43	2.49	2.46	2.44	2.42	2.40	2.38	2.36	2.34

Chart 16 : Year-wise Energy Consumption and Demand Trend for Commercial Sector

Percentage contribution of electricity and LPG are 59% and 41% of the total energy consumption in the commercial sector.

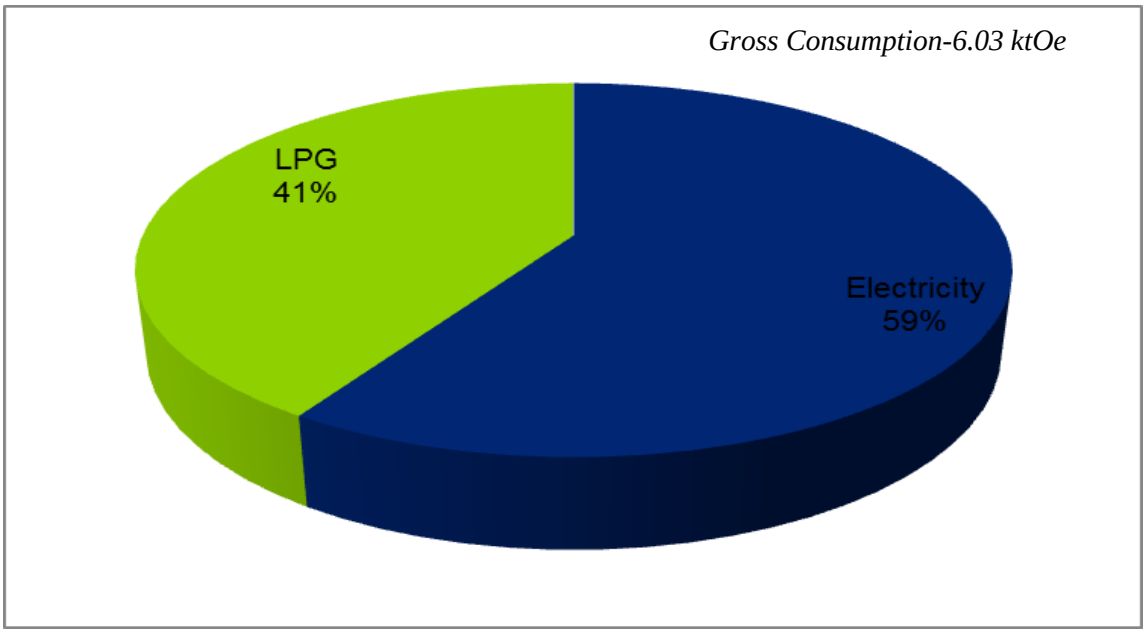


Chart 17 : Percentage Contribution of Different Energy Type in Commercial Sector (2008-09)

3.4 Industrial Sector

Industrial sector is the least energy intensive sector. There are very few small scale industries within the Municipal boundary of the city. Gross energy consumption in the Industrial sector in the baseline year 2008-2009 was 0.61 ktOe and it is growing with an annual growth rate of 2.60%. Electricity is the main source of energy for the industrial sector in Shimla. Year wise energy consumption for the industrial sector is given below in the table and corresponding chart.

Table 8:Year-wise Gross Energy Consumption in Industrial Sector

Year/ Energy Type	Gross Energy Consumption in Industrial Sector (ktOe)							Growth Rate(CAGR)
	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	%
Electricity	0.36	0.46	0.71	0.83	0.61	0.45	0.42	2.60
Gross	0.36	0.46	0.71	0.83	0.61	0.45	0.42	2.60

(Source: HPSEB City Division and Division-1, Shimla)

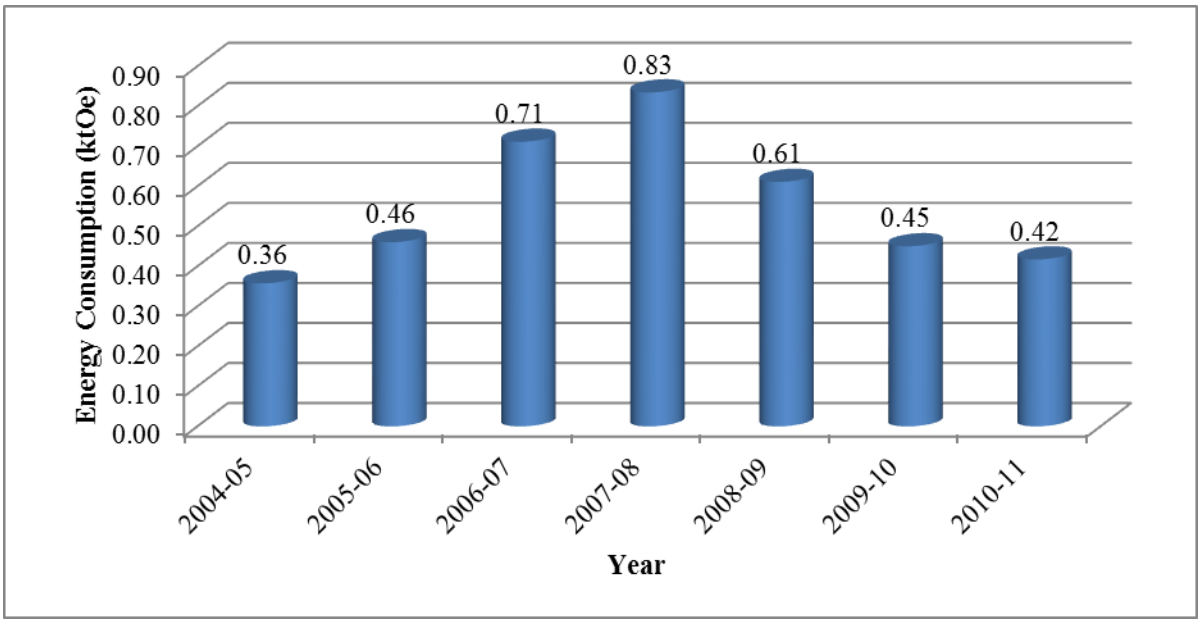


Chart 18 : Year-wise Energy Consumption Trend in Industrial Sector

After analyzing the past trend of energy consumption it was concluded that the energy demand will increase in this sector also but the growth rate will be less than other sectors. The projected demand in the year 2013-14 and 2018-19 will be 0.45 ktOe and 0.51 ktOe respectively. Year- wise demand trend is given below in the table and chart below.

Table 9 : Year-wise Projected Energy Demand for Industrial Sector

Year/ Energy Type	Year-wise Projected Demand for Industrial Sector (ktOe)							
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Electricity	0.43	0.44	0.45	0.46	0.47	0.49	0.50	0.51
Gross	0.43	0.44	0.45	0.46	0.47	0.49	0.50	0.51

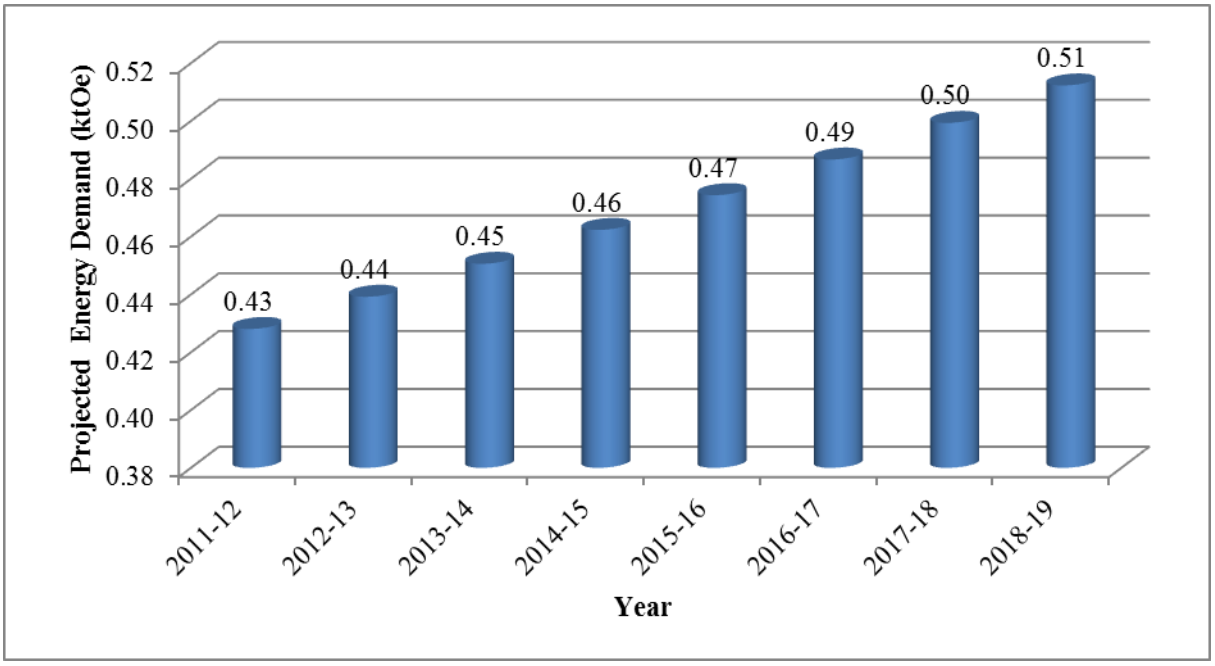


Chart 19 : Year-wise Energy Demand Trend for Industrial Sector

3.5 Institutional Sector

Institutional sector is the third largest consumer of energy which account for 10% of the gross consumption. Gross energy consumption in the Institutional sector in the baseline year 2008-2009 was 2.51 ktOe and it is growing with an annual growth rate of 10.9%. Year wise energy consumption for the Institutional sector is given below in the table and the corresponding chart.

Table 10 :Year-wise Gross Energy Consumption in Institutional Sector

Year/ Energy Type	Gross Energy Consumption in Institutional Sector (ktOe)						Growth Rate(CAGR)
	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	%
Electricity	1.36	2.16	2.29	2.51	2.86	2.29	10.91
Gross	1.36	2.16	2.29	2.51	2.86	2.29	-

(Source: HPSEB City Division and Division-1, Shimla)

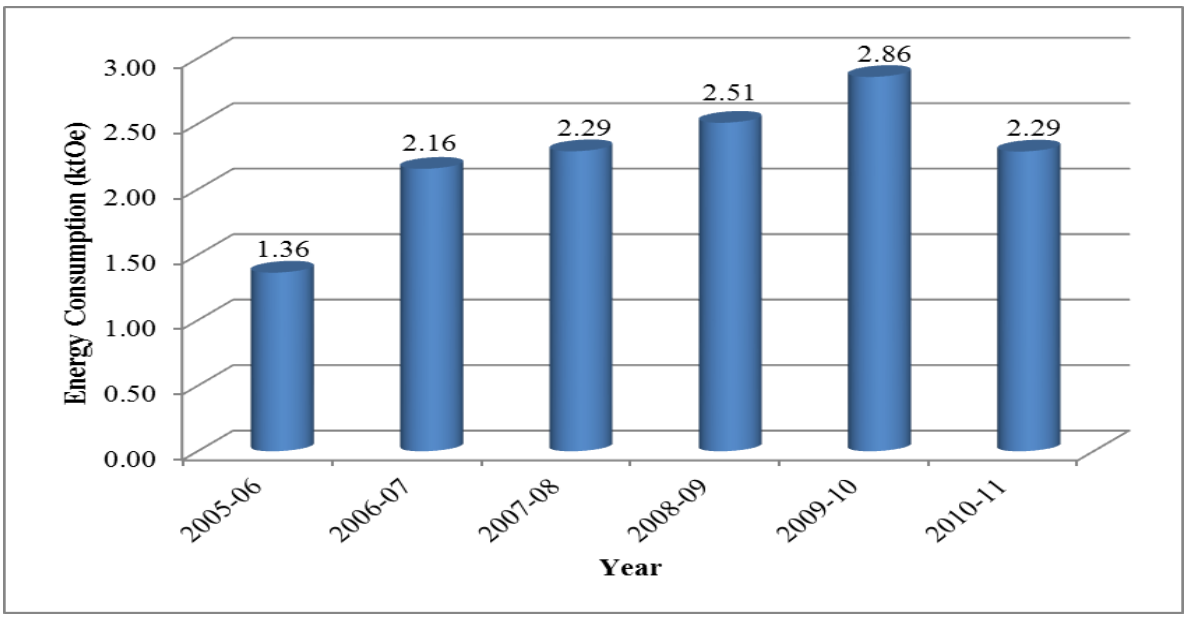


Chart 20 :Year-wise Energy Consumption Trend in Institutional Sector

The Projected energy demand in the year 2013-14 and 2018-19 will be 3.12 ktOe and 5.24 ktOe respectively. Electricity is the main source of energy for this sector in Shimla.

Table 11 : Projected Energy Demand for Institutional Sector

Year/ Energy Type	Year-wise Projected Demand for Institutional Sector(ktOe)							
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Electricity	2.54	2.82	3.12	3.46	3.84	4.26	4.73	5.24
Gross	2.54	2.82	3.12	3.46	3.84	4.26	4.73	5.24

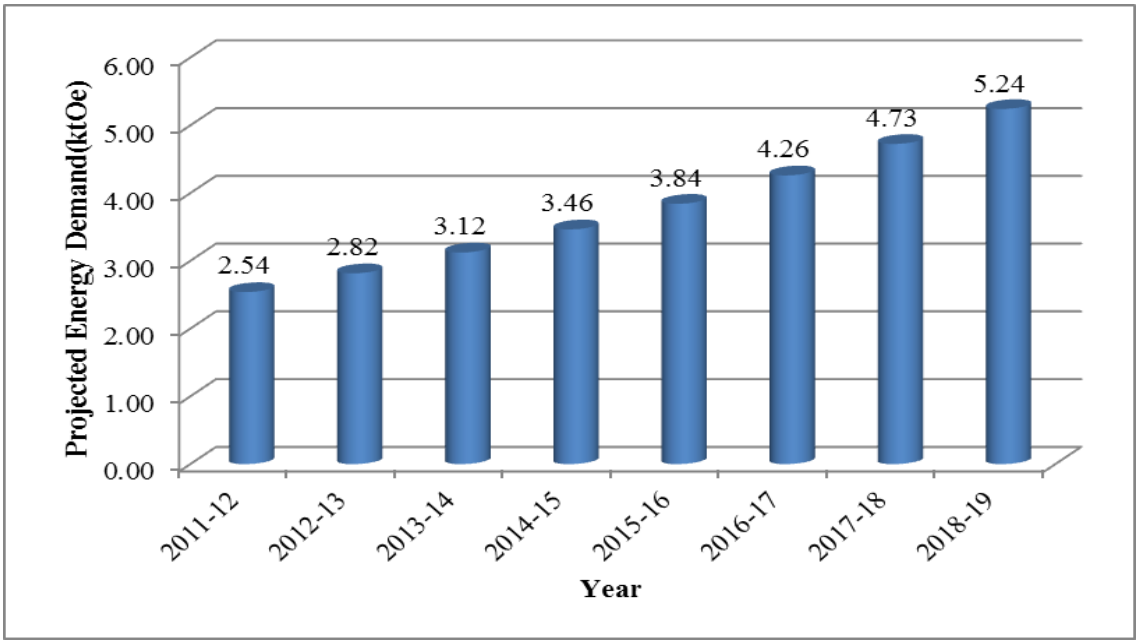


Chart 21 : Projected Energy Demand for Institutional Sector

3.6 Municipal Services

Gross energy consumption in the Municipal sector in the baseline year 2008-09 was 0.175 ktOe and it is growing with an annual growth rate of 2.66%. Electricity is the main source of energy for the municipal services. Water works and street lighting systems are the two most energy intensive services which comes under this sector. Electricity consumed by these two services in the baseline year 2008-09 was 2.21MU. Year wise energy consumption and its trend for this sector are given below in the table and the corresponding Chart.

Table 12 :Year-wise Gross Energy Consumption in Municipal Sector

Year/ Energy Type	Gross Energy Consumption in Municipal Sector (ktOe)							Growth Rate(CAGR)
	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	%
Electricity	0.164	0.178	0.163	0.162	0.175	0.190	0.192	2.66
Gross	0.16	0.18	0.16	0.16	0.17	0.19	0.19	-

(Source: HPSEB City Division and Division-1, Shimla)

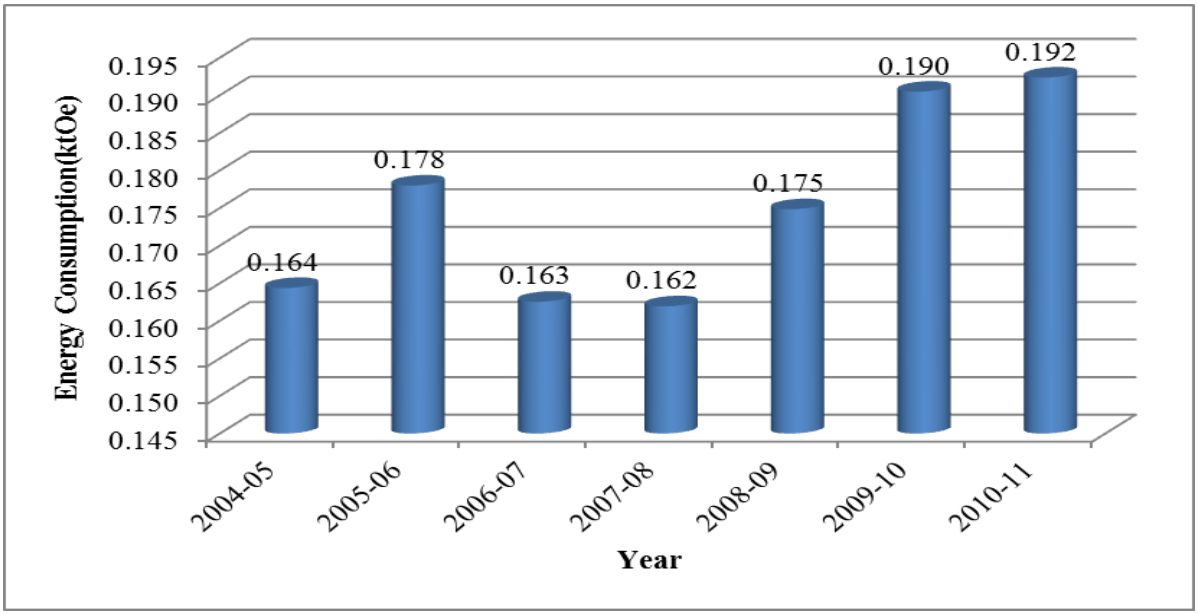


Chart 22 : Year-wise Energy Consumption Trend in Municipal Sector

Projected energy demand for Municipal Services in the year 2013-14 and 2018-19 is 0.21 ktOe and 0.24 ktOe respectively. Year wise energy demand for this sector is given below in the table and the corresponding chart.

Table 13 : Projected Energy Demand for Municipal Sector

Year/ Energy Type	Year-wise Projected Demand for Municipal Sector (ktOe)							
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Electricity	0.197	0.203	0.208	0.214	0.219	0.225	0.231	0.237
Gross	0.20	0.20	0.21	0.21	0.22	0.23	0.23	0.24

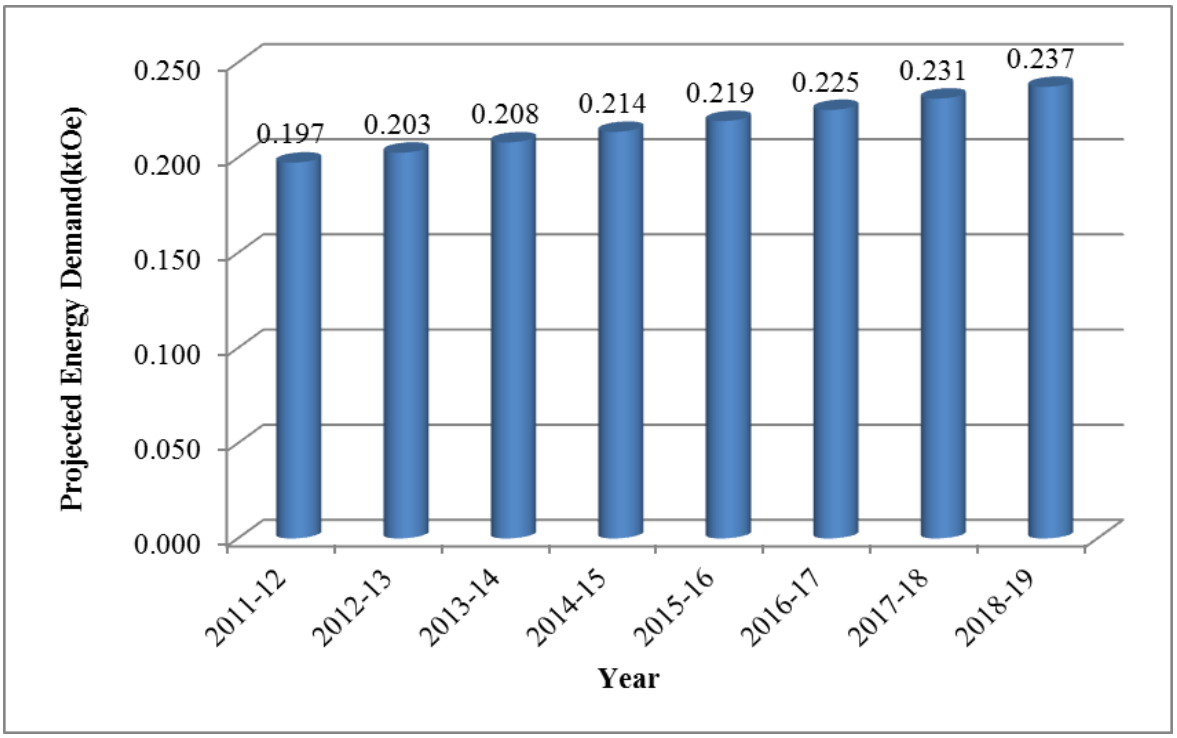


Chart 23 : Projected Energy Demand for Municipal Sector

3.7 GHG Emission

Gross greenhouse gas (GHG) emission in the baseline year 2008-09 at the city level was approximately 295,000 tCO_2e and it is growing with an annual growth rate of 9.80%. The projected emission would be approximately 340,000 tCO_2e and 424,000 tCO_2e in the year 2013-14 and 2018-19 respectively. Detail energy consumption and corresponding emission is given below in the table and chart.

Table 14:Year-wise Gross Energy Consumption and Corresponding GHG Emission in BAU

Year	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Gross Energy Consumption (ktOe)	30.16	31.86	30.65	31.94	33.31	34.77	36.32	37.96	39.68	41.50	43.42
Gross Energy Consumption (MWh)	350644	370445	356388	371386	387365	404337	422322	441341	461424	482602	504911
Gross GHGs Emission (000tCO2e)	295	311	299	312	325	340	355	371	388	405	424

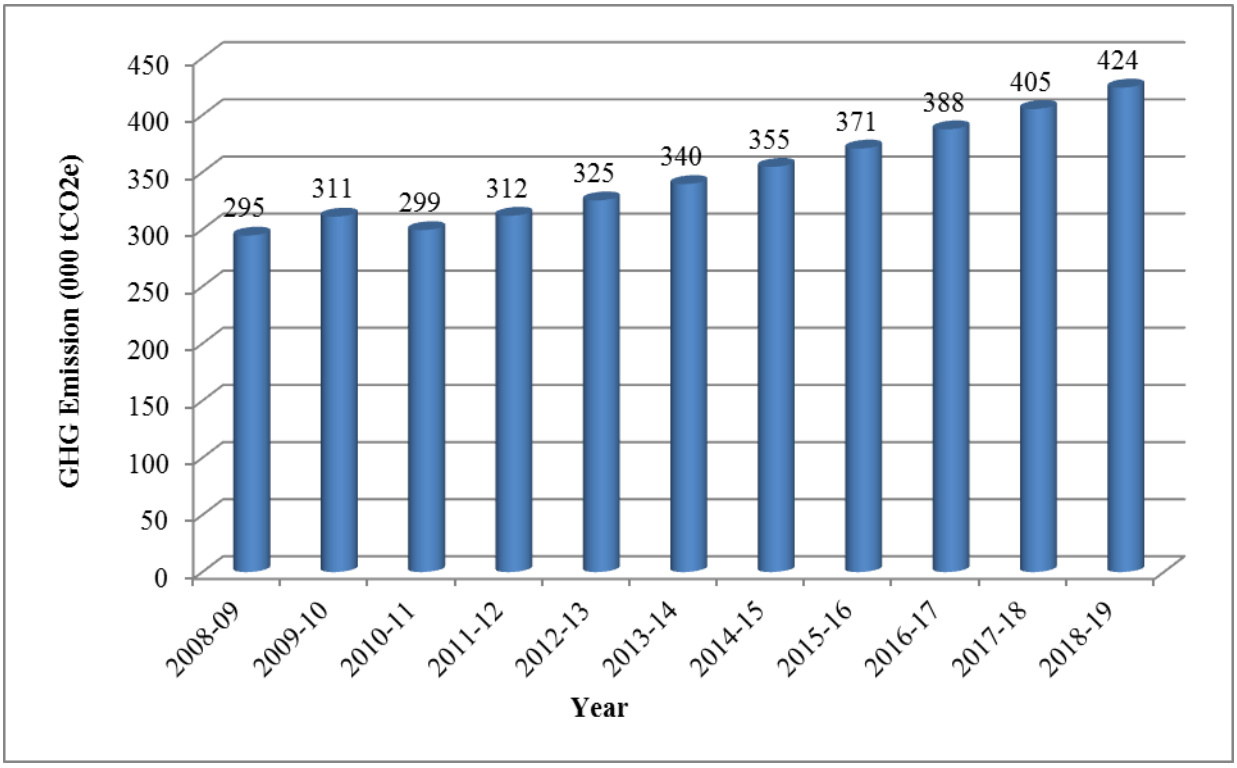


Chart 24 : Year-wise Gross GHG Emission Trend in BAU

Among all the five sectors which was considered under the scope of this master plan, residenrial sector is the largest emitter of the GHGs. Percentage contribution of each sector in the total emission is given below in the chart.

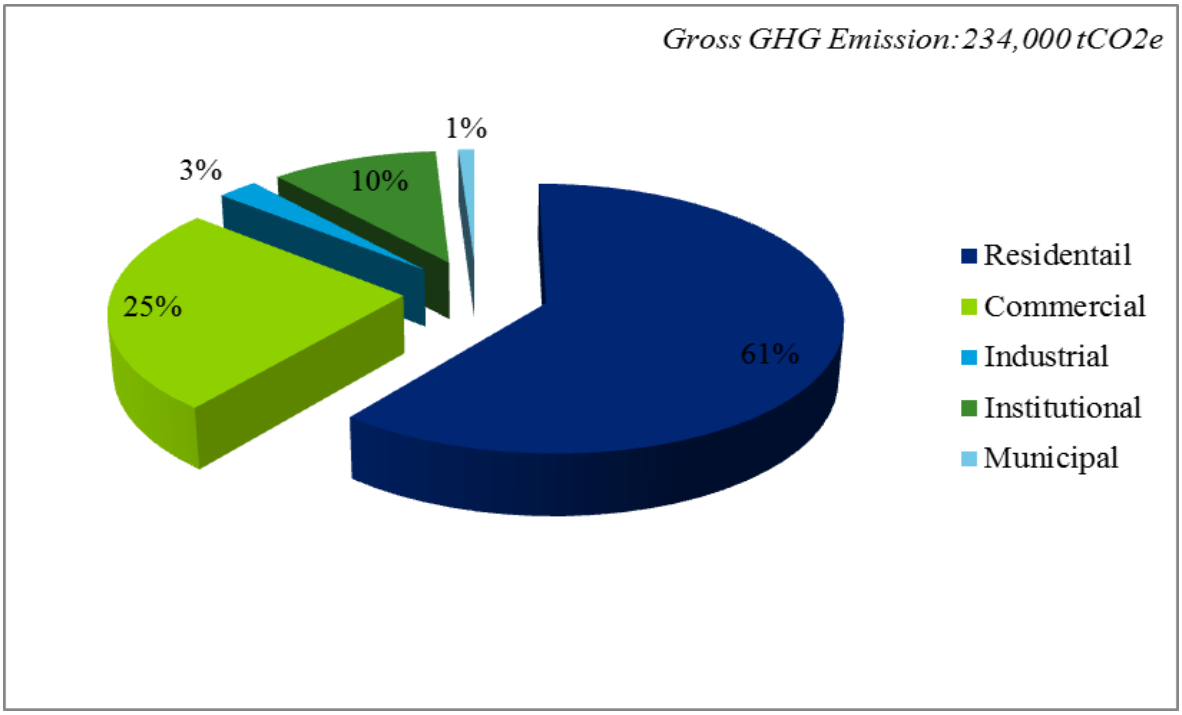


Chart 25 : Sector-wise GHG Emission in the Baseline Year-2008-09

4 ENERGY PLANNING & SECTOR WISE STRATEGY

4.1 Assessment of Renewable Energy Resources

Resource assessment is one of the most important and essential steps towards identification and evaluation of possible interventions & project identification. Various option of generating power from renewable energy resources has been assessed below to make Shimla a sustainable city.

4.1.1 Biomass

Biomass like agro-waste in the form of straws and stalks, agro-industrial processing residues, dedicated energy plantations and forest waste can be used as a fuel for power generation.

Shimla planning area covers an area of 9950 Hectare in which 61 % i.e. 6080 Hectare is under the forest cover. The only possible source of biomass within the city boundary is wood chips. But the forests within the city boundary are reserved so that the availability of biomass for power generation is negligible.

4.1.2 Waste to Energy

It has been observed that about 90% commercial establishments have their own arrangement of Waste Disposal. Remaining 10% use other methods to dispose of solid waste. Municipal Corporation waste collection system is required to be modernized. The average generation of waste in Shimla Planning Area is estimated to be 70-75 MT per day at an average of 0.43 kg per capita per day[2] . The generation and collection is characterized by high level of seasonal variations with 30% increase during summer which is due to high tourist inflow in the city. The characterization of solid waste from Shimla indicates that 60-65% of the waste is kitchen organic waste which contains wet and dry organic matter. Balance constitutes paper, metals, glass, textiles, plastics, polythene and other debris. Composition and quantity of waste collected is given below in the following chart.

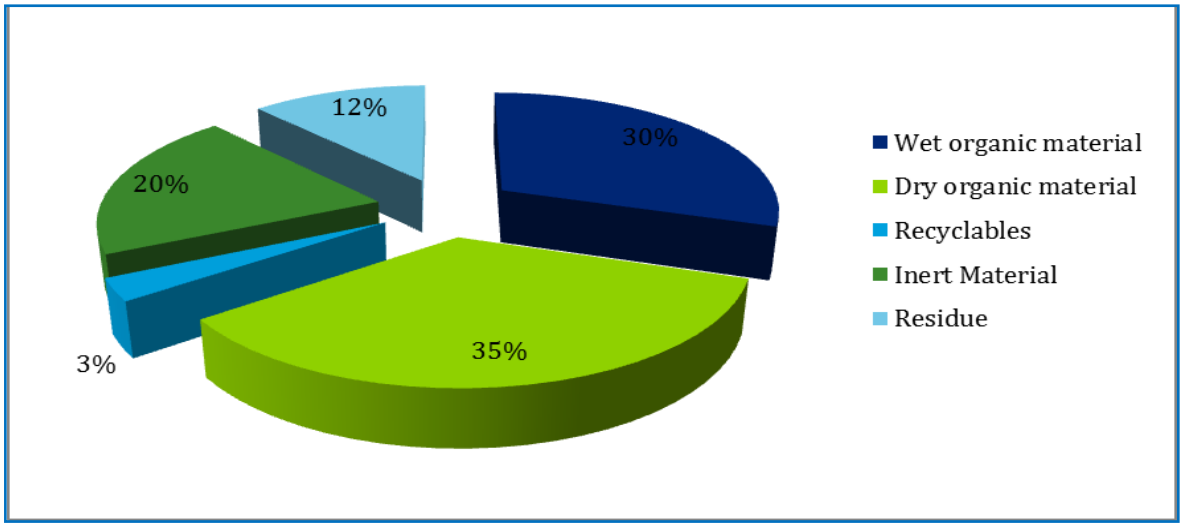


Chart 26 : Composition of Municipal Waste in Shimla

[2] Source: City Development Plan-JNNURM

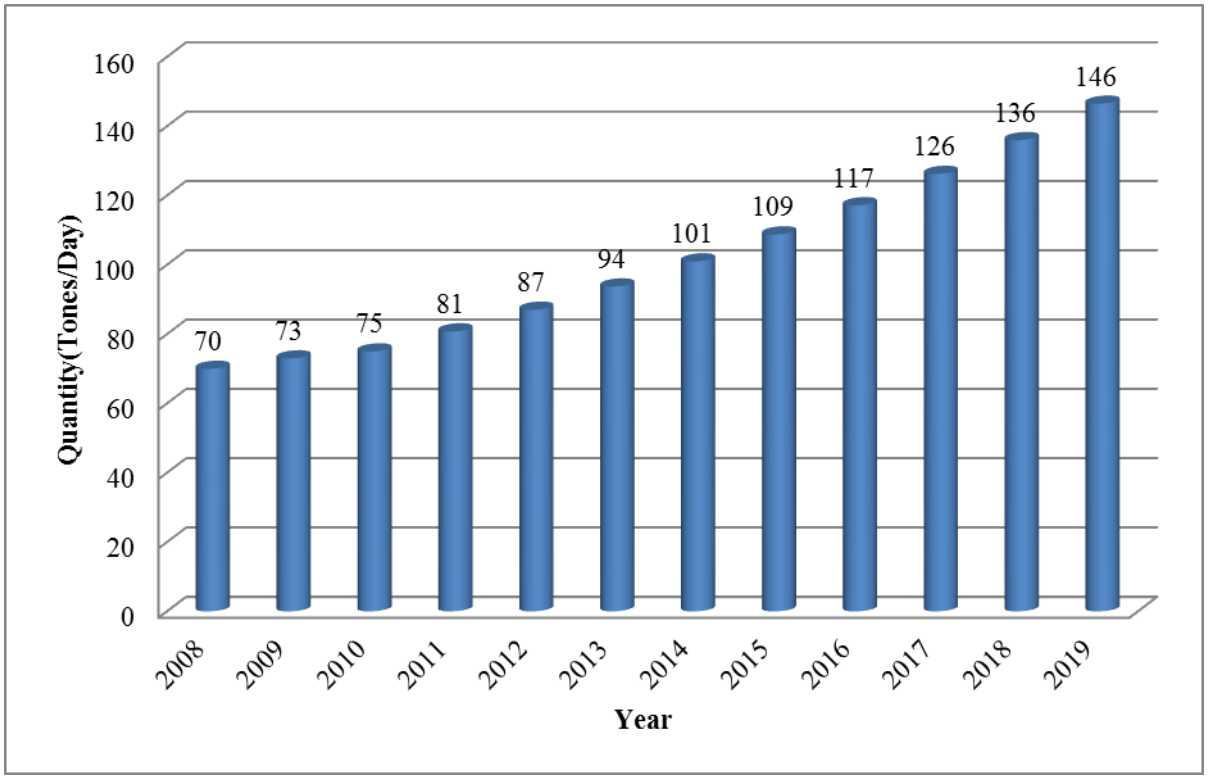


Chart 27 : Year-wise Waste Generation in Shimla
(Source: Municipal Corporation office, Shimla)

As per information received SMC has out-sourced the waste management facility for setting up a solid waste management plant to Mumbai-based Hanger Biotech Energies Private Ltd. The company shall reuse and recycle the MSW. The four end products which shall be produced from the MSW are as below:

1. Compost – Bio Organic Fertilizer (from wet waste).
2. Green Fuel – Refined RDF (from dry waste)
3. Sand - for construction activity (from inert waste).
4. Metals and Plastics being recycled (from recyclables)

During the first stakeholder meeting at Shimla it was told by the representative of the waste management company (Hanger Biotech Energies Private Ltd.) that due to low quantity of waste, setting up an RDF based power plant is commercially not viable.

A rough assessment of the potential of recovery of energy from MSW through different treatment methods can be made from knowledge of its calorific value and organic fraction, as under. The assessment below is based on widely used estimates as exact data was not available from the city.

Waste to Energy through thermal chemical conversion	
Solid waste Input	50 tonnes
Net Calorific Value (conservative estimate)	2400 kcal/kg
Energy recovery potential (NCV x W x 1000/860)	139535 kWh
Power generation potential	5814 kW
Conversion efficiency	25%
Net Power generation potential	1.45 MWe
Plant Load Factor	70%
Net electrical energy savings potential @70% PLF	7 MU
Emission reduction per year	32485 Tonnes
Total Investment	1017 Lakh
MNRE subsidy	50%
Payback Period	2.6 years

Waste to Energy Potential in Kitchen Waste through bio-methanation:

Kitchen waste is good source of biodegradable matter. Kitchen waste generated and collected in significant quantities can be led into bio-chemical conversion to produce energy in the form of biogas.

Kitchen waste based bio-gas plant can be set-up in hotels, hospitals, hostels and societies where the collected waste is at least 100Kg per day. The following assessment is based on assumptions and gross estimates. One inherent problem associated with kitchen waste is that waste generated is not homogenous in organic content and hence, its anaerobic digestion is not uniform. This problem leads to incomplete digestion and inconsistent generation of biogas. An assessment has been made based for installing such a system in societies and areas where the collection is at least 100 kg. The following assessment is based on assumptions and gross estimates.

Kitchen Waste based bio-gas plant

Feature	**Details**
Size of the Plant.	5 cubic metre
Kitchen waste requirement	100-120 kg
Cost	1.5-2 Lakhs
Probable Type	• Biogas Plants with Ferro cement digester • Biogas Plants with Fibre Glass Reinforced Plastic (FRP) Gas holder
Application	**Coking:** Biogas can be used in a Biogas chulhas/ burner for cooking. A biogas plant of 2 cu.m. capacity is sufficient for providing cooking fuel to a family of 4 persons.

	Lighting: Biogas can be also used for lighting a biogas lamp in indoor or outdoor. The requirement of gas for powering a 100 candle lamp (60 W) is 0.13 cu.m. per hour. **Power Generation:** Biogas can be used to operate a dual fuel or 100% biogas engine and can replace upto 80% of diesel in dual fuel engines. **Refrigeneration:** Biogas can also be used for cooling applications in operating the chilling machines

4.1.3 Power Generation from Sewage Treatment Plant

Power can be produced by capturing methane generated in anaerobic treatment of the sludge during the waste water treatment process. The potential of power generation depends upon the capacity of the treatment plant, amount of biodegradable matter present in the sewage and local environmental condition. As per information received by the irrigation and public health department there are six sewage treatment plants in Shimla.

Table 15 : Detail of Sewage Treatment Plant in Shimla

S. N	Name of Sewage Treatment Plant	Capacity (MLD)	Locations	Existing Technology Used
1	Lalpani	19.35	Near Baragaon on Shoghi Bypass	Up flow anaerobic sludge blanket(UASB)
2	Sanjauli Malyana	4.44	Below Malyana Village on Shoghi Sanjauli Bypass	Extended Aeration System
3	Dhalli	0.76	Below Dhalli Churat Road	
4	Snowdown	1.35	Near Barmoo Village below Snowdown	
5	North Disposal	5.80	At Golcha below Annadale	
6	Summer Hill	3.93	At Gadog Village Summer Hill	

(Source: I & PH Department Shimla)

There is a possibility of generating power from sewage treatment plants in Shimla. STP located at Lalpani is of the largest capacity and also use UASB process which is an anaerobic in nature. Biogas with a high concentration of methane is produced as a by-product in this process and may be captured and used as an energy source, to generate electricity for export and to cover its own running power. Typically a 1 MW plant can be installed for 80-100 MLD of municipal sewage treatment plant. Flow diagram for the whole process is given below.

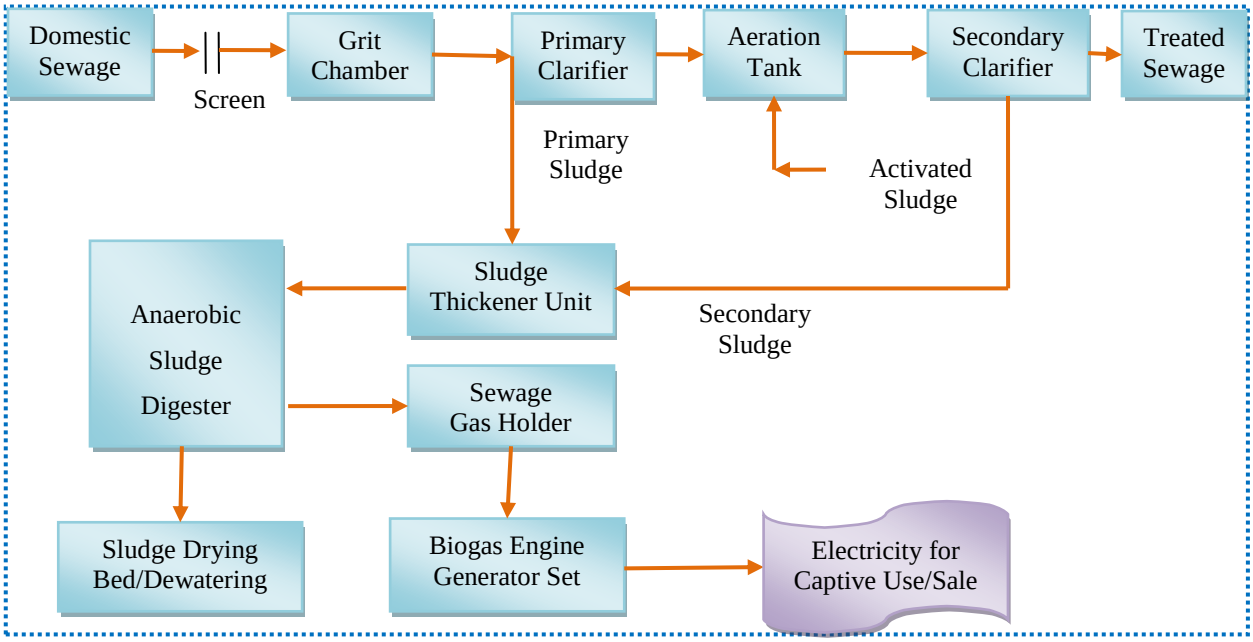
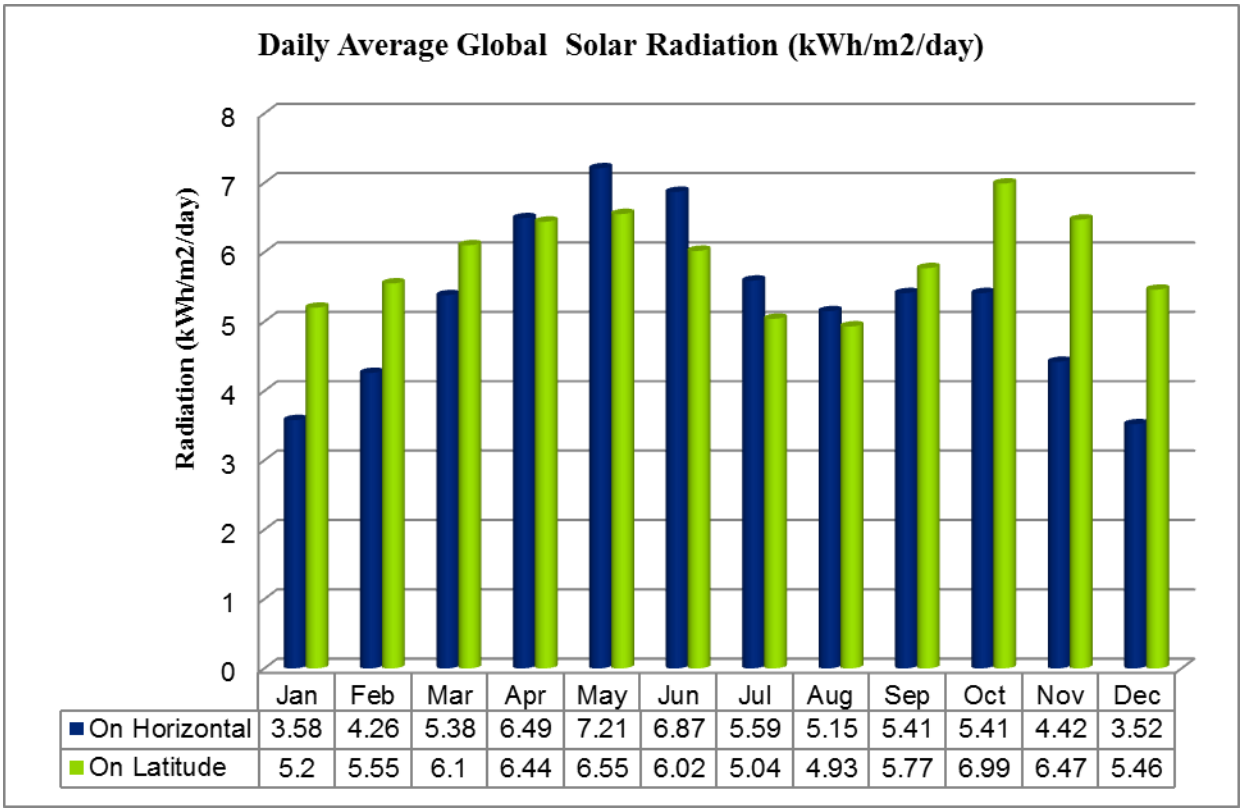


Chart 28 : Power Generation from Sewage Treatment Plant

4.1.4 Solar Energy:

The energy content of solar radiation can be used as light, heat and electricity. Most part of India is enabled with rich solar energy as it is located in the equatorial sun belt of the earth. The daily average solar energy incident over India varies from 4 to 7 kWh/m^2 with about 2,300–3,200 sunshine hours per year, depending upon the location.

Distribution of monthly diffused solar radiation (kWh/m^2) and annual global solar radiation (KW/m^2-year) in Shimla is given below in the table. Distribution of annual diffused solar radiation (kWh/m^2) and annual global solar radiation (Kw/m^2-year) in India is also given in annexure-3.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
On Horizontal	3.58	4.26	5.38	6.49	7.21	6.87	5.59	5.15	5.41	5.41	4.42	3.52
On Latitude	5.2	5.55	6.1	6.44	6.55	6.02	5.04	4.93	5.77	6.99	6.47	5.46

Chart 29: Daily Average Solar Insolation Data over Shimla

(Data Source: eosweb.larc.nasa.gov/cgi-bin/see/ret screen)

Availability of sun light remains low during the winter season (November to February) and average solar radiation (diffused as well as global) is also low with respect to other parts in India, but still the available solar radiation is sufficient to utilize it efficiently for various applications across all the sectors.

The two most important applications of solar energy are Solar Thermal Application and Electricity Generation. The assessment of potential application is discussed below.

I. **Solar Thermal Applications:** It can be used for water heating, space heating, process heat generation and solar cooking in the city.

As Shimla is a cold place, residents, Hotels, Hospitals and Institutes require hot water almost throughout the year. From the field contact it was observed that, till date penetration of solar water heater in Shimla is very low. Most of the hotels, institutes, and households are still using electrical geysers and LPG stoves to fulfill the need of hot water.

There is a good potential for the application of SWHS instead of conventional electrical geysers across all sectors in the city. Both Flat plate collector (FPC) and Evacuated tube collector (ETC) technology is suitable in Shimla and can be efficiently used to fulfill small as well large scale hot water requirement. There is ample scope for Solar Steam Cooking System instead of LPG stoves for large scale food cooking in the institutional sector in Shimla.

II. **Solar Electrical Applications**: Solar energy can be used for large scale electricity generation for commercial application as well as small scale power generation for captive use. Electricity generated is either made available to users through a local grid in a 'stand-alone' mode or connected to the conventional power grid in a 'grid-interactive' mode.

Grid Connected Solar Power Technology: The two well established technologies for electricity generation using solar radiation are Concentrating Solar Thermal (CST) and Solar Photovoltaic (SPV). It can be further sub divided based on the type of concentrating devise used, type of SPV panels and type of materials used for SPV cells. Different types of solar power plants are given below in the chart.

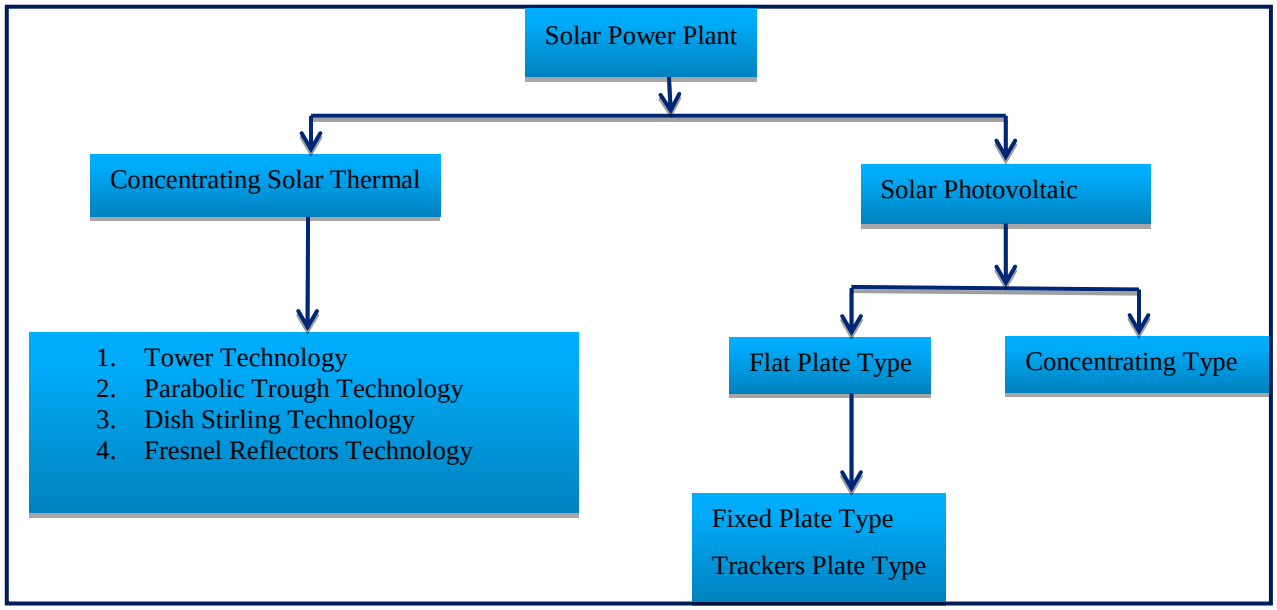


Chart 30: Classification of Solar Power Technology

Off-Grid Application of Solar Power in Shimla: There is huge potential for off-Grid application of solar PV in Shimla; the greatest potential area is roof top based solar PV and Solar Street & Home Lighting systems for Municipal Sector and Residential sector. SPV of different capacity ranging from 2kWp to5kWp can be installed on the roof top of Office buildings, Hotels, Hospitals, Institutional buildings in stand-alone mode for the captive use. Detail for setting – up 1kWp SPV Plant is given below in the table

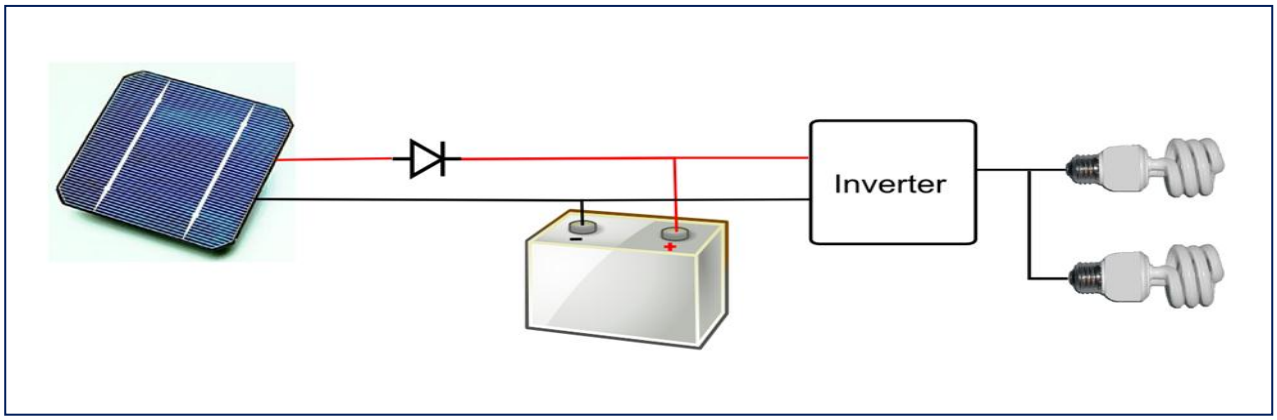


Figure 31 : Schematic Diagram Off-Grid PV System with Battery Charger

Table 16 : Details for Setting-up 1kWp Solar PV Power Plant

Capacity	**1kWp**	
Panel Type	Tata-BP –BP175B	
Panel Size	1.6m*.80m	
No of Panels	6	
Total Area Required	7.5sqm	
Gross Capital Cost	2.00 -2.50 Lakh	
Subsidy	For State Utilities/Govt. Organization	90% of the cost or Rs.243/watt(with battery back-up), Rs.171/watt(without battery back-up)
	For Private Sector	30% of the cost or Rs.81/watt(with battery back-up), 57/watt(without battery back-up)

4.1.5 Wind Power:

Generation of electricity from wind mainly depends upon the wind density and speed of the wind available in the region. A minimum wind speed (Cut-in Speed) is required at which the wind turbine generate usable power. This wind speed is typically between 7 and 10 mph for most turbines.

Centre of Wind Energy Technology(C-WET) which is an autonomous institution set-up by the Ministry of New and Renewable Energy, Government of India, identifies resource rich regions in the country by conducting wind resource survey.

Although Shimla is a hilly region but due to low wind density/speed there is no potential to generate power from the wind.Wind power density map is given in annexure-4.

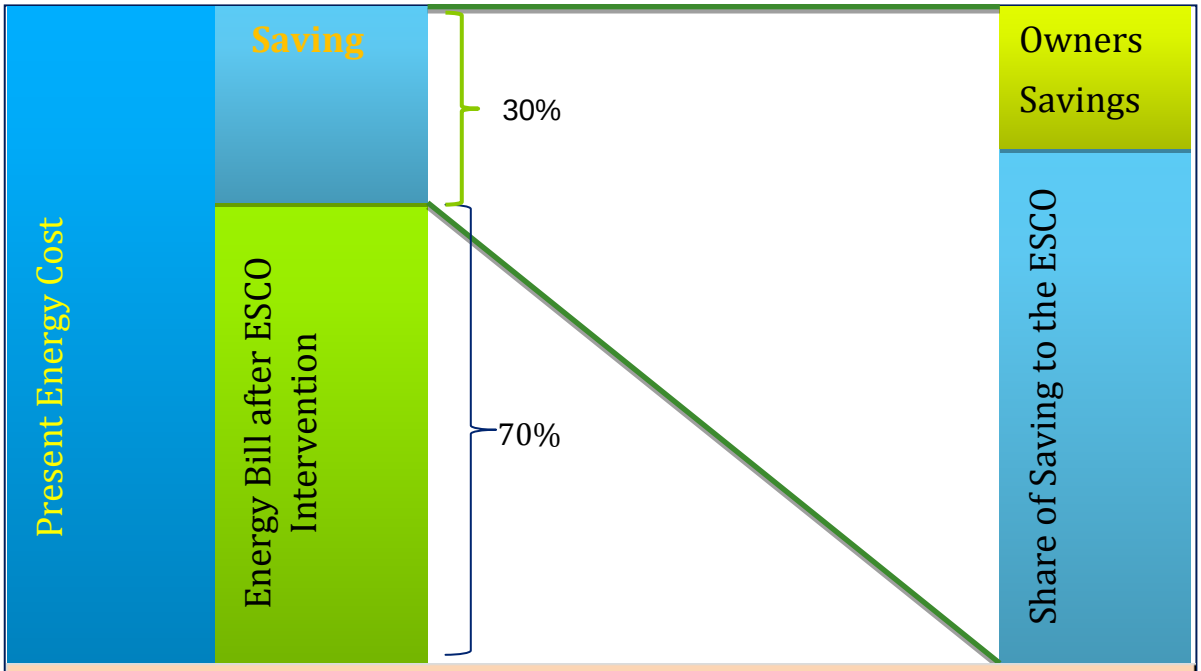
4.2 Assessment of Energy Conservations Options

After the analysis of data received from the field contact conducted across various sectors it has been observed that there is potential for energy savings by using different measures such as improving the energy efficiency, improving the power factor, retrofitting or replacing the existing energy consuming appliance and systems. By implementing energy conservation measures across all sectors, the projected demand can be reduced significantly.

Tangible result can be achieved by adopting various models for implementing the energy efficiency projects. One of the very popular models for implementing the energy efficiency projects across various sectors is Energy Services Company Model (ESCO). The concept of ESCO and detail of ESCO model for energy conservation projects is discussed below.

ESCOs Model for Energy Saving Projects: An Energy Services Companies (ESCOs) offer broad range of comprehensive energy solutions including design and implementation of energy saving projects including a guarantee for the savings. The remuneration of ESCO is linked to the project's performance, which means the ESCO's payment is directly linked to the amount of energy saved. The share of money saved after the successful implementation of the project may vary from project to project depending upon the estimated saving potential and on the agreement between Owner's and ESCOs. For a typical project it may be 85% to ESCO & 15% to Owners

List of qualified ESCOs are available on the BEE website. A typical ESCO model is described in the chart given below.



Sharing of Savings between ESCO & Owner's

Year	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
ESCO Share of Saving	85%	85%	85%	85%	85%	85%	85%	0%
Owner,s	15%	15%	15%	15%	15%	15%	15%	100%

Figure 32: ESCO Model for Implementing the Energy Efficiency Project

4.3 Existing Renewable Energy System in Shimla:

Apart from few Solar Water Heating Systems there are no renewable energy system currently existing within the municipal boundary of the Shimla city. List of installed SWHS is provided below.

Location	Capacity (LPD)	Location	Capacity (LPD)
Hotel Himland	3500	St. Bede College	2100
Hotel Surya	4500	Lorentz School	2100
Bright Land	2000	Residential Sector(Gross Installation)	50000
Hotel Honeymoon	2000		
Hotel Sukhsagar	4000		
Hotel Holiday Home	1000		
Chelsa School	3600		

(Source: HIMURJA & TATA BP Solar).

4.4 Sector Wise Strategies

4.4.1 Residential Sector:

In an urban residential set-up energy is mainly used for cooking, water heating, space heating & cooling and lighting but its end use is also region specific and climate dependent. It was observed during the field contact that lighting, cooking, space heating and water heating is the main energy load in case of Shimla.

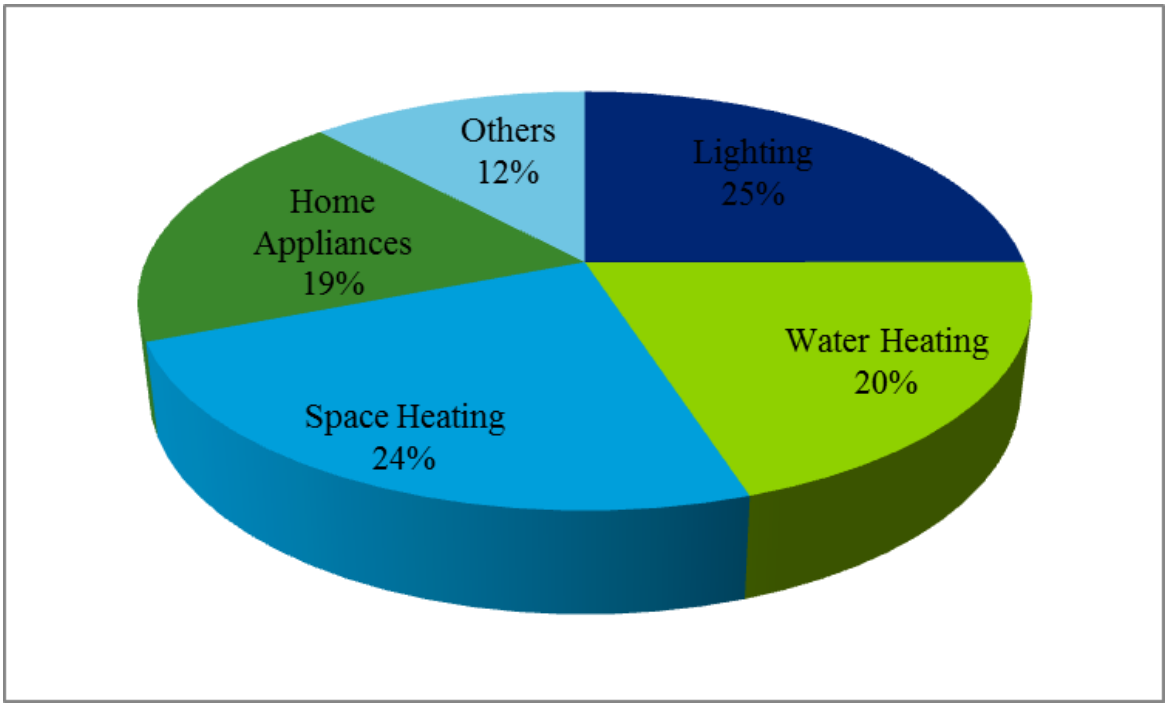


Chart 33 : End-use of Electricity in Baseline Year 2008-09 in Residential Sector

Although energy consumption per household in Shimla is not very high compared to other cities, still due to lack of implementation of effective energy efficiency measures residential buildings in the city give rise to significant energy wastage. After proper implementation of energy saving measures and increasing the solar energy contribution, huge amount of energy can be saved. Strategy for energy savings and renewable energy interventions are discussed below.

4.4.1.1 Energy Saving Strategy

High Efficiency Lamps: Low efficiency conventional lamps should be completely replaced with high efficiency lamps like T-12 (40 Watt), copper ballast tube light with the energy efficient T-5(28 Watt) electronic ballast tube light, incandescent light bulbs with CFL & LED. CFL & LEDs consume 75% & 80% less energy than incandescent lamp respectively. A comparison of various parameters pertaining to the incandescent lamp and efficient lamps is given below in table:

Table 17 : Comparison & Benefit Analysis of CFLs, LEDs & Incandescent Lamps.

Comparison	Incandescent Lamps	Compact Florescent Lamps(CFL)	Light Emitting Diodes(LEDs)
Light Out-put(Lumens)	**800**	**800**	**800**
Rated Watts(W)	60	15	8.00
Lamp Life (Hours)	1200	8000	50000
Electricity used(kWh) (365*4hrs)	88	22	12
Energy Cost@2.50 Rs/kWh**	219	55	29
CO_2 Emission/year(kg)	186	47	25
Energy Saving/lamps/year(kWh)	-	66	76
Direct Monetary Saving(Rs.)	-	164	190
Emission Reduction/ lamps/year(kg CO2/year)	-	140	190
Cost/Per Lamps(Rs.)	15-20	125-150	400-500
Payback Period (Month)	-	10	28

***http://www.hpseb.com/tariff.htm*

The penetration of energy efficient lamps like CFL & T-5 is still very low in Shimla. The main reason is the low awareness about benefits and their high price as compared to standard incandescent Lamps. A specific campaign in cooperation with the lamp manufacturers, state owned power utilities and retail marketing chains, would improve penetration and lead to overall energy savings.

"Atal Bijali Bachat Yojna" has been launched by HP Government in 2008 under which 4 CFL has been distributed free of cost to 16 lac families in the state to reduce the domestic electricity consumption. A similar kind of scheme can also be launched by SLNA (HIMURJA) & SMC for Shimla City under the Solar City Scheme.

There are 39,393[3] households in Shimla. Targeting 50% of the total house hold in the city and replacing one T-12 by T-5 and one 40 W Incandescent bulb with 16 W CFL per house-hold/year (Assuming 5 uses hours/day) in the next 6-7years can save approximately 1689 MWh of electricity and 1436 tCO_2e reduction can be achieved.

SPV Home Lighting System: It would be a very good replacement for conventional lighting system. Its penetration can be increased by providing additional subsidy on the basis of income of the purchasers. Installing 35W[4] solar home lighting system in 10% of the total households in the next 6-7 years which is the target will save 99MWh (Cumulative) of electricity.

Solar Cooker: Solar-cooker would be a good option for poor urban people who still use kerosene and wood for cooking. There are 1782 slum packets which have been identified by Municipal Corporation

[3] Projected for 2011
[4] (Burning 3 hrs.*240 days)

located within the city boundary and have total population of 10734[5]. Detail list of the slums is provided in annexure-8. SLNA should provide heavy subsidy on the purchase. An awareness campaign mentioning environmental benefit and subsidy available on the purchase through electronic or print media (Local Newspaper) will make it popular and will increase penetration among poor and low-income group people of the city.

Installation of Multi-Family & Individual Solar Water Heating System: Solar Water Heating Systems (SWHS) can play an important role in energy systems in Shimla. It has been found during the field contact that residents of the city require hot water for almost 8 months and most of the residential homes mainly use electrical geyser. There is vast potential for SWHS installation to cater the hot water need in the residential homes in the city. It can easily heat water to a temperature of 60-80° C which is even more than desired temperature for domestic uses like bathing & cleaning. Both individual as well as multi-family (Centralize system for the government quarters, multistory apartments, existing colonies and up-coming new townships) SHWS is technically and commercially viable in the city. Targeting 15% (6000) of the total household and installing one 100 LPD SWHS on each in the next 6-7 years shall save 7386 MWh of electricity and shall reduce emission by 6278 tCO2e.

- **Energy Saving by SWHS:** One system of 100 LPD (2 sq.m of collector area) can replace an electric geyser of 2 KW capacity in a home. Assuming 250 days of solar hot water use in Shimla, the savings could be 1250 units per year respectively i.e. replacement of a 2 KW electric geyser working for 2 ½ hours in a day.

Project Idea Note-1

Project Title:	Installation of Solar Water Heating System
Project Description:	Installation of 6,000 Solar Water Heating System each of capacity 100 to 200 LPD in individual house-holds as well as community based SWHS in government quarters and multistory apartments.
Project Benefits:	Energy Saving
	Improvement in Environmental Conditions
Gross Project Cost :	11 Crores
Implementation Structure:	Residents of the city and SMC with technical support from HIMURJA and technology provider shall implement.
Financing Mechanism :	Capital cost to be financed by Individual/Beneficiaries. Financial assistance as subsidy would be provided by HIMURJA.
Time Frame:	2012 to 2019
Institutional Responsibility:	SMC,HIMURJA and Technology Providers
Preparatory Activity for Implementation:	Plan and Policies
	Awareness Generation
	Inviting Application from the Interested Resident/Beneficiary
	Preparation of DPR

New Financing Mechanism for SWHS: In spite of financial support from MNRE/HIMURJA, domestic users are not shifting towards the SHWS. It has been found during the field contact that lack of proper financing support/subsidy is still a barrier which prevents the domestic users to shift towards the SHWS.

[5] JNNRUM-CDP Shimla

A Financing strategy for making SHWS economically viable for Domestic/Non-profit sector is given below in the chart.

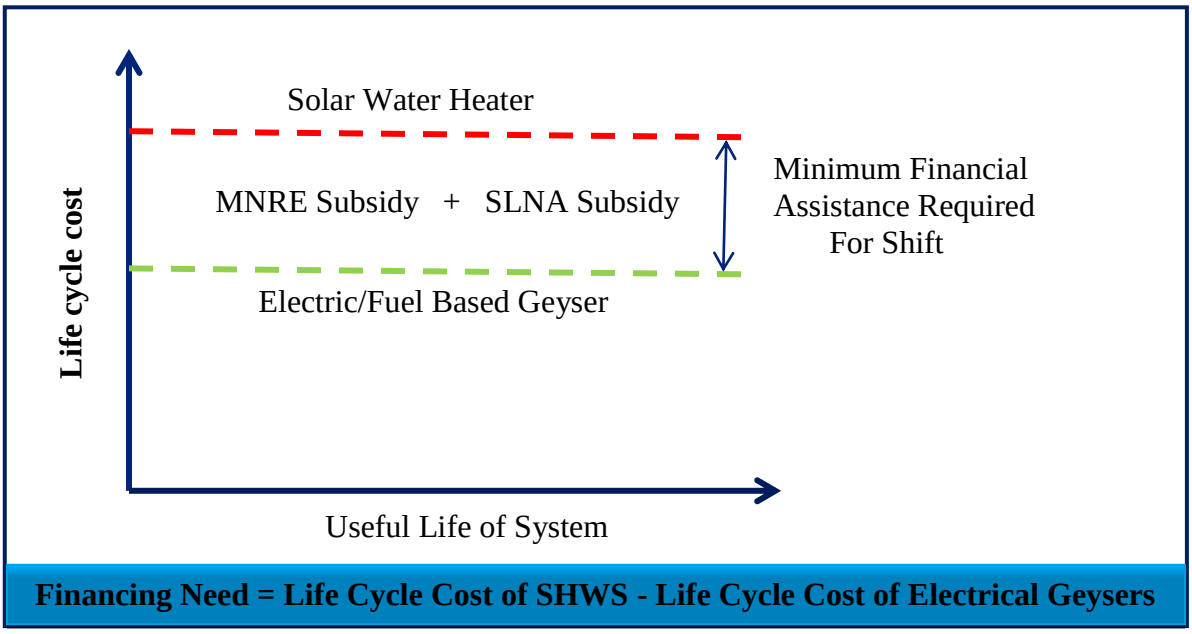


Chart 34 : Financing Strategy for SHWS Installation in Domestic/Non-profit sector

SLNA/SMC should draw an action plan and set a target to install at least 1000 SWHS (40 in each ward) every year. The use of 1000 SWHS of 100 each can contribute to a peak load saving of approximately 1 MW and can prevent emission of 1500 tCO_{2e} annually.

Cost Benefit of Solar Water Heaters: Economic viability of SHWS depends upon the various parameters such as hot water usage pattern, ambient temperature, incident radiation, solar energy factor and end use temperature. It varies widely for different places and sectors. A simple calculation assuming end use torture at 40^0C is given below.

Table 18 : Cost Benefit Analysis of SHWS

Market Cost of 100 LPD PFC-SWHS(INR)	18600.00
Subsidy by MNRE/ HIMURJA(INR)	9000.00
Wattage Rating of Electrical Geyser(W)	2000.00
Volumetric Capacity(Liter)	25.00
Running Hours (Hrs./Day)	4.00
Running Months(Per Year)	7.00
Electricity Consumed(kWh/Year)	1680.00
Unit cost of Electricity (Rs/ kWh)	3.00
Annual Energy Cost (INR.)	5040.00
Simple Payback Period(Year)	**1.90**

Voluntary Labeling/ Certification Initiatives: A certification program namely *Energy Efficient home/Solar home/ Sustainable home* can be jointly launched by the HIMURJA, SMC & DISCOM for the

existing residential buildings. A benchmark can be set for annual energy consumption or certain criteria/ parameter should be predefined by the certifying agency. If a building consumes less energy than the benchmark set by the SLNA/DISCOM this certificate should be provided to them. Also a computer based database of all certified homes can be maintained by the certifying agencies for inter-departmental verification.

Following criteria can be set for getting the energy efficiency certificate

- At least one 100 LPD SWHS should be installed on roof top
- All lamps should be energy efficient (T-5 & CFL)
- All electrical home appliances should be BEE 4-5* rated.
- Per capita energy consumption should be less than the benchmark set by the SLNA
- Zero consumption of Kerosene oil.
- Should have minimum 20 Sq. m of south facing area on which SPV (3 kWp) can be installed.
- Guarantee an energy consumption which is lower than the set benchmark set by the certifying agency.

Owners of the energy certified building/homes would be benefited against holding this certificate on total energy bill or some discount on the electricity tariff. This shall promote the energy efficiency in the residential building sectors.

Awareness Generation About Energy Efficient Home Appliances: Home appliance such as Refrigerator, heater, washing machine, Air Conditions etc. consume considerable amount of energy in the residential sector, this can be minimized by creating awareness among citizen to use BEE-star labeled appliances instead of energy-inefficient home appliances. This can be achieved by organizing workshops/seminars and explaining long term benefit of the energy efficient devices. SNA/SMC should at least organize 4-5 such events on the city level annually.

ECBC/GRIHA Rating for Upcoming Township: There should be a mandatory provision for the upcoming townships that all the building in the township must implement the Energy Conservation Building Code.

4.4.1.2 Renewable Energy Interventions

Installation of Roof-top SPV System: Although due to heavy forest cover, homes located in few areas within the city boundary do not receive good solar radiation throughout the day, but still there are many households which receive good sunshine and there is potential to generate electricity through roof-top based SPV system. 2-5KWp roof top SPV system can be installed on the roof top of houses across the city.

Project Idea Note-2

Project Title:	Installation of Roof-top Based SPV System.
Project Description:	Installation of 2000 roof top based SPV system each of capacity 2-5 KWp on individual house-holds.
Project Benefits:	Clean Energy Generation

	Additional Revenue from the sale of CERs
	Improvement in Environmental Conditions
Gross Project Cost :	80 Crores
Implementation Structure:	Residents of the city and SMC with technical support from HIMURJA and technology provider shall implement.
Financing Mechanism :	Partial Capital cost to be financed HIMURJA as a subsidy and rest by Individual/Beneficiaries
Time Frame:	2012 to 2019
Institutional Responsibility:	SMC,HIMURJA and Technology Providers
Preparatory Activity for Implementation:	Plan and Policies
	Awareness Generation
	Inviting Application from the Interested Resident/Beneficiary
	Preparation of DPR

Table 19 : RE & EE Strategy for Residential Sector

Implementable RE & EE Strategy Sheet for Residential Sector							
Strategies & Intervention	**Units**	**Target Capacity**	**Total Investment (Lakh-INR)**	**MNRE/HIMURJA Subsidy (Lakh-INR)**	**Users Contribution (Lakh-INR)**	**Energy Saving Potential (MWh)**	**Emission Reduction (tCO2e)**
Replacement of T-12 & Incandescent Bulb	Nos.	19696	48.26	-	48.26	1689.47	1436.05
Solar Home Lighting System (@35W/Home)	Nos.	3939	693.32	207.99	485.32	99.27	84.38
Installation of SWHS (@100LPD/Home)	LPD	6000	1116.84	531.80	585.04	7386.18	6278.25
Use of Solar Lantern (@7W/Home)	Nos.	5721	125.87	-	125.87	10.98	9.34
Roof-Top SPV Power Plant (@2kWp/Home)	Nos.	2000	8000.00	2400.00	5600.00	9400.00	3995.00
Gross Investment	**Crores**	**99.84**					
Gross Energy Saving	**MU**	**15.59**					
Gross Emission Reduction	**ktCO2e**	**15.80**					

EE strategy & RE intervention is summarized in the table given below with quantification and estimated cost. Energy consumption trend in Business as Usual Scenario (BAU) & Solar City Scenario (SCS) with average saving of 14-15% each year is given below in chart. Suggested EE & RE strategies together can save 13.89 MU of electricity in the next 6-7 years and shall reduce the emission of 11.80 ktCO2e.

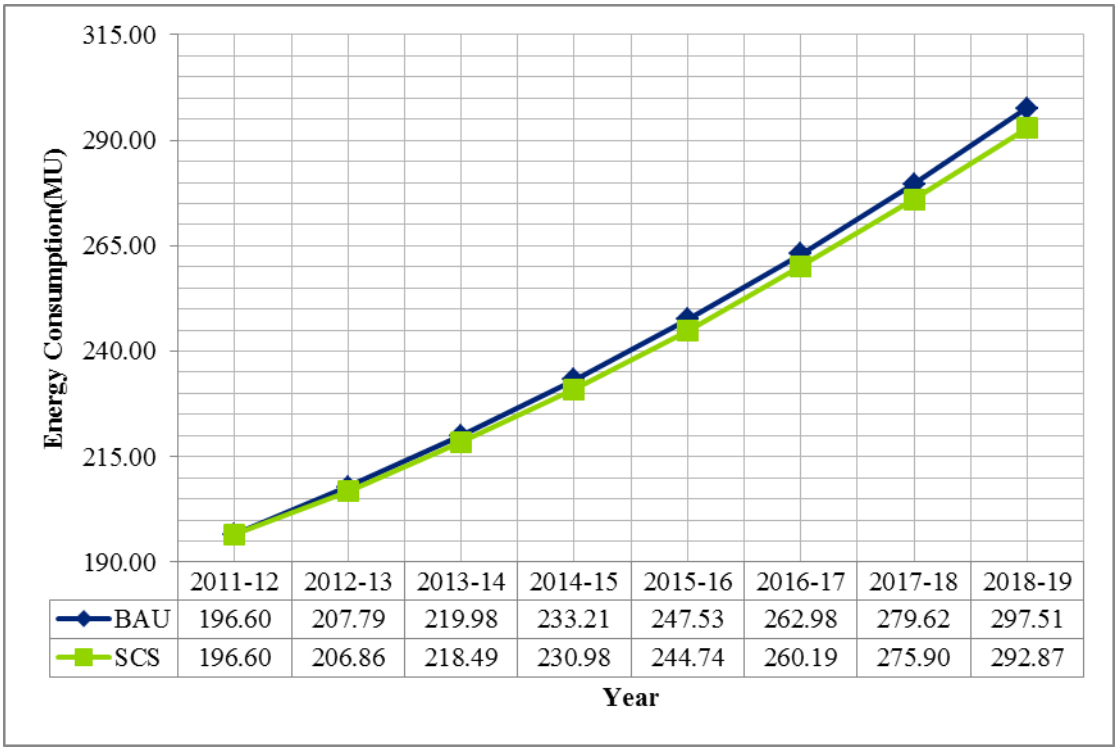


Chart 35 : Energy Consumption Trend in BAU & SCS for Residential Sector

4.4.2 Commercial Sector

This segment consists of commercial establishments such as hotels, restaurants, malls, shopping complexes and local markets. Among all commercial activities, hotel & tourism industry is the most important in Shimla. Hotels are spread all over the city with a maximum density near the mall road.

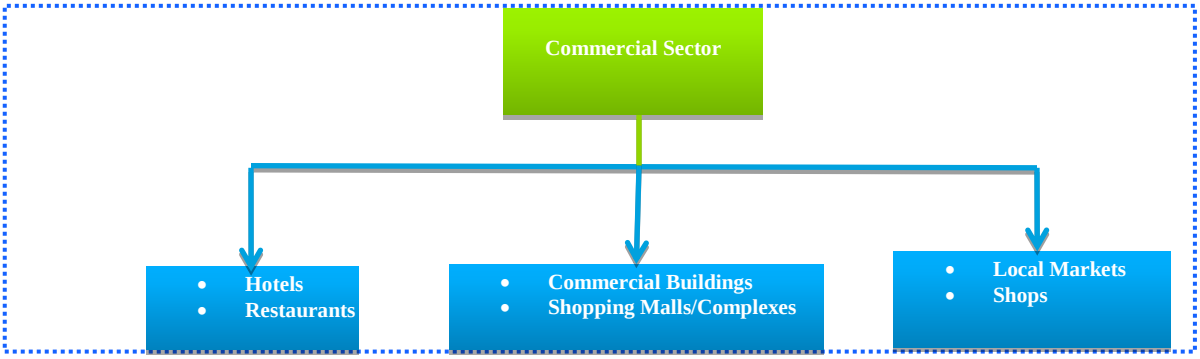


Chart 36: Overview of Commercial Sector

Energy systems in this sector mainly include lighting, cooking, water heating and space heating. Because of the cold environment the major contributors are water heating and space heating systems. During the field contact it has been found that not much attention has been paid towards the energy efficiency in this sector. There exist a significant potential to improve energy efficiency in existing hotels, government & commercial office buildings and restaurants and subsequent reduction of commercial sector electricity energy demand at city level.

4.4.2.1 Energy Efficiency Strategy

Efficient Lighting System: Hotels and other commercial buildings in Shimla are still using inefficient lamps like T-12 and incandescent bulbs. These must be replaced by energy efficient lamps like T-5 and CFLs and LEDs. There are approximately 350 hotels and 68 restaurants in Shimla including guest houses which together have more than 5000 rooms. Replacing one T-12 & one 40 W incandescent bulb with T-5 & 16 W CFL respectively can save 361 MWh energy annually.

Installation of Solar Water Heating System (SWHS): Most of the hotels in Shimla presently use electrical geysers to fulfil the hot water requirement in the guest rooms, laundry and kitchen. The hot water requirement of this segment is for all 12 months in the year, unlike residential sector with 8 to 9 months of hot water requirement.

This sector is the most potential sector for the energy saving by the application of SWHS replacing electrical or fuel based geysers. SLNA/SMC should frame a policy that will make it mandatory for hotels which have more than 15 rooms to install at least one 500 LPD SWHS. 314 such installations in this sector in the next 6-7 years will save 1960 MWh of electricity.

Solar Space Heating: Solar process heating systems are designed to provide large quantities of hot water or space heating for nonresidential buildings. A typical system includes solar collectors that work along with a pump, a heat exchanger, and/or one or more large storage tanks. The two main types of solar collectors used - an evacuated-tube collector and a parabolic-trough collector - can operate at high temperatures with high efficiency. An evacuated-tube collector is a shallow box full of many glass, double-walled tubes and reflectors to heat the fluid inside the tubes. A vacuum between the two walls insulates the inner tube, holding in the heat. Parabolic troughs are long, rectangular, curved (U-shaped) mirrors tilted to focus sunlight on a tube, which runs down the center of the trough. This heats the fluid within the tube. Solar Space Heating Systems can be installed for Hotels, Restaurants, Institutional buildings etc.

Project Idea Note-3

Project Title:	Installation of Solar Water Heating System and Solar Space Heating in hotels
Project Description	Installation of 314 Solar Water Heating System each of capacity 500 LPD in on Hotels Building Across the City
Project Benefits:	Energy Saving
	Improvement in Environmental Conditions
Gross Project Cost :	2 Crores
Implementation Structure:	Hotel owners and SMC with technical support from HIMURJA and technology provider will implement.
Financing Mechanism :	Capital cost to be financed by Hotels/Beneficiaries. Financial assistance as subsidy would be provided by HIMURJA.
Time Frame:	2012 to 2019
Institutional Responsibility:	Hotelier association ,SMC,HIMURJA and Technology Providers

Preparatory Activity for Implementation:	Plan and Policies
	Awareness Generation
	Inviting Application from the Interested Hotels
	Preparation of DPR

Enforce and Implement Energy Conservation Building Code: Enforce Energy Conservation Building Code for all applicable buildings. After proper implementation of the ECBC code, peak load reduction of 45% and electricity consumption reduction of 60% in new constructions is possible.

Energy Star Rating Program for Commercial Buildings: SLNA & SMC may jointly launch a program for commercials buildings in the city based on actual performance of the building in terms of specific energy usage. This programme would rate office buildings on a 1-5 Star scale with 5 Star labeled buildings being the most efficient. Energy Performance Index (EPI) in kWh / sq.m/ year will be considered for rating the building. EPI shall be kWh/sq.m/year in terms of purchased & generated electricity divided by the built up area in sq.m.

Installation of Building Energy Management Systems (BEMS): A Building Energy Management System (BEMS) is a computer based centralized & integrated control and monitoring system that helps to manage and monitor engineering services including cooling, heating, ventilation and air conditioning within a building or group of buildings. Use of a BEMS can reduce total energy costs by 10%. SLNA or SMC should make it mandatory for all commercial buildings.

Initiating Green Building/GRIHA Rating Programme: Urban development authority such as HIMUDA and other public work department (PWD, CPWD) should frame a policy that all upcoming commercial building must be GRIHA rated. It evaluates the overall environmental performance of the building and reduces overall energy consumption of the building.

Mandating Energy Audit: SMC should frame a policy under which all Hotels rated 3-star and above must conduct energy audit for its building after every two years and submit the findings and a copy of the report to the Municipal Corporation.

4.4.2.2 Renewable Energy Interventions

Installation of Roof-Top SPV Panels for Power Generation: 5kWp to 10 kWp grid connected/off-grid SPV panels can be installed on the roof top of the hotels and other commercial buildings depending on the area available. There are total 350 hotels & 68 restaurants in the city. Targeting 70% of the commercial buildings (Hotels & Restaurants) and installing 10 kWp SPV plant on each will generate approximately 7050 MWh of electricity in the next 6-7 years which is approximately 10% of the total baseline energy consumption of the commercial sector.

Benefits of following GRIHA rating system

- Up to 30% reduction in energy consumption
- Limited waste generation due to recycling
- Less consumption of water
- Reduced pollution load & liability

Some GRIHA Rated Building is given below

- Suzlon One Earth
- Centre for Environmental Sciences and Engineering Building
- Fortis Hospital
- Common Wealth Games
- Hindustan Lever Limited

Project Idea Note-4

Project Title:	Installation of Roof-top Based SPV System.
Project Description:	Installation of 300 roof top based SPV system each of capacity 5 to10 KWp on hotel buildings in the Shimla
Project Benefits:	Clean Energy Generation
	Additional Revenue from the sale of CERs
	Improvement in Environmental Conditions
	Improvement of Solar Infrastructure in the state
Gross Project Cost :	60 Crores
Implementation Structure:	Hotels across the city and SMC with technical support from HIMURJA and technology provider shall implement.
Financing Mechanism :	Hotels may use debt-equity model for financing the project. Partial Capital cost would be financed HIMURJA as a subsidy
Time Frame:	2012 to 2019
Institutional Responsibility:	Hotelier Association SMC,HIMURJA and Technology

	Providers
Preparatory Activity for Implementation:	Plan and Policies
	Awareness Generation
	Inviting Application from the Interested Hotels
	Preparation of DPR

Awareness Program: Municipal Corporation/ SLNA should organize annual workshop/ Seminar/ meetings with hotel association/hotel owners and technology providers which shall sensitize hotel industry about new energy saving/ renewable technology available for managing the energy system of the hotels.

Table 20: RE & EE Strategy for Commercial Sector

Implementable Strategy Sheet-RE & EE for Commercial Sector							
Strategies & Intervention	**Units**	**Target Capacity**	**Total Investment (Lakh-INR)**	**MNRE/IMURJA Subsidy (Lakh-INR)**	**Users Contribution (Lakh-INR)**	**Energy Saving Potential(MWh)**	**Emission Reduction (tCO2e)**
Replacement of T-12 & Incandescent Bulb	Nos.	4189	10	-	10	361	307
Installation of SWHS (@500LPD/Building)	LPD	314	219	132	88	1959	1665
Solar Lighting System (@75W/Building)	Nos.	167	55	16	38	9	8
Roof-Top SPV Plant (@10kWp/Building)	Nos.	300	6000	1800	4200	7050	5993
Gross Investment	**Crores**	**62.85**					
Gross Energy Saving	**MU**	**9.38**					
Gross Emission Reduction	**ktCO2e**	**7.97**					

EE strategy & RE intervention is summarized in the table given with quantification and estimated cost. Energy consumption trend in BAU & SCS with average saving 14-15% each year is given below in chart. Suggested EE & RE strategies together can save approximately 9.40 MU of electricity in the next 6-7 years and will reduce the emission by 7.80 k tCO_2e.

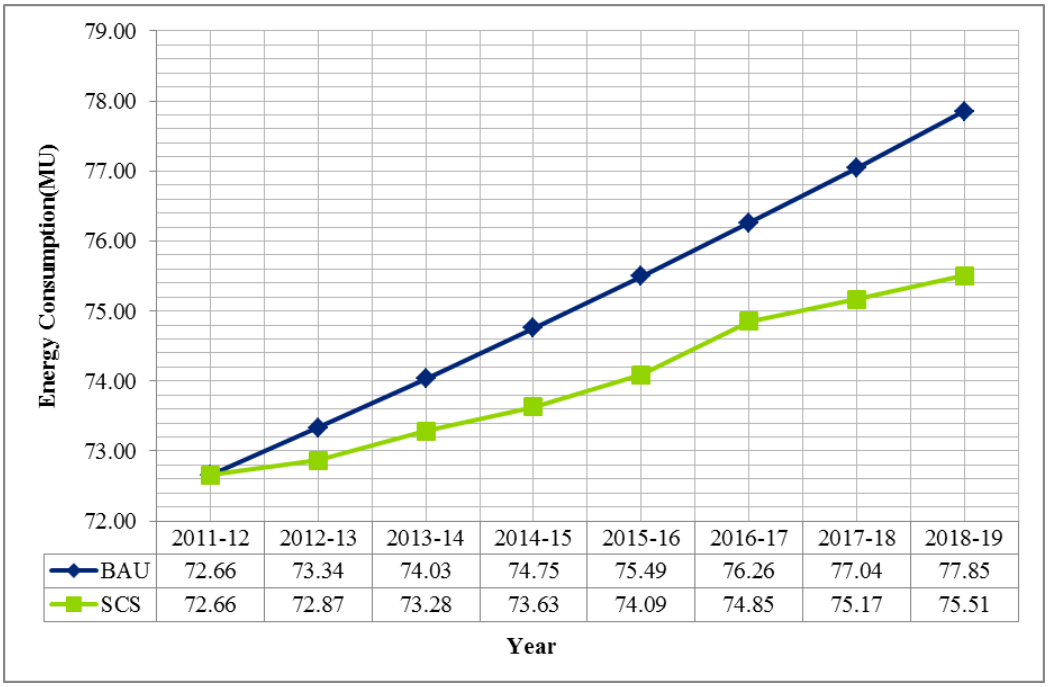


Chart 37 : Energy Consumption Trend in BAU & SCS for Commercial Sector

4.4.3 Industrial Sector

Industrial Sector in Shimla is the least energy intensive sector. There is no medium or large scale industries located within the city boundary. There are around 260 registered small scale industries in Shimla and can be classified in sectors as shown in the table given below. Gross consumption in the baseline year 2008-09 for this sector was 0.61ktOe.

Table 21: Number of Industrial Units in the Shimla City

Category of Industry	No. of Units
Food based Industries	30
Textile	16
Leather	6
Wood and Wood Works	41
Paper & Paper products.	22
Other Manufacturing and Service Industry	145
Total	**260**

(Source: District Industrial Center-Shimla)

4.4.3.1 Energy Efficiency Strategy

Installation of Solar Water Heating System (SWHS): Food processing, Textile and Leather industries require hot water for different process. In BAU, these units are using conventional fuels to fulfill hot water requirement. There is scope for SWHS installation in this sector as well.

4.4.3.2 Renewable Energy Interventions

Gross energy consumption in the industrial sector in the baseline year was approximately 7000 MWh. A 1.5 MW SPV power plant dedicated to industries will offset half of industrial consumption.

Table 22 : RE & EE Strategy for Industrial Sector

Implementable Strategy Sheet-RE & EE for Industrial Sector							
Strategies & Intervention	**Units**	**Target Capacity**	**Total Investment (Lakh-INR)**	**MNRE/HIMURJA Subsidy (Lakh-INR)**	**Users Contribution (Lakh-INR)**	**Energy Saving Potential (MWh)**	**Emission Reduction (tCO2e)**
Installation of SWHS (@500LPD)	Nos.	74	51	30	21	463	393
Dedicated SPV Power Plant	kWp	1500	1500	450	1050	3525	2996
Gross Investment	**Crores**	**15.5**					
Gross Energy Saving	**MU**	**3.99**					
Gross Emission Reduction	**ktCO2e**	**3.39**					

EE strategy & RE intervention is summarized in the table with quantification and estimated cost. Energy consumption trend in BAU & SCS with average saving of 14-15% each year is given below in chart. Suggested EE & RE strategies together can save approximately 4 MU of electricity in the next 6-7 years and will reduce the emission by 3.40 ktCO2e.

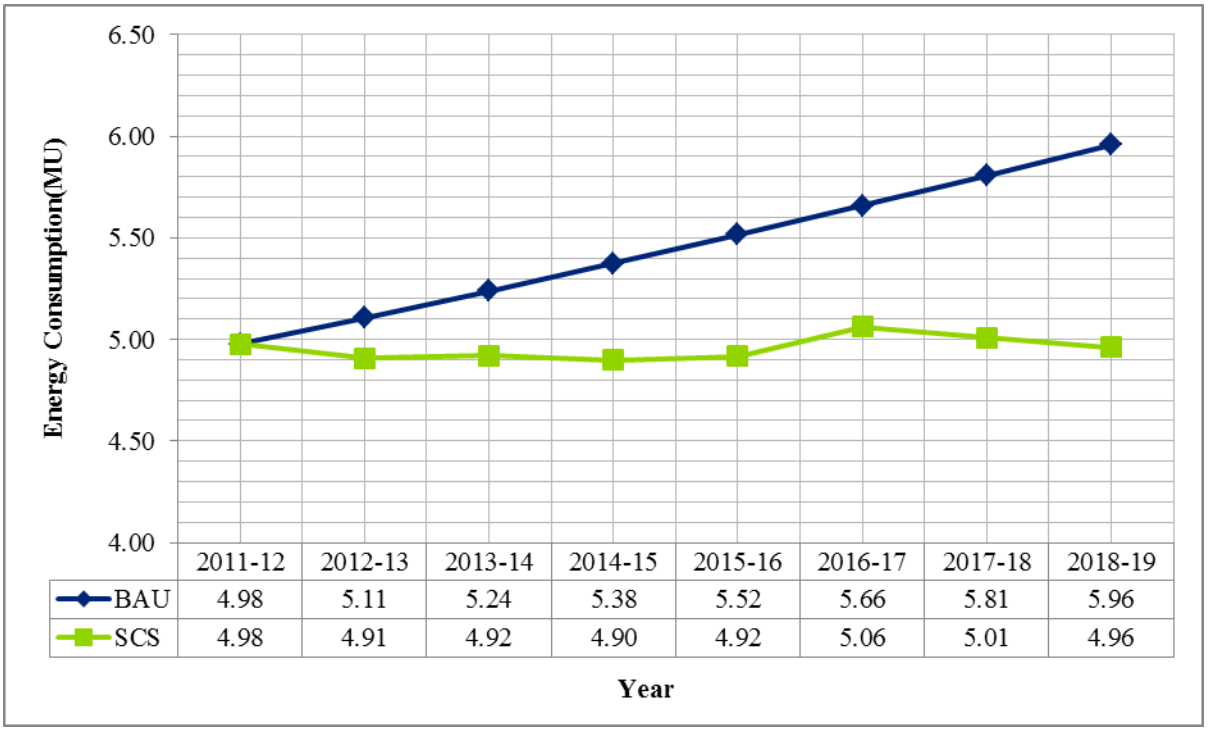


Chart 38: Energy Consumption in BAU & SCS for Industrial Sector

Awareness Program: Municipal Corporation/ SLNA must organize workshop/ Seminar/ meeting with industrialist association/owners and technology providers which shall update industry about new energy

saving/ renewable technology available for managing the energy systems of Industries. At least one such workshop/seminar is required every year.

4.4.4 Institutional Sector

This segment consists of schools, Colleges, Research Institutes, Hospitals, Government office Buildings, Religious Buildings and Heritage Buildings. Among above mentioned categories, hospital buildings is the most energy intensive due to its longer operational time with respect to others institutional buildings. The main energy load in the hospitals are Lighting, Steam & hot water generation and HVAC, while in educational/government office buildings, the major energy load are Lighting and space heating.

During the field contact, it has been found that institutional sectors have several cost effective energy conservation opportunities, which have remained untapped due to several reasons. The major barriers have been low awareness among the staffs and limited availability of in-house expertise to identify and implement energy saving majors.

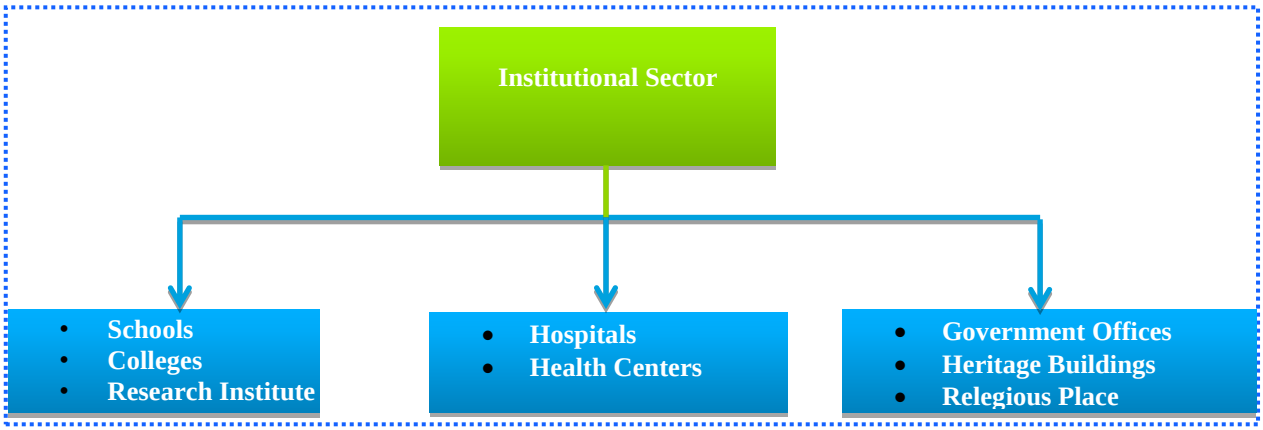


Chart 39 : Overview of Institutional Sector

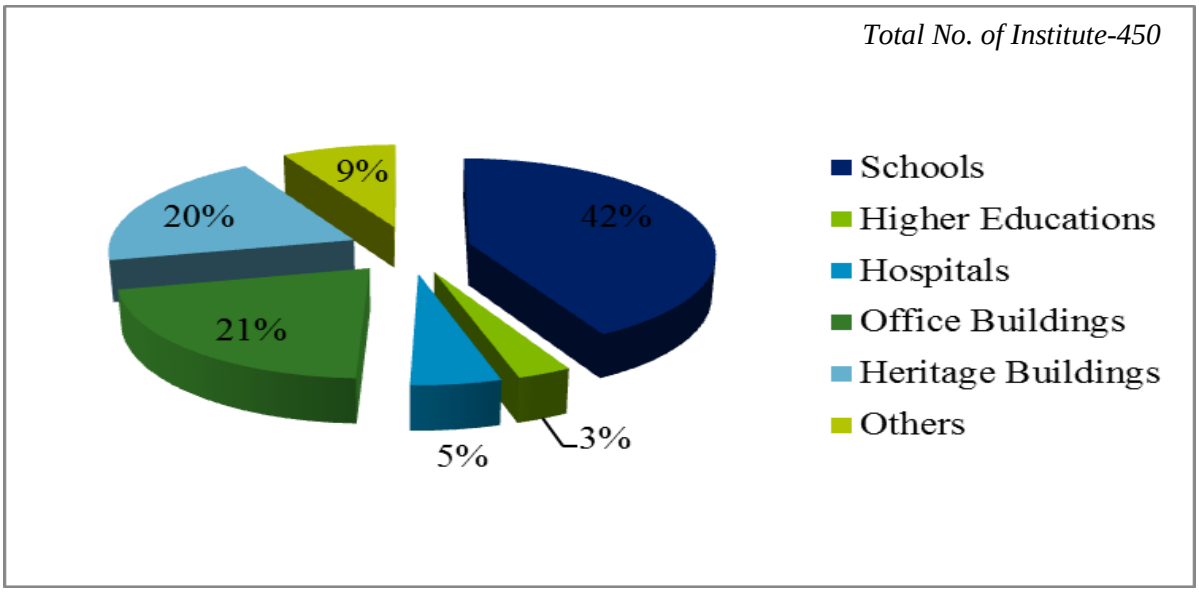


Chart 40: Distribution of Institutional Buildings in Shimla

4.4.4.1 Energy Saving Strategy

Efficient Lighting System: During the field contact it has been found that there is scope of energy saving in the lighting system in the institutional sector. Inefficient lamps must be replaced with energy efficient lamps. There are approximately 450 institutional buildings which have been identified from the energy conservation point of view within the city boundary. Replacing T-12(40 W) with T-5(28W) & Incandescent 40W by 15W CFL will save 238 MWh electricity.

Energy Audit for Hospitals & Educational Institute: There should be a framework/policy under which all Hospitals and Educational Institute must conduct energy audit for its buildings after every two years and submit the findings and a copy of report to SLNA/Municipal Corporation.

Solar Steam Cooking for Hostels/Hospitals: Solar steam cooking systems can be installed in the residential schools; colleges for cooking food.10 such installation of cooking capacity for 200 people each can save 592 MWh of electricity and will reduce emission by 503 tCO_2e annually.

Project Idea Note- 5

Project Title:	Installation of Solar Cooking System at Hostels
Project Description:	Installation of Scheffler- dish cooking system for cooking food at HP University's Boys & Girls Hostel.
Number of Boys Hostel	Seven
Total Number of Boarders Residing(Boys)	883
Number of Girls Hostel	Seven
Total Number of Boarders Residing(Girls)	1130
Project Benefits:	Energy Saving
	Improvement in Environmental Conditions
Gross Project Cost :	25 Lakhs
Implementation Structure:	Hostel Administration/Management (University) with technical support from HIMURJA and technology provider shall implement.
Financing Mechanism :	40% Capital Cost shall be financed by University while 60% of the cost to be financed by HIMURJA/MNRE as subsidy.
Time Frame:	2012 to 2014
Institutional Responsibility:	University Administration/Management ,HIMURJA and Technology Providers
	Initial Discussion with University Administration/ Management
Preparatory Activity for Implementation:	Site & Capacity Assessment / Vendors Interaction
	Techno-Economic Feasibility Study
	Preparation of DPR

Installation of Solar Water Heating System (SWHS): During field contact it has been observed that institutional buildings in the city also need substantial amount of hot water during its operation hours, particularly hospitals, which require large amount of hot water for various purposes. Hot water requirement can be easily fulfilled by SWHS. Installation of two 100 LPD system on 338 buildings (80% of the total institutional buildings) will save 844 MWh of electricity.

Project Idea Note-6

Project Title:	Installation of Solar Water Heating System in Hospitals and Residential Schools
Project Description	Installation of 338 Solar Water Heating System each of capacity 200 LPD in hospitals and residential schools across the city for meeting the hot water requirement.
Project Benefits:	Energy Saving
	Improvement in Environmental Conditions
Gross Project Cost :	216 Lakhs
MNRE/ HIMURJA Subsidy	130 Lakhs
Implementation Structure:	School Management/Administration and SMC with technical support from HIMURJA and technology provider shall implement.
Financing Mechanism :	Capital cost to be financed by Schools/Hospitals. 60 % subsidy would be provided by HIMURJA.
Time Frame:	2012 to 2019
Institutional Responsibility:	Hotelier association ,SMC,HIMURJA and Technology Providers
Preparatory Activity for Implementation:	Plan and Policies
	Awareness Generation
	Inviting Application from the Interested Hospitals/Schools
	Preparation of DPR

Energy Star Rating Program for institutional Buildings: SLNA & SMC may jointly launch the Star Rating Program for Schools/Colleges/Hospital buildings in the city based on actual performance in terms of specific energy consumption. This programme would rate buildings on a 1-5 Star scale with 5 Star labeled buildings being the most efficient. Energy Performance Index (EPI) in kWh /Sq.m/ year will be considered for rating the buildings.

Installation of Building Energy Management Systems (BEMS): Use of a BEMS can reduce total energy costs by 10%.

4.4.4.2 Renewable Energy Interventions

Installation of Roof-Top SPV Panels for Power Generation: 5kWp to 15 kWp grid connected/off-grid SPV panels can be installed on the roof top of institutional buildings across the city depending on the area available. There are approximately 200 Schools, 15 Colleges/Higher/Research institute, 25 Hospitals, 55 Heritage and approximately100 government office buildings including Raj Bhavan &Vidhan Sabha within the city boundary. SLNA should make mandatory, the installation of the SPV panels depending

upon roof area available. 10 kWp SPV plant on 405 institutional buildings across the city will generate 9.5 MU of electricity and will reduce emission by 8090 tCO2e annually.

Project Idea Note-7

Project Title:	Roof-top SPV Plant at Institutional Building Across the City
Project Description:	Installation of 405 SPV power plants each of capacity 10kWp at Institutional Building across the city.
Project Benefits:	Partial Load Reduction of the building
	Addition revenue generation by the sale of CERs
	Improvement in Environmental Conditions
Gross Project Cost :	81 Crores
MNRE/ HIMURJA Subsidy	30% to 90% of gross cost
Implementation Structure:	Institutions with technical support from HIMURJA and technology provider shall implement.
Financing Mechanism :	Subsidy of 30 to 90% is available from SLNA/MNRE. Partials investment form institutions shall also be required
Time Frame:	2012 to 2019
Institutional Responsibility:	Institutions administration & HIMURJA
Preparatory Activity for Implementation:	Internal Planning & Approval
	Vendors Interaction
	Techno-Economic Feasibility Study
	Preparation of DPR

Project Idea Note: 8

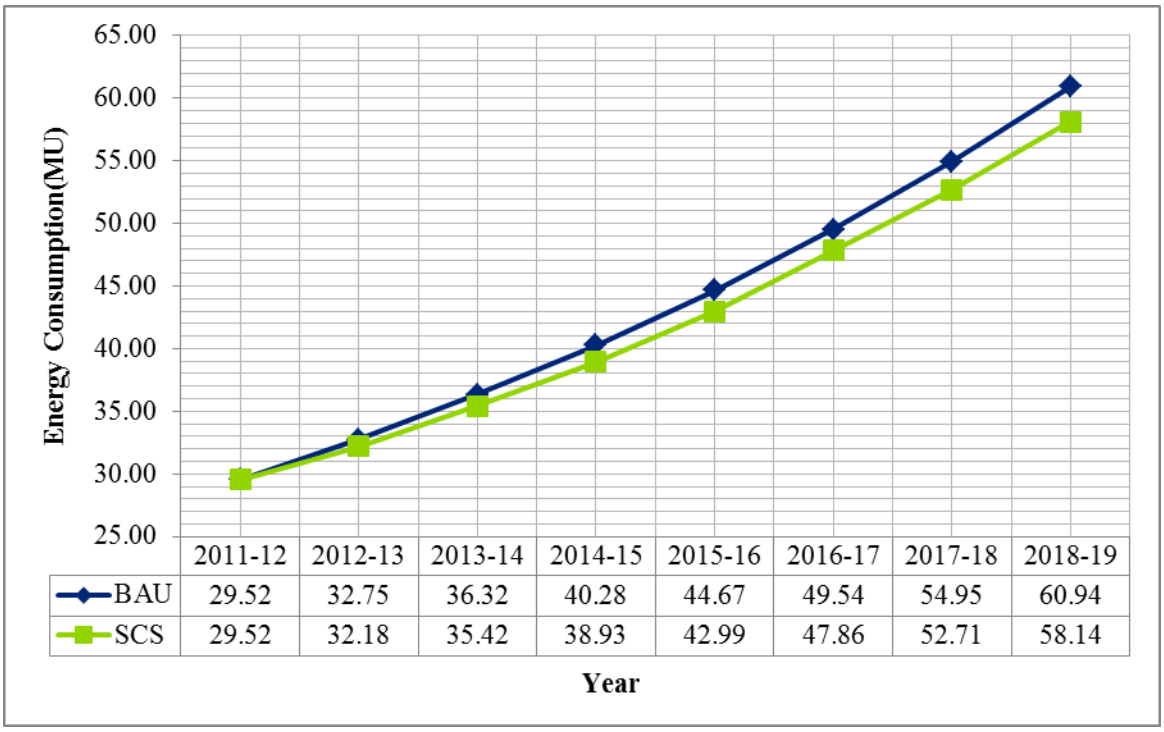
Project Title:	Roof-top SPV Plant at Sanatorium Hospital.
Project Description:	Installation of 20-25 kWp SPV power plants at roof top of Sanatorium Hospital for captive use.
Project Benefits:	Partial Load Reduction of the building
	Addition revenue generation by the sale of CERs
	Improvement in Environmental Conditions
Gross Project Cost :	60-70 Lakhs
MNRE/ HIMURJA Subsidy	Up to 30% of the project cost
Implementation Structure:	Hospital Administration with technical support from HIMURJA and technology provider shall implement.

Financing Mechanism :	Capital cost shall be financed by the hospital administration. Subsidy up to 30% is available from SLNA/MNRE.
Time Frame:	2012 to 2014
Institutional Responsibility:	Hospital administration & HIMURJA
Preparatory Activity for Implementation:	Internal Planning & Approval
	Vendors Interaction
	Techno-Economic Feasibility Study
	Preparation of DPR

Table 23: RE & EE Strategy for Institutional Sector

Implementable RE & EE Strategy Sheet for Institutional Sector							
Strategies & Intervention	**Units**	**Target Capacity**	**Total Investment (Lakh -INR)**	**MNRE/HIMURJA subsidy (Lakh -INR)**	**Users Contribution (Lakh -INR)**	**Energy Saving Potential (MWh)**	**Emission Reduction (tCO2e)**
Replacement of T-12 &,Incandescent Bulb	Nos	3375	8	0	8	238	202
Solar Lighting System (@75W/Building)	Nos	405	133	40	93	22	19
Installation of SWHS (@200LPD/Building)	Nos	338	216	130	86	844	717
Solar Steam Cooking for Hostels	Nos	10	140	84	56	592	503
Roof-Top SPV Plant (@10kWp/Building)	Nos	405	8100	2430	5670	9518	8090
Gross Investment	**Crores**	**85.97**					
Gross Energy Saving	**MU**	**11.21**					
Gross Emission Reduction	**ktCO2e**	**9.53**					

EE strategy & RE intervention is summarized in the table with quantification and estimated cost. Energy consumption trend in BAU & SCS with average saving 14-15% each year is given below in chart. Suggested EE & RE strategies together can save 11.21 MU of electricity in the next 6-7 years and shall reduce the emission by 9.53 tCO_2e.



	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
BAU	29.52	32.75	36.32	40.28	44.67	49.54	54.95	60.94
SCS	29.52	32.18	35.42	38.93	42.99	47.86	52.71	58.14

Chart 41 : Energy Consumption Trend in BAU & SCS for Institutional Sector

4.4.5 Municipal Services:

As is common with most municipalities, the major energy loads in Shimla Municipality are typically the water pumping systems, street lighting and municipal buildings such as offices; health centers etc. These three are the most energy intensive services which come under the umbrella of SMC.

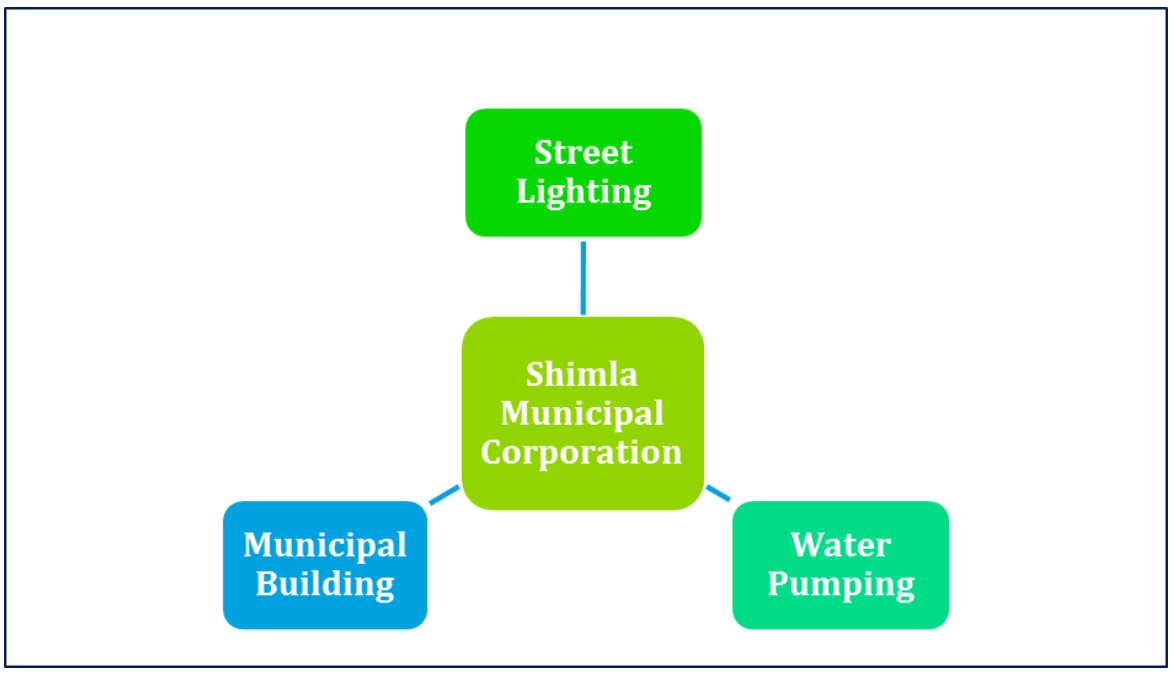


Chart 42 : Energy Intensive Systems under the Shimla Municipal Corporation

Gross energy consumption in municipal sector in the baseline year 2008-09 was 2.41 MU. 68% of the gross energy was consumed by the street lighting system and 29% by the water works. Detail break-up of the end use of total energy consumption is given in the chart below. After analyzing the current street lighting system & water works based on the data received from SMC office, it has been found that there is enormous potential for the energy as well as monetary savings across three most energy intensive services. Strategies for each service are discussed below with detail of saving potentials.

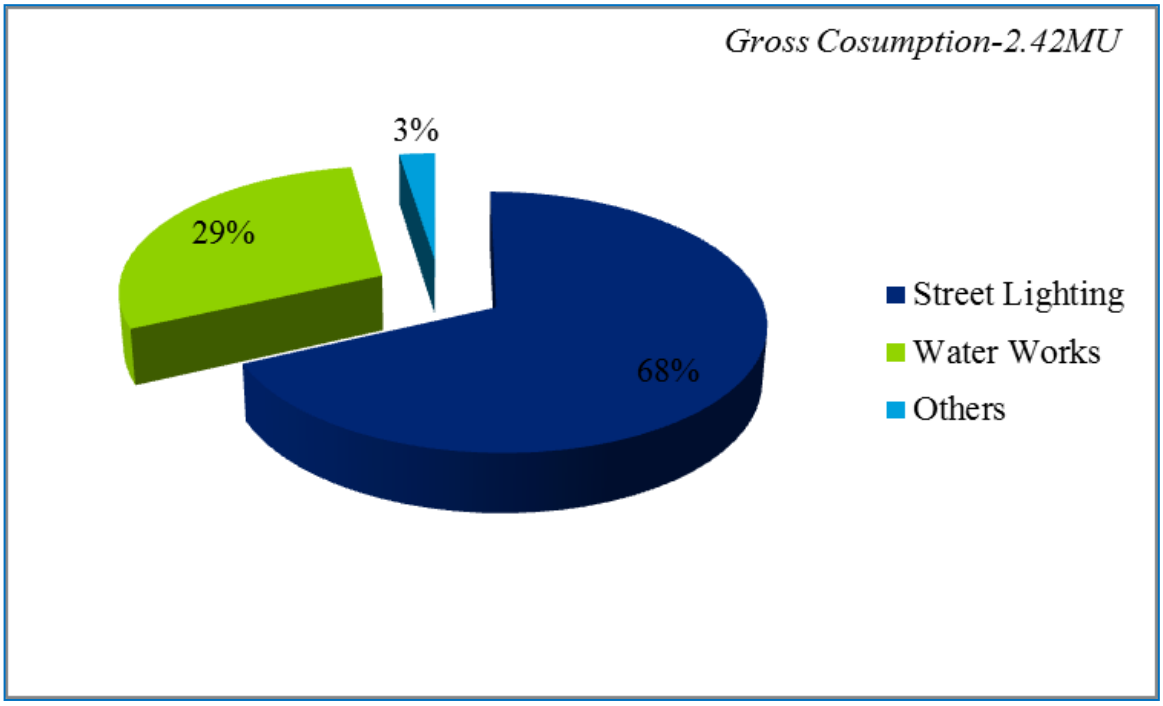


Chart 43 : End use of Energy in the Municipal Sector.

4.4.5.1 Energy Conservation Options

Efficient Street Lamps: Based on data collected from the municipal corporation log book, it has been found that the street lighting system in SMC has total 7178 lamps which include Sodium Vapor Lamp, Mercury Vapor Lamps, Metal Halide, Halogen Lamps, CFL and Fluorescent Tube Lights. Out of 7178 lamps more than 3500 lamps are conventional Fluorescent Tube Lights (T-12) types with conventional ballast which are very inefficient and it contributes approximately 30% of the total energy consumption in the street lighting system. These lamps can be replaced with the new and energy efficient T-5 tube lights. Other types of lamps in the system can also be replaced by new and efficient lamps which is currently available in the market.

The total energy consumed by street lighting system in the base year 2008-2009 was 1.65 MU. A detail inventory of lamps currently present in Shimla street lighting system is provided in annexur**e-1**

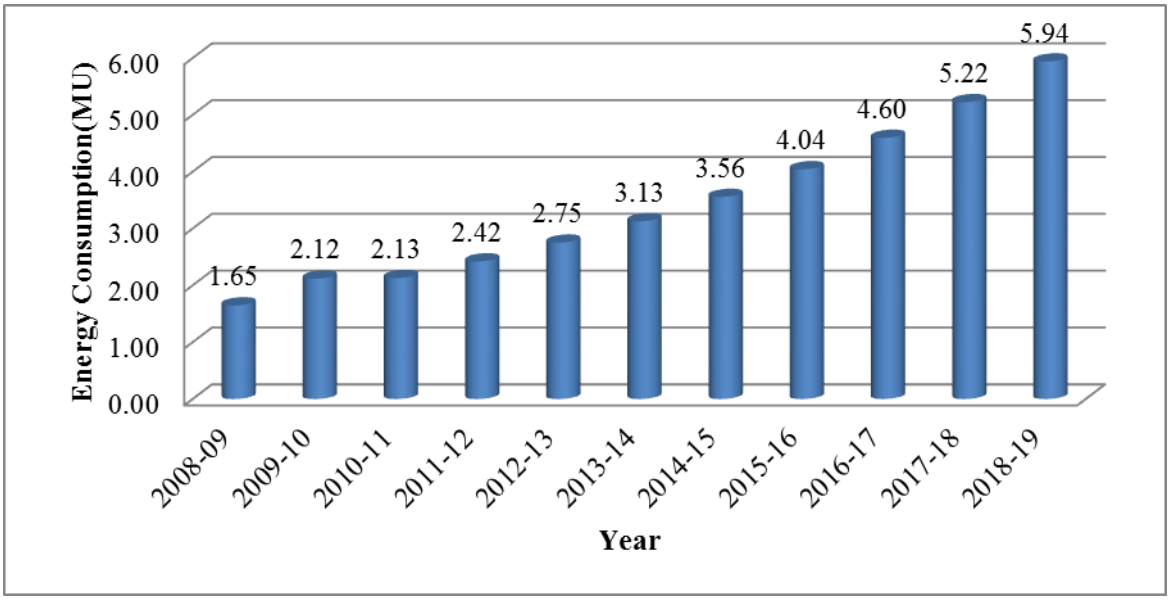


Chart 44: Energy Consumption Trend for Street Lighting System in Shimla

Based on the calculation of energy, savings of approximately 40% is possible in street lighting system by replacing the inefficient lamps with the new energy efficient lighting system equipped with electronic ballast and astronomical time switch. A simple comparison analysis and cost benefit analysis for T-12 & T-5 is given below in the table.

Table 24 : Cost Benefit Analysis of T-12 & T-5 Fluorescent Tube Lights

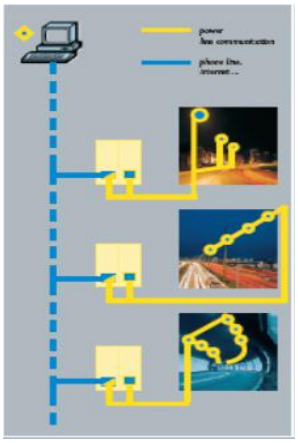
Characteristics	Conventional 40W FTL(T-12)	Efficient 28W FTL(T-5)
Expected Life (hrs.)	5000	20000
Energy input per hour (W)	52	29
Consumption in 10 hrs. per day (KW)	0.52	0.29
Annual Consumption (Units)	190	106
Yearly Energy Cost (@ Rs.5.40** per unit)	1025	572
Annual Savings (Rs.)	453	
Investment(Replacing Whole Fixture,T-12 by T-5)	450-550	
Payback Period(Years)	1.00-1.20	

*****: SMC Log-book for Street Lighting System***

Project Idea Sheet-9

Project Title:	Renewal of Street Lighting System
Project Description:	Replacement of existing 3500 T-12 Tube-lights with energy efficient T-5 Tube-lights in the street lighting system across the city.
Project Benefits:	Energy Saving
	Monetary Benefits
	Improvement in Environmental Conditions
Gross Project Cost :	14 Lacs
Implementation Structure:	Municipal Corporation shall implement. Implement by ESCO Model shall be more appropriate.
Financing Mechanism :	Capital Cost shall be financed by Municipal Corporation using funds to rise through grant under Solar City Project (MNRE).
Time Frame:	2012 to 2014
Institutional Responsibility:	Shimla Municipal Corporation
Preparatory Activity for Implementation:	Internal Planning & Approval
	Vendors Interaction
	Techno-Economic Feasibility Study
	Preparation of DPR

Automation of Street Lighting System: It is a software based digital system which enables individual light points to be switched on or off at any given time, or to be set to any dimming level that the lamp allows, ensuring maximum flexibility for the lighting installation. It is a real time device for energy conservation in street lighting. It can save energy up to 8 % against conventional manual operation by precisely changing ON and OFF time on daily basis.



In addition, it has replace word or rephrase sentence real-time based staggering facility to turn OFF streetlight / energy down mode when there is no / low traffic at late night and turn ON by early morning or full energy mode when traffic starts. This can save total energy up to 33 %depending upon staggering / energy down mode timings

Project Idea Sheet-10

Project Title:	Automation of Street Lighting System
Project Benefits:	Energy Saving
	Monetary Benefits
	Improvement in Environmental Conditions
Gross Project Cost :	5to 7 Lacs
Implementation Structure:	Municipal Corporation with technical support from HIMURJA shall implement
Financing Mechanism :	Capital Cost shall be financed Municipal Corporation using Funds to rise through grant under Solar City Project (MNRE).
Time Frame:	2012 to 2014
Institutional Responsibility:	Shimla Municipal Corporation
Preparatory Activity for Implementation:	Internal Planning & Approval
	Vendors Interaction
	Techno-Economic Feasibility Study
	Preparation of DPR

Installation of Solar Street Lights: Installation of Solar Street lighting is a good option. Although availability of sun light throughout the year for the entire day at every location is a problem in Shimla due to heavy forest cover within the city but after proper site assessment, it can installed in selected areas.

Vehicle lanes, Parking lots and roads on the Mall & Ridge are the most suitable locations for the installation of solar street lights because these locations do not require very high level of lux intensity.
1150 installation of 74W LED based solar lighting system in the next seven years will save approximately 100 MWh of electricity

Project Idea Sheet-11

Project Title:	Installation of Solar Street Lighting System
Project Description:	Installation of 1150 Solar Lighting System each of 74 W-(LED) across the city.
Project Benefits:	Energy Saving
	Improvement in Environmental Conditions
Gross Project Cost :	2.75 Crores
MNRE/HIMURJA Subsidy@90%	2.48 Crores
Implementation Structure:	Municipal Corporation with technical help from HIMURJA and technology provider shall implement.
Financing Mechanism :	Capital Cost shall be financed Municipal Corporation using funds to rise through grant under Solar City Project (MNRE).A subsidy up to 90% shall be provided by HIMURJA/MNRE.
Time Frame:	2012 to 2019
Institutional Responsibility:	Shimla Municipal Corporation
Preparatory Activity for Implementation:	Internal Planning & Approval
	Vendors Interaction
	Techno-Economic Feasibility Study
	Preparation of DPR
	Preparation of DPR

Pump Efficiency Improvement: Based on the data received, it has been observed that most of the pumps of SMC are running at average efficiency of approximately 55-60% which is very low. Pumps with overall efficiency (pump and motor combination) 75 to 80 % are available. Based on the calculation, it has been found that approximately 20-25% energy can be saved annually by increasing the overall efficiency. Higher efficiency can be achieved either by retrofitting in the old system or replacing low

efficiency pumps with high efficiency pumps. The detail of water pumping system of SMC is attached in annexure-2.

Use of Variable Speed/Frequency Drive (VSD/VFD): Variable speed drive for pump provides significant flexibility and improves the operation efficiency. VSD for centrifugal pumps enables maintaining fixed pressure vs. changing flow condition or inversely flow vs. pressure. The significant amount of energy can be saved by installing VSD control in the water pumping system instead of throttling, bypassing or other less efficient flow control methods. By improving the pumps efficiency and VFD installation together, 182 MWh energy can be saved.

4.4.5.2 Renewable Energy Intervention:

Captive SPV Plant at Ridge: The large plane area on Ridge is one of the most potent areas for installation of SPV panel due to good availability of solar radiation. SPV plant of 20-25 kWp capacity can be installed for generating electricity. Electricity generated can be directly used by SMC main office building. This power plant can generate approximately 50MWh of electricity annually.

Project Idea Note-12

Project Title:	Captive SPV Plant at Ridge
Project Description:	Installation of 25 kWp SPV power plant at Ridge for captive use. Power generated shall be directly used by Shimla Municipal Building.
Project Benefits:	Partial Load Reduction of SMC office building
	Addition revenue generation by the sale of CERs
	Attracting ECO-Tourism
	Improvement in Environmental Conditions
Gross Project Cost :	60 Lacs
HIMURJA Subsidy	90% of the Project Cost
Implementation Structure:	Municipal Corporation with the technical support from HIMURJA and technology provider shall implement.
Financing Mechanism :	Capital Cost shall be financed by Municipal Corporation using funds to be raised through grant under Solar City Project (MNRE).
Time Frame:	2012 to 2014
Institutional Responsibility:	Shimla Municipal Corporation
Preparatory Activity for Implementation:	Internal Planning & Approval
	Vendors Interaction
	Techno-Economic Feasibility Study
	Preparation of DPR

Roof-top SPV Plant at SMC Main Office Building: There is a good availability of sunshine on SMC main building located on the Ridge. South facing area is around 75 square meters. An SPV plant of 10-15kWp can be installed for the captive use. This power plant can generate approximately 25 MWh of electricity annually.

Project Idea Note: 13

Project Title:	Roof-top SPV Plant at SMC Building
Project Description:	Installation of 10 kWp SPV power plant at Shimla Municipal Building. Ridge for captive use. Power generated shall be directly used by Shimla Municipal Building.
Project Benefits:	Partial Load Reduction of SMC office building
	Addition revenue generation by the sale of CERs
	Attracting ECO-Tourism
	Improvement in Environmental Conditions
Gross Project Cost :	25Lacs
HIMURJA Subsidy	90% of the Project Cost
Implementation Structure:	Municipal Corporation with the technical support from HIMURJA and technology provider shall implement.
Financing Mechanism :	Capital Cost shallshall be financed by Municipal Corporation using funds to rise through grant under Solar City Project (MNRE).
Time Frame:	2012 to 2014
Institutional Responsibility:	Shimla Municipal Corporation
Preparatory Activity for Implementation:	Internal Planning & Approval
	Vendors Interaction
	Techno-Economic Feasibility Study
	Preparation of DPR

Biogas Generation and Bottling Plant: According to the data received from the municipal corporation office it has been found that 3500 - 4000 kg of vegetable waste and 500 -700 kg of manure is being generated daily in the Sabji Market located in the Lower Bajar. It is transported to the Dharnika Bgicha for the disposal. This can be used for generation of biogas which can be bottled and sold.

Picture 3: Vegetable Waste at Lower Bajar Sabji Mandi, Shimla

Project Idea Sheet-14

Project Title:	Installation of Biogas Plant
Project Description:	Installation of 400 cum Biogas generation and bottling plant based on the vegetable waste at Dharnika Bgicha
Project Benefits:	Energy generation
	Waste minimization and organic fertilizer production
	Monetary Benefits/CDM Revenue
	Improvement in Environmental Conditions
Gross Project Cost :	25-30 Lacs
Implementation Structure:	Municipal Corporation shall implement. Implementation by EPC mode shall be more appropriate.
Financing Mechanism :	Capital Cost shall be financed by Municipal Corporation using funds to be raised through grant under Solar City Project (MNRE).
Time Frame:	2013 to 2015
Institutional Responsibility:	Shimla Municipal Corporation
Preparatory Activity for Implementation:	Internal Planning & Approval
	Vendors Interaction
	Site Selection
	Techno-Economic Feasibility Study
	Preparation of DPR

Methane Recovery and Power Generation from STP: There are six sewage treatment plants in Shimla of total capacity 37 MLD. A power plant of capacity 0.50 to 0.75 MW can be installed for captive use or power generated can be sold to the Grid**.** This can generate approximately 3100MWh of electricity annually.

Picture 3: Sewage Treatment Plant at Lalpani, Shimla

Project Idea Note-15

Project Title:	Methane Recovery & Power Generation from STP
Project Description:	Installation of 0.60 MW power plant based on methane recovered from the sewage treatment plant (STP).
Project Benefits: 8y	Energy saving
	Waste minimization
	Additional revenue by the sale of CERs
	Improvement in Environmental Conditions
Gross Project Cost :	5 to 6 Crores
Implementation Structure:	Municipal Corporation, Irrigation and Public Health (I& PH) department with the technical support from HIMURJA and technology provider shallshall implement.
Financing Mechanism :	Capital Cost shall be financed byMunicipal Corporation/GoHP using funds to be raised through grant under Solar City Project (MNRE).
Time Frame:	2012 to 2014
Institutional Responsibility:	Shimla Municipal Corporation and I&PH
Preparatory Activity for Implementation:	Internal Planning & Approval
	Vendors Interaction
	Techno-Economic Feasibility Study
	Preparation of DPR

Table 25 : RE & EE Strategy for Municipal Sector

Implementable RE & EE Strategy Sheet for Municipal Sector							
Strategy & Interventions	**Units**	**Target Capacity**	**Total Investment (Lakh-INR)**	**MNRE/HIMURJA Subsidy (Lakh-INR)**	**SMC (Lakh-INR)**	**Energy Saving Potential (MWh)**	**Emission Reduction (tOC2e)**
Efficient Street Lighting	Nos.	3500	14	0	14	294	250
Solar Street Lighting	Nos.	1150	276	248	28	100	85
VFD Installation on Pumps	Nos.	6	13.45	0	13	182	155
Biogas Plant (Vegetable Waste)	CUM	400	30	15	15.0	4000	3400
STP(Methane Recovery) Based Power Plant	MW	0.60	500	100	400	3100	55335
Gross Investment	**Crores**	**8.33**					
Gross Energy Saving	**MU**	**7.68**					
Gross Emission Reduction	**ktCO2e**	**59.22**					

Implementable energy efficiency and renewable energy strategies/measures for Municipal sector with its estimated cost and corresponding cumulative energy saving potential is given below in the table. Energy consumption trend in BAU & SCS with average saving 14-15% each year is given below in chart. Suggested EE & RE strategies together can save 7.68 MU of electricity in the next 6-7 years and will reduce the emission by 59.22 $ktCO_2e$.

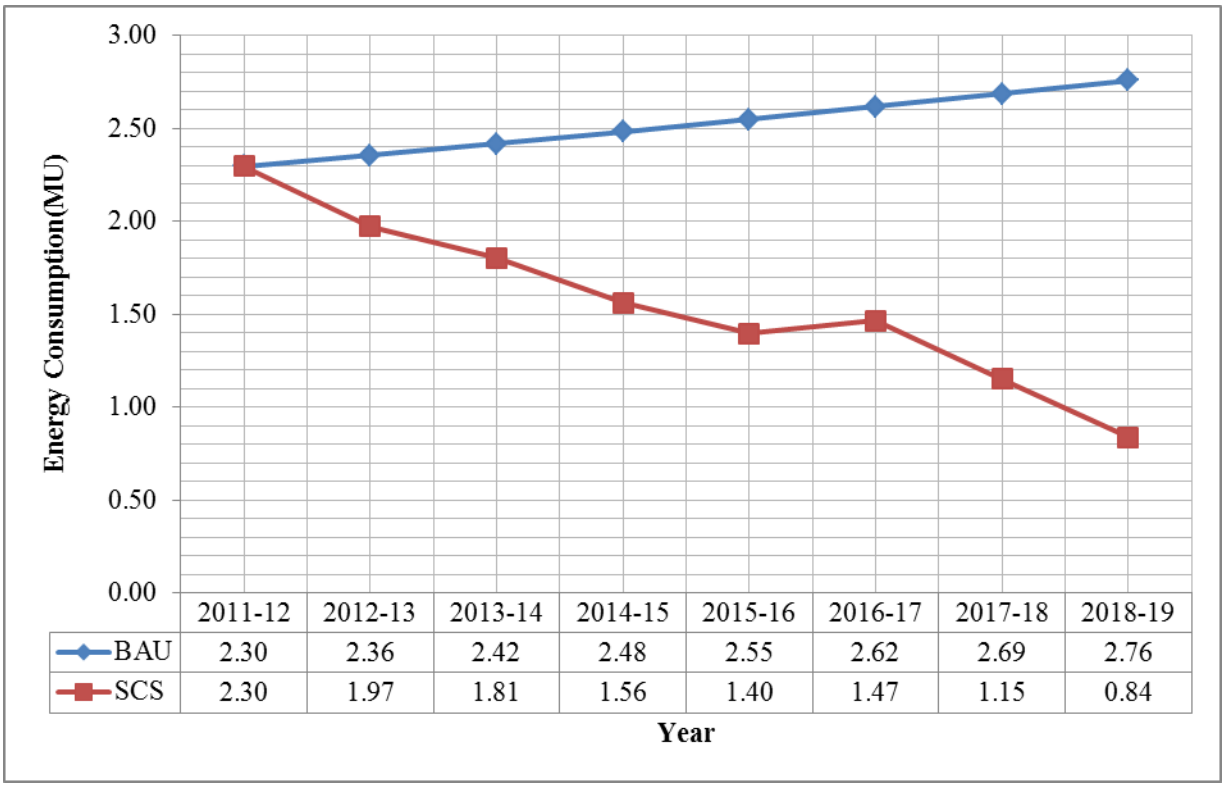


Chart 45 : Energy Consumption Trend in BAU & SCS for Municipal Sector

Use of Wood Biomass for Thermal Application

Wood being a versatile fuel, can be burned in many different forms to provide all heating energy requirement for cooking, hot water and space heating during winter. Until recently wood fuelled heating has had the drawback of a lack of controllability. Automatic wood fuelled boilers, and many stoves, overcome this problem by utilising thermostats, which automatically control fuel and air intake with very responsive and programmable temperature settings. Using wood to heat commercial and public buildings is common in countries such as North America, Sweden, Austria and Denmark.

Modern wood stoves

Owing to the cold climate in Shimla, many households, especially in the lower income group, use wood collected locally for space heating and cooking purposes. Wood stove technology has been developed to a point where clean burning and efficient stoves are now commonly available. Operating in an almost sealed enclosure, and with a well-controlled and distributed air supply, a number of these stoves are now approved for use in smoke control areas. Several designs of wood stoves are available to heat a single room or to meet complete thermal energy demand of a house or an institutional building. The use of modern designs result in higher combustion efficiency and lower carbon dioxide emissions, temperatures, and produces better fuel economy and fewer solid deposits than earlier designs. This technology provides the almost complete combustion of the tars and creosotes produced, resulting in a self-cleaning viewing window on the stove door and fewer deposits in the flue ways. Wood stoves incorporating a hot water boiler are also available in the market today. Such stoves can potentially provide the entire heating and hot water requirement for a house or an institution. Some manufacturers market stoves suitable for burning both coal and wood, but such stoves are usually a compromise design between the different requirements for burning these two fuels. Ranges can be used for cooking, hot water and central heating

Biogas from Kitchen Waste:

Using bio-methanation technology all domestic bio waste including wastewater from the kitchen can be used to produce biogas. Use of domestic waste to produce biogas will help in reducing consumption of cooking fuel and better waste management in the cities. The municipal corporation will also save energy and expenses in collection and disposal of such waste.

The biodegradable waste material and wastewater from the kitchen is fed into the plant through the inlet chamber of the plant. This waste is converted into biogas with the help of a special type of anaerobic bacteria. The main component of the gas produced is methane. The space required for a domestic plant is about one square meter. The portable plant developed by M/s Biotech can be installed in a day depending upon the model of the plant. The gas generated from the waste of a family of 3 -5 members is sufficient to operate for 2 hours per day in a single burner stove. Typical payback period of such plant is about 2 years. The slurry in liquid form can be used as fertilizer.

Biogas from Institutional Waste:

Conversion of bio waste generated in the institutions like hostels, hospitals, hostels, old age-homes, could be a highly attractive way of reducing waste disposal hassle and save fuel for cooking and heating water. At the same time the cooking fuel consumption of these Institutions is also very high. The solid Bio Manure / Organic fertilizer generated from the pre digesters can be utilized as a fertilizer.

Toilet attached Biogas Plant:

Like any other bio waste, human excreta can be treated through biomethanation process to produce biogas. The night soil bas biogas plant can replace the conventional septic tank. Treated slurry coming out

from the plant can be utilized as liquid fertilizer. All other easily biodegradable waste can also be treated together with human excreta in the same plant. Apart from residential apartments, the toilet of the public institutions like hostels, hostels, hospitals etc. can be attached with large sized plants for treating the human wastes for the production of biogas. The size of such plants is determined in accordance with the total number of inmates of these institutions. The treatment plant can be installed either as a single unit or more units in different locations. The installation of a night soil based biogas plant is more feasible during the building construction time.

Research and Development in Solar arena

Development of Solar Industrial Oven using Scheffler Solar Concentrators.

Scheffler solar dish concentrators have become quite popular in India for steam generation applications, especially for cooking in community kitchens. There is ample scope to develop commercial and industrial applications using Scheffler solar dish concentrators as a primary heat source. An arrangement of a pair of Scheffler solar dish concentrators for industrial oven application has been devised inside the body of the oven. Initial test results show that the proposed configuration is capable of providing heat duty of 9 kWth at an operating temperature of 1250 ^{o}C.

Pre-Heated solar pv dryer for farmers and entrepreneurs

PV dryers are very useful in adding values to the agricultural produce but there is an inherent problem of non-uniform heating. Addressing this, a pre-heat multipurpose PV system is being developed with a well-designed air heating tunnel having PV fan and interconnecting fixtures to let the hot air enter in especially designed drying cabinet.

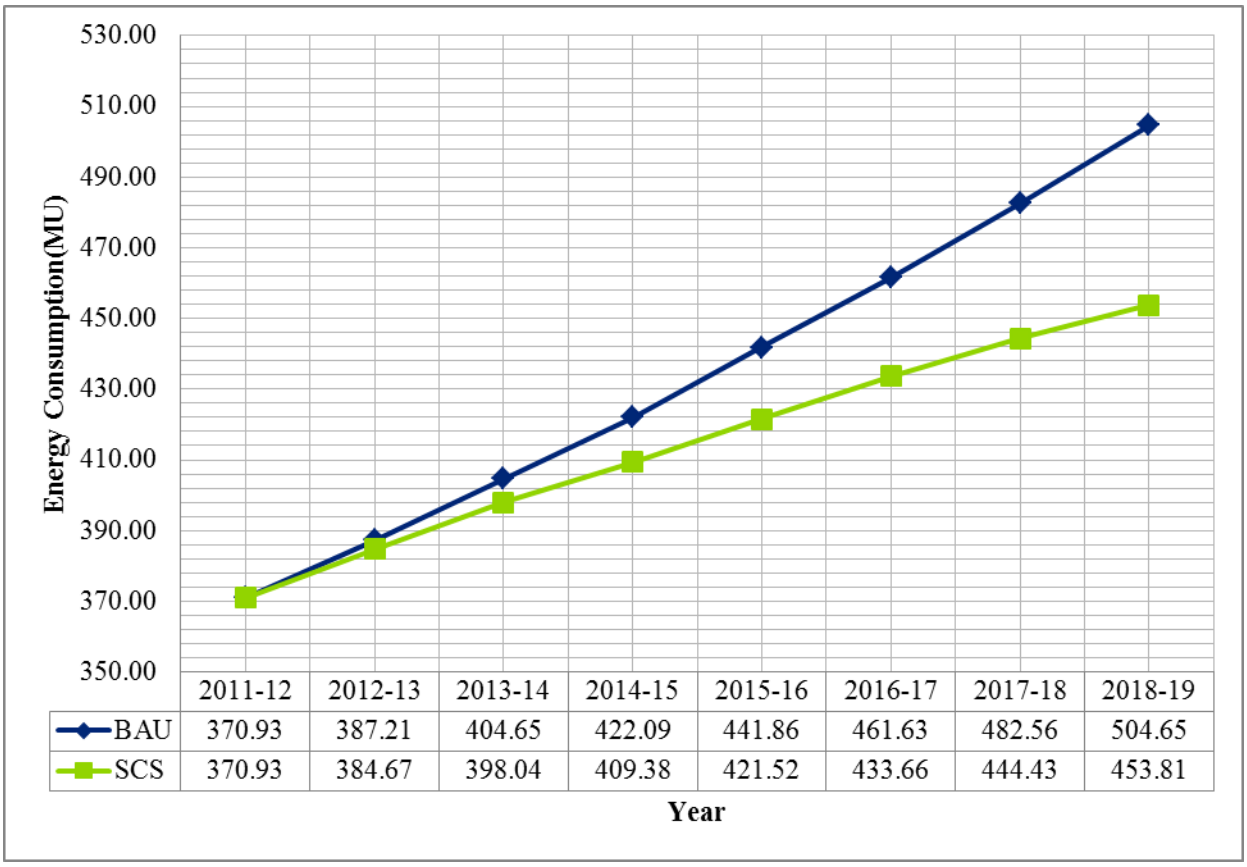
5 YEAR-WISE GOAL OF SAVING

Based on the sector wise strategy for demand side management opportunities and supply side interventions through renewable energy technologies, the following targets are proposed in order to meet the proposed goal which is 10% (Approximately 50000MWh) of the projected demand in Businesses as Usual Scenario(BAU).

Table 26: Year-wise Energy Saving Goal

City	Goal (MWh)	Intervention	Year wise Cumulative Energy Saving Goal in MWh							% of Goal to Meet	GHG Reduction (tCO2e)
			1st Year (2012-13)	2nd Year (2013-14)	3rd Year (2014-15)	4th Year (2015-16)	5th Year (2016-17)	6th Year (2017-18)	7th Year (2018-19)		
Year -Wise Percentage Saving			**5%**	**8%**	**12%**	**15%**	**15%**	**20%**	**25%**		
Shimla	**50491**	Cumulative EE(MWh)	712	1852	3562	5700	7837	10687	14249	**27.00**	**12112**
		EE(MWh)	712	1140	1710	2137	2137	2850	3562		
		Municipal	29	46	69	86	86	115	144		
		Residential	459	735	1102	1378	1378	1837	2296		
		Commercial	116	186	280	349	349	466	582		
		Industrial	23	37	56	69	69	93	116		
		Institutional	85	136	203	254	254	339	424		
		Cumulative RE(MWh)	1830	4757	9148	14637	20126	27444	36593	**73.00**	**31104**
		RE(MWh)	1830	2927	4391	5489	5489	7319	9148		
		Municipal	355.0	568	852	1065	1065	1420	1775		
		Residential	470.0	752	1128	1410	1410	1880	2350		
		Commercial	352.5	564	846	1058	1058	1410	1763		
		Industrial	176.3	282	423	529	529	705	881		
		Institutional	475.9	761	1142	1428	1428	1904	2379		
		Cumulative EE & EE(MWh)	**2542**	**6609**	**12710**	**20337**	**27963**	**38131**	**50842**	**100**	**43215**

Gross energy demand in the year 2018-19 in Business as Usual Scenario would be 504.65 MU but after implementing the recommended measures it would be 453.81MU in Solar City Scenario which is approximately 10% (50MU) less than the BAU.



	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
BAU	370.93	387.21	404.65	422.09	441.86	461.63	482.56	504.65
SCS	370.93	384.67	398.04	409.38	421.52	433.66	444.43	453.81

Chart 46: Overall Energy Consumption Trend in BAU & SCS

6 ACTION PLAN FOR ACHIVING SET GOALS

The action plan for achieving the set goals includes implementation of recommended renewable energy and energy conservation projects across all the sectors. An organizational set-up is given below in the flow chart to implement the suggested projects.

Solar City Cell/ Energy Management Cell: Member of Solar City and Energy management cell shall select the implementable project from each sector and send it to SMC & HIMURJA for approval and budget allocation.

SMC & HIMURJA: SMC & HIMURJA shall jointly assess the techno-economical aspects of the projects. After assessment and approval from SMC/SLNA Solar city cell shall send it to the execution team for next process.

Appointment of Consultant: Project Development /Execution team shall appoint the consultant for feasibility study and DPR preparation.

Contracting: Contract shall be awarded to the project developers and subsequent implementation shall take place.

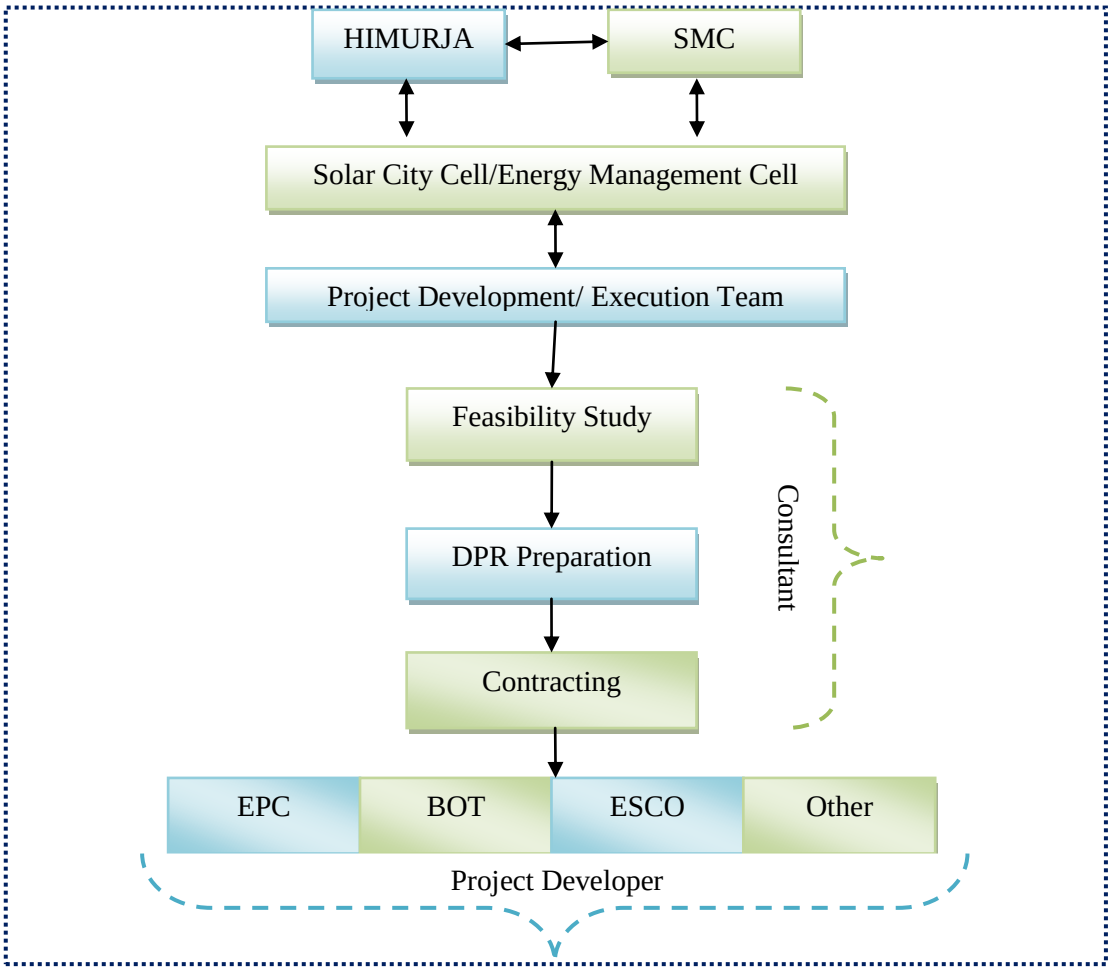


Chart 47 : Action Plan for Implementing the Solar City Projects

6.1 Capacity Building:

While working with SMC to compile the data required for analyzing the energy conservation opportunities, Deloitte recognized that municipal corporations lacked the institutional capacity to maximize the management of their energy use. The municipal corporation did not have an adequate data collection and management system capable of demonstrating where and why energy was being used. The lack of capacity to manage energy use at the city level has led to significant wastage of energy, reducing the level of service and increasing costs. Providing SMC with the expertise such as qualified energy Auditors/ Managers/ to manage energy, identify the potential savings opportunity and implement efficiency actions will improve the energy related services and will lead the city towards sustainable development. Following capacity building measures are suggested to achieve the goals.

Formation of Energy Management Cell (EMC): Establish a separate Energy Management Cell within the Municipal Corporation or SLNA to identify, conceptualize, and implement energy efficiency projects and programme based on periodic analysis of energy-use data.

Computerization of the Database: At present all data available with SMC are in hard copy format and it is very difficult to compile data. There is urgent need to make the system fully computerized for creating, and updating the data base and monitoring and tracking the energy consumption patterns at the city level.

Staff Training: Staff training is required on regular basis addressing various aspects of data management and energy efficiency. At least two training session/workshop is required each year on Energy efficiency / Energy Audit /Data management/ for all the Senior Engineers, Junior Engineers and Municipal Staffs.

6.2 Awareness Generation:

Residential Sector:

- **Seminar /Workshop/Exhibitions:** Annual seminar and workshop focusing upon switch ON/OFF policy, use of energy efficient lamps & BEE star rated home appliances, and solar water heater systems application.

- **Electronic & Print Media:** Advertisement through local TV-Channels and Newspaper mentioning the benefit of SWHS, SPV Home lights and subsidy available on these items will help in creating awareness among common people.

Commercial Sector:

- **Annual Meeting/Workshop:** Hotel Industry is the main commercial activity in Shimla and this sector consumes considerable amount of energy. Organize annual meeting/Workshop with the

Hotel Association and technology provider briefing about the latest technologies available to manage and minimize the energy consumption of the existing and new buildings.

Institutional Sector:

- **Seminar/ Work shop:** Organize annual workshop and seminar at university and college, briefing about the new renewable energy technologies and its long term benefit.

- **Green School Award:** It is suggested that SMC/HIMURJA should jointly launch a green school award. The School which consumes minimum energy per student will be awarded as green school. This will create awareness about importance of energy among students and faculty members.

Aditya Solar Shops in the district of Shimla was established but now has been reported closed. Application to MNRE for establishment of Akshay Urja Shops in the districts of Shimla can again be initiated for awareness generation for the local population as well as tourists visiting the place.

7 BUDGET ESTIMATES AND POTENTIAL SOURCE OF FUNDING

Based on the sector wise proposed project activity to improve the present and projected energy consumption scenario of the city, quantum of investment required for various sectors is estimated for *Solar City Development Plan* over a specified time frame to achieve the mission goals. Gross investment need is approximately 272.50 Crores for next 6-7 years.

The costing provided for the projects is an estimation based on similar kind of projects and vendor interaction with suitable escalation factors in each sector for the implementing period.

Table 27: Sector-wise Investment Need & Possible Source of Funding

Sector	Total Rs. (Crores)	Sources of Funds
Residential	99.84	MNRE/GoHP/HIMURJA/Self Financing
Commercial	62.85	Loan/ Equity Financing
Industrial	15.51	Loan/ Equity Financing
Institutional	85.97	MNRE/GoHP/ Equity Financing
Municipal	8.33	GoHP/ SMC
Gross (Crores)	**272.50**	

Table 28 :Sector-wise Project Cost and Subsidy Detail

Sector	Gross Value (Crores)	MNER/HIMURJA Subsidy(Crores)	Users Contribution (Crores)
Residential	99.84	31.40	68.44
Commercial	62.85	19.48	43.36
Industrial	15.51	4.80	10.71
Institutional	85.97	26.83	59.14
Municipal	8.33	3.63	4.70
Gross Investment	**272.50**	**86.15**	**186.35**

Table 29 : Year- wise Budget Allocation

Year	1st Year (2012-13)	2nd Year (2013-14)	3rd Year (2014-15)	4th Year (2015-16)	5th Year (2016-17)	6th Year (2017-18)	7th Year (2018-19)
Percentage	5%	8%	12%	15%	15%	20%	25%
Gross Investment (Crores)	13.6	21.8	32.7	40.9	40.9	54.5	68.1
Subsidy(Crores)	4.3	6.9	10.3	12.9	12.9	17.2	21.5
User Contribution (Crores)	9.32	14.91	22.36	27.95	27.95	37.27	46.59

The sector wise project cost shows that maximum investment is required in the residential (34 %) sector followed by the institutional (30 %) and commercial (23 %) sector.

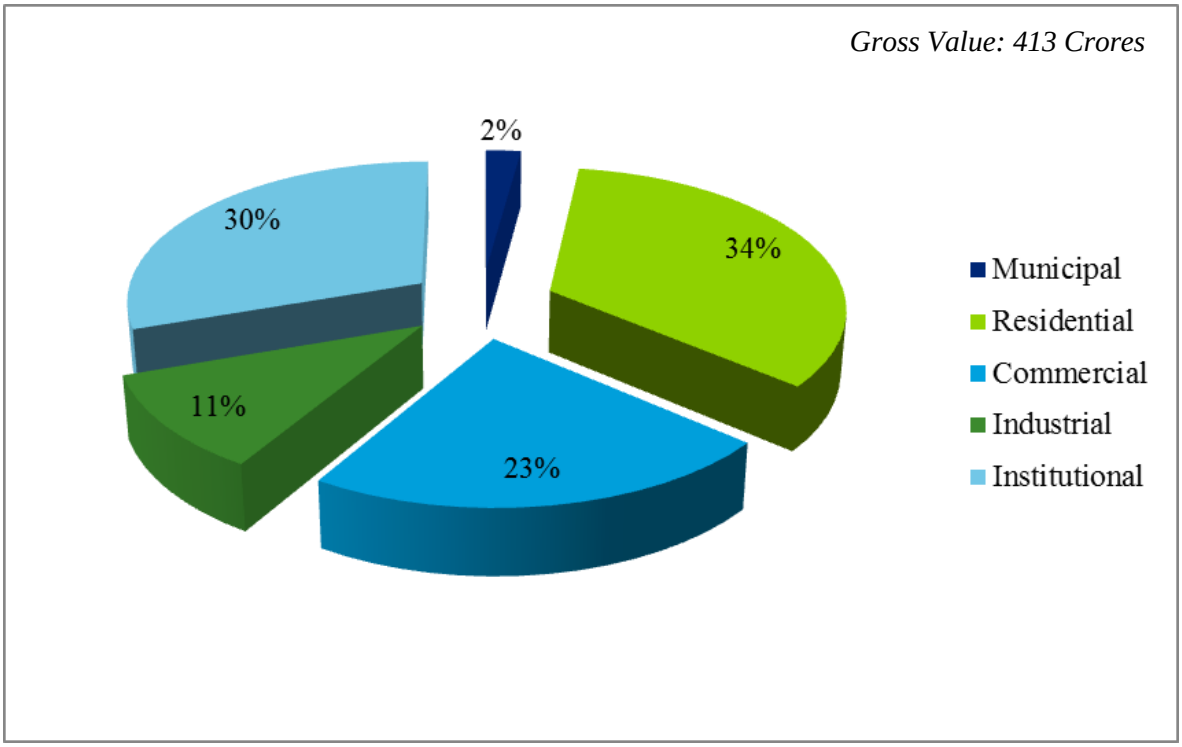


Chart 48 : Sectoral Percentage Contribution to the Gross Budget

Government of India (GoI) launched the Jawaharlal Nehru National Solar Mission (JNNSM) in January 2010.Under the phase I of the JNNSM there are schemes to promote off-grid and decentralized Solar applications. The scheme shall be implemented through multiple channel partners which would be used for its implementation. Channel Partners[6] shall include the following.

- **Renewable Energy Service Providing Companies (RESCOs) :** These are companies which install, own and operate RE systems and provide energy services to consumers.

- **Financial institutions including microfinance institutions acting as aggregators:** These are the Institutions which are involved in consumer finance and ave established base of customers in rural/urban areas and outreach through self- help groups etc. They can avail credit linked capital subsidy on behalf of their borrowers from IREDA.

- **Financial Integrators:** These are entities which may integrate different sources of finance including carbonfinance, government assistance and other sources of funds to design financial products/instruments and make these available to their clients at an affordable cost. These entities would tie up with manufacturers and service providers.

[6] List of channel partners accredited by MNRE for Off-Grid and Decentralized Solar Applications under JNNSM as on 25.07.2012 can be accessed through the following link :
http://mnre.gov.in/file-manager/UserFiles/list_channelpartners_st_jnnsm.pdf

- **System Integrators:** These are the companies which would provide RE systems & services to clients including design, supply, integration, and installation, O&M and other services.

- **Programme Administrators:** These include State and Central Government bodies, departments, State Nodal Agencies, NGOs etc. These entities would directly implement the scheme and access capital subsidy from MNRE

8 PILOT PROJECT IDENTIFICATION

8.1 Pilot Project No.-1

Project Title	Upgradation of Street lighting system
Project Description:	Replacement of existing energy intensive lighting system/lamps by the energy efficient lamps and installation of Solar street lighting systems. • *Replacement of T-12(40W) by T-5(28W)* • *Replacement of HPSV/HML(150W-450W) by LED(70W-150W)* • *Installation of Solar Street Lighting System(75W)*
Project Cost :	• *180 Lakh*
Implementation Framework:	ESCO & Service Contract
Financing Mechanism :	Capital cost will be financed by the implementing ESCO which would be recovered by the energy saving. O&M cost will also to be borne by ESCO.
Institutional Responsibility:	SMC

8.2 Pilot Project No.-2

Project Title	10 kWp Captive Solar PV Plant at Municipal office Building
Project Description:	A 10 kWp captive solar PV power plant installation at municipal office building. Electricity generated by the plant will be used by the municipal building itself. • *Technology:* SPV(Thin Film/Crystalline Silicon) • *Panel Size*:1.60m*0.80m • *No. of SPV Panels:* 60 • *Area Required:*70-75 Sq.m • *Power Generation* :20-25 MWh(Annually Commissioning)
Project Cost :	• *Total Cost:25*-30 Lakh • *MNRE Subsidy*:22-27 Lakh(905 of the Project Cost) • *Cost to the Developer:*3-4Lakh
Implementation Framework	EPC & O&M Contract
Financing Mechanism :	Capital cost to be financed by SMC using funds to rise through grant under Solar City Project (MNRE) and loan from different renewable

	energy project financing institution such as IREDA
Institutional Responsibility:	SMC/HIMURJA

8.3 Pilot Project No.-3

Project Title	20-25 kWp Grid-Connected Solar PV Plant at Ridge.
Project Description:	A 20-25 kWp grid-connected/off grid solar PV power plant installation at Ridge. • *Technology:* Concentrating Photovoltaic (CPV) • *Panel Size*:1.60m*0.80m • *No. of SPV Panels:* 120 • *Area Required:*150-175 Sq.m • *Power Generation* :45-55 MWh(Annually After Commissioning))
Project Cost :	• *Total Cost:*60-75 Lakh • *MNRE Subsidy*:50-60 Lakh(90% of the Project Cost) • *Cost to the Developer:*10-15Lakh
Implementation Framework	EPC & O&M Contract
Financing Mechanism :	Capital cost to be financed by SMC using funds to rise through grant under Solar City Project (MNRE) and loan from different renewable energy project financing institution such as IREDA
Institutional Responsibility:	SMC/HIMURJA

8.4 Pilot Project No.-4

Project Title	0.60 MW Captive/Grid-Connected Power Plant at STP.
Project Description:	Methane Recovery form the STP and Installation of 0.50-1MW power plant for captive use or Grid-connected *Power Generation* :1800-3600 MWh(Annually After Commissioning)
Project Cost :	• *Total Cost:6*-8 Corers • *MNRE Subsidy*: 1 to 2 Corers • *Cost to the Developer:* 5 to 7 Crores
EXPECTED CDM	•
Implementation Framework:	EPC & O&M Contract
Financing Mechanism :	Capital cost to be financed by SMC/ I& PH/GoHP using funds to rise through grant under Solar City Project (MNRE) and loan from

	different renewable energy project financing institution such as IREDA.
Institutional Responsibility:	SMC/I& PH

8.5 Pilot Project No.-5

Project Title	Community Solar Cooking System (Indoor cooking)
Project Description:	Installation of Scheffler Reflector-Dish Solar Cooking System for Boys and Girls Hostel at HP University. • *Technology:* Elliptical dish shape known as Scheffler reflector. Dish made of multiple pieces of reflecting mirrors • *Area Required per Dish :* 7.0 - 9.5 Sq.m • *Temperature attained :* up to 250 °C • *Cooking per Dish* : 50 Persons • *Expected Life:* 15 years. Reflecting mirrors may require early replacement. • *Other Material requirement:* Frame & support structure, tracking mechanism, Secondary Reflector.
Project Cost :	• *Total Cost:10-12 Lakhs* • *MNRE Subsidy*: 60 % of the Capital Cost • *Cost to the Developer:* 4 -5 Lakhs • *Payback period: 4-5 years*
Implementation Framework:	Installed and commissioned by the supplier.
Financing Mechanism :	Capital cost to be financed by SMC/University using funds to rise through grant under Solar City Project (MNRE) and loan from different renewable energy project financing institution such as IREDA.
Institutional Responsibility:	SMC/HP University

9 ANNEXURE

Annexure 1: List of Manufacturers and Dealers

List of Manufacturers and Dealers Solar PV

1) M/s Maharishi Solar Technology Pvt. Ltd.

M/s. Maharishi Solar Technology Pvt. Ltd

A- 14, Mohan Cooprative Industrial Estate,

Mathura Road, New Delhi-110044

Phone No. 011-40909090 / 40909091 Fax: 011-26959669

Contact Person of the company for any type of customer grievance related to dealer with contact details: Mr. S. Mehmood Hasan

Regional Manager Marketing

Mob. No. -9711494906

E-mail : hasan@maharishisolar.com

Sr No.	District	Name and Address of Dealer/service center	Contact Person	Phone
i.	Kangra	M/s HIM POLES & LIGHTS S-1 Phase-3 IND Area Sansar Pur Terrace Distt. Kangra Himachal Pradesh	Mr. Sanjeev Sharma	9350250251
ii.	Taliwal	M/s. Hrinyagarbha Solar Energy Pvt. Ltd. Plot No. 62, Phase – III, Taliwal, Himachal Pradesh.	Mr. Y. K. Malhotra	9810198770

2) TATA BP Solar Pvt Ltd.

Sr No.	District	Name and Address of Dealer/service center	Contact Person	Phone
i.	Mandi, Kangra, Kullu, Hamirpur, Una, Bilaspur, Chamba & Shimla	Vatsalayam Enterprises 8-Mann House, Elysium Hill Shankli, Shimla-3	Ashish Sharda	9816077699

3) Gautam Polymers

Gautam Polymers,114/6A,IIE Ranipur,

SIDCUL, Haridwar-249403, 01334-239101

Contact Person of the company for any type of customer grievance related to dealer with contact details –

Ms Shubhra Mohanka- 9310241987

i.	Shimla	Treadecom Distributions, New Shimla, HP	Mr.Bansal	9816389871

4) Kotak Urja Pvt. Ltd.

i.	Palanpur	Ahluwalia Solars		

5) Ritika Systems Pvt. Ltd.

M/s Ritika Systems Pvt. Ltd. C-22/18,

Sector – 57, NOIDA – 201301, U. P.

Contact Person of the company for any type of customer grievance related to dealer with contact details : - Mrs. Krishna Dogra – 0120 – 2586610				
i.	Mandi, Kullu, Solan, Shimla, Kangra	Inter Solar Systems Pvt. Ltd., 901 Industrial Area, Phase - II Chandigarh	Mr. Devinder Kaushal	9814004139
ii.	All Districts	Him Akshay Urja Shop - Main Road, Kotwali Bazar, Dharamshala, Himachal Pradesh	Dr. Anjan K Kalia	9418225569
iii.	Kangra, Mandi, Shimla, Solan, Dharamshala	Hi Tech Enterprises, Guruduwara Road, Dharamshala, H. P.	Mr. Pankaj Dhawan	9418093400
6) Su Solartech Systems (P) Ltd., Phone : 0172-2792699 SCO-184, Sector 7-C, Tele fax : 0172-2792576 Chandigarh-160019 (India) Email : info@susolartech.com				
i.	Mandi	RB Sales Corporation NH-21, Old Bus Stand, Bhojpur, Sunder Nagar	Rakesh Bhardwaj	098161-33667, 9318715802
7) Gautam Polymers Polymers,114/6A,IIE Ranipur, SIDCUL, Haridwar-249403, 01334-239101 Ms Shubhra Mohanka- 9310241987				
i.	Shimla	Treadecom Distributions, New Shimla, HP	Mr.Bansal	9816389871

List of Manufacturers of Evacuated Tube Collector (ETC) Based Solar Water Heating Systems

Sr No	Manufacturer/ Supplier	Contact Details	Type of ETC	Major Specifications		Date of Validity
				Length (mm)	Outer inner tube Dia (mm)	
i.	**M/s Pure Solar Pvt. Ltd.** C/o PA-Times, Kasauli-Dharampur Rd, Distt.Solan, Tehsil-Kasauli,	Tel: 01792-264177, 264033, 264750 Mob: 09816064750: E-Mail:puresolarindia@yahoo.in	Water-in-glass	1500	47/37	31-03-2013

List of Flat Plate Collector (FPC) Based Solar Water Heating Systems

CML No	Name and address	Validity	specification
9902590	Nex-Gen Solar Systems, VPO Sudher	18/12/2012	Solar flat plate collector, size

	18/12/2012 Operative (Dharamsala) Tehsil Dharamsala City : Dharamsala Dist : Kangra State : Himachal Pradesh Pin : 176215		Length 1860 mm, Width 1240 mm, Height 100 mm
9824697	Plaza Power & Infrastructure Co., 923/56, Village2 0/10/2012 Operative Katha, Baddi Dist : Solan State : Himachal Pradesh Pin : 173205	2 0/10/2012	Solar flat plate collector for water heating Size: Length-2034 mm, Width-1030 mm, Height-100

Manufacturers of Box-type Solar cooker

Sl. No.	Name & Address of Manufacturer	Contact Details
1	M/S Universal Engineers Enterprises Garg Bhavan, Prince Road Gandhi Nagar, Moradabad (U.P.)	0591-2493619 (Telefax) : 0591-2499768
2	M/s Rural Engineering School , Rojmal, Tal.: Gadhada (SN) District Bhavnagar-364750, Gujarat	Tel : 02847 ?294127 Fax: 02847 253535 e-mail: ruralschool@rediffmail.com
3	Khadi Gramodhyog Prayog Samiti Gandhi Ashram, Ahmedabad-380 027	Telefax: 079-27552469 Mobile : 9825484275, 9879784255

Manufacturers making all type of dish cookers (Small, medium & large including indoor cooking)

Sr. No	Name and address	Phone, fax, E-mail
1	M/s Sharada Inventions 94/1, MIDC Satpur Nashik-422007	Tel : 0253 2352444 Mobile: 09822018810 (Mr.Kapadia, MD) Fax : 0253-2336014 E-mail : suresh.kapadia@gmail.com Website: www.sharadainventions.com
2	Fabrako Engineers E-6 Industrial Area -2 Rae Bareli-229001 (U P)	Tel :0535-2217089 Mobile:9911099459 E-Mail: rajivfabrako@yahoo.In
3	M/s Unisun Technologies (P) Ltd. 7, Ist Floor, Kodava Samaja Building, Ist Main Road, Vasanthanagar, Bangalore - 560 052.	Ph: 91 80 22289663, 22355239 Mobile: 09880022272 (Mr. Shivanand Nashi), Fax: 91 80 22289294 E-mail: unisun@vsnl.com Web: www.unisun.net
4	energy 5, Haider Building, Outside Sojati gate Jodhpur, Rajasthan -342001	Telefax. : 0291- 2630432, 2639045 Mobile: 09829022899 (Mr. Sanjeev Kachhwaha) E-mail : kachhwaha@yahoo.com
5	Aadhunik Global Energy Tinytech Plants Tagore Road Rajkot 360002	Phones : 91 281 248 0166 (Office) 91 92 27 60 65 70 (Mobile) Email : Energy@Tinytechindia.Com Tinytech@Tinytechindia.Com Web : Www.Tinytechindia.Com
	Manufacturers making small dish only	
1	M/s Rajkamal Enterprises, Plot no. C-58, Lane No.3, MIDC, Awadhan:424311, Dhule	Mobile 9822510702
2	Manik solar innovation, Adda Bastian Road, Near Raja Hospital, Jalandhar City: 144008, Punjab	Mobile : 9872919566, 9814503153 E-mail : manikinnovation@gmail.com
3	Rudra Solar Energy, H-2, Swamisharan Complex, Near Ramwadi, Isanpur, Ahmedabad: 382443 , Gujarat.	Mobile: 9327962332, 9429446671 E-mail : sales@rudrasolarenergy.com

4	Non-Conventional Energy Technologies, Industrial Estate, Leh	Mobile: 7298689505, 9419178046 E-mail : ncet@bigfoot.com
5	Safe Environmental Energy Devices & Systems 204-A, GG-1, Vikas Puri, New Delhi-110018	Mobile: 9810665076

List of known Manufacturers/suppliers/institutions involved in Installation of flat plate collector based Solar Driers/Air Heating Systems

Sr. No	Name & Address	Phone/Fax/ e-mail etc
1	M/S Planters Energy Network (PEN) No. 5, Powerhouse Street N.R.T. Nagar Theni-625531, Tamilnadu	Phone: 04546-255272/ 255271 Telefax: 04546-255271 E-Mail : pen01@sify.com , & mdu_pen@sancharnet.in
2	M/S NRG Technologies 989/6, GIDC Estate, Makarpura, Vadodara-390010	Phone & Fax: 0265-2642094 E.Mail : nrgtechnologists@yahoo.com
3	M/S Kotak Urja Pvt.Ltd. No. 378, 10th Cross, 4th Phase Peenya Industrial Estate, Bangalore -560 058.	Tel. (080) 23560456-7; Fax : 23562233 E-Mail : kotakurja@vsnl.com
4	Director Sardar Patel Renewable Energy Research Institute, Post Box No. 2, Vallabh Vidyanagar-388120, Gujarat	Ph.: 02692-231332/ 35011, Fax: 02692-37982 E-mail : director@spreri.org
5	M/S ATR Solar , #1,RMR Complex, 2nd Floor, SS Colony, North Gate, (opp. Devaki Scans) Madurai-625010	Tel: 0452-3025400 Mobile: 9344453444, 9843265400. Email: atrsolar@gmail.com Web: www.atrsolar.com
6	M/S STEELHACKS INDUSTRIES , 525-526, G.I.D.C., Vithal Udyognagar 388121, Dist. Anand. Gujarat. (INDIA)	Tel: 91-2692236156,235518 Fax : 912692236534 Email: info@unisolar.com, unisol26@gmail.com Web:www.unisolar.com
7	KN IYER Managing Director “Akshya Vikas” Convention 29/2862, Near Gandhi Square Poonithura P.O., Cochin – 682 038	Ph.: 0484-2707228, 2707339 Mob: 91-9847113501 Email: info@kraftworksolar.com, kraftworksolar@hotmail.com Web: kraftworksolar.com

List of the manufacturers of approved Domestic Portable Biomass Cookstove Models

Sr. No	Name & Address	Models
1	Shri Vikram S. Kale, Proprietor, Vikram Stoves & Fabricators Plot No. A-37 MIDC, Osmanabad-413501. Telefax : 02472 228401. (M) 09422465477 vikramskale@rediffmail.com	Vikram Biomass Chulha
2	M/S UNICUS ENGINEERING PRIVATE LIMITED Regd. office ; 23, madhusudan Nagar Unit - IV, Bhubaneswar, Pin :- 751001 Factory Office : 178/5535, Chakeisihani, Mancheswar, Bhubaneswar, PIN :- 751010 (M) 09439556490, 09861794100 nursingha06@yahoo.co.in	Harsha (CSIR,IMMT Design)
3	Ms. Neha Juneja Co-founder, Greenway Grameen Infra Pvt Ltd, 301, Chawla Complex, Sector 15, CBD Belapur, Navi Mumbai 400614 Tel: 91-22-41239169, (M) 91-9930751591 www.grameeninfra.com	Greenway Smart Stove (For light cooking – 2-3 persons)
4	M/s Ravi Engineering & Chemical Works Plot No.55, Sector-24, Pocket-28 3rd Floor, Rohini New Delhi-110085. 27932786, (M) 9911773887 www.firenzel.com contact@firenzel.com	Firenzel Stove (For light cooking – 2-3 persons)
	Forced Draft Cookstove	
5	Shri Mahesh Yagnaraman, Managing Director, First Energy Pvt. Ltd., B 101, Signet Corner Building, Baner Road, Baner, Pune – 411045(Fax:020-67210444) 91-20-67210500 yagnaramans@gmail.com	Oorja Model (IISc. Bangalore Design)

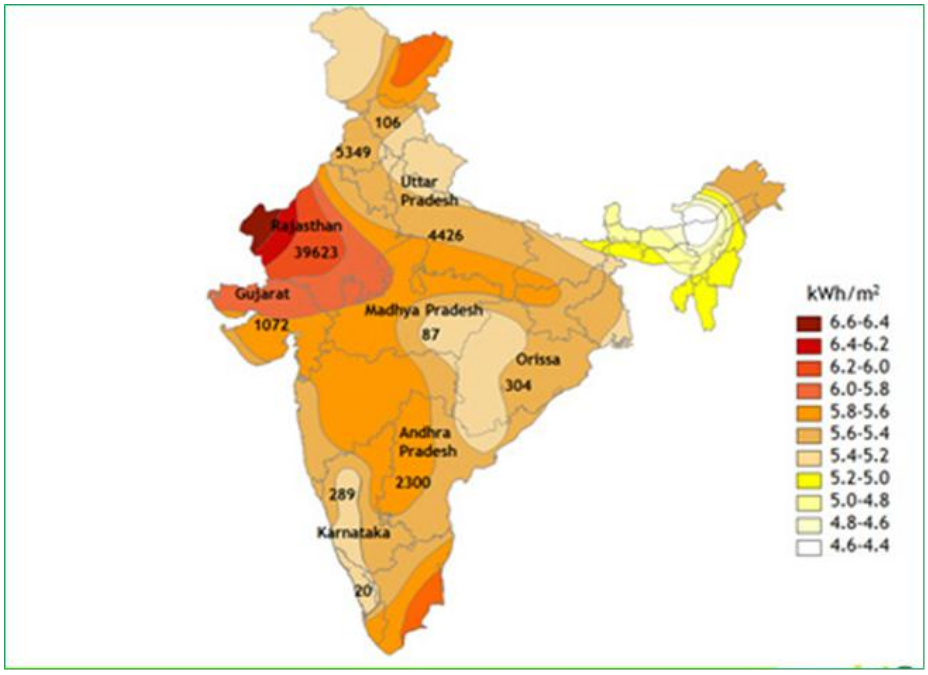
Annexure 2: Detail of Street Lights/Lamps

Type of Lamp	Number of Fixture	Wattage
FTL 1x4 ft (T-12)	3501	40
FTL 1x2ft(T-12)	501	20
MVL	915	125
MVL	498	250
SVL	116	150
SVL	455	250
T-8	155	NA
T-5	630	24
CFL	38	22
CFL	7	18
Halogen	4	1000
Flood Light(SVL)	4	250
High Mast Light	9	NA
Laser Light	3	NA
LED	342	70

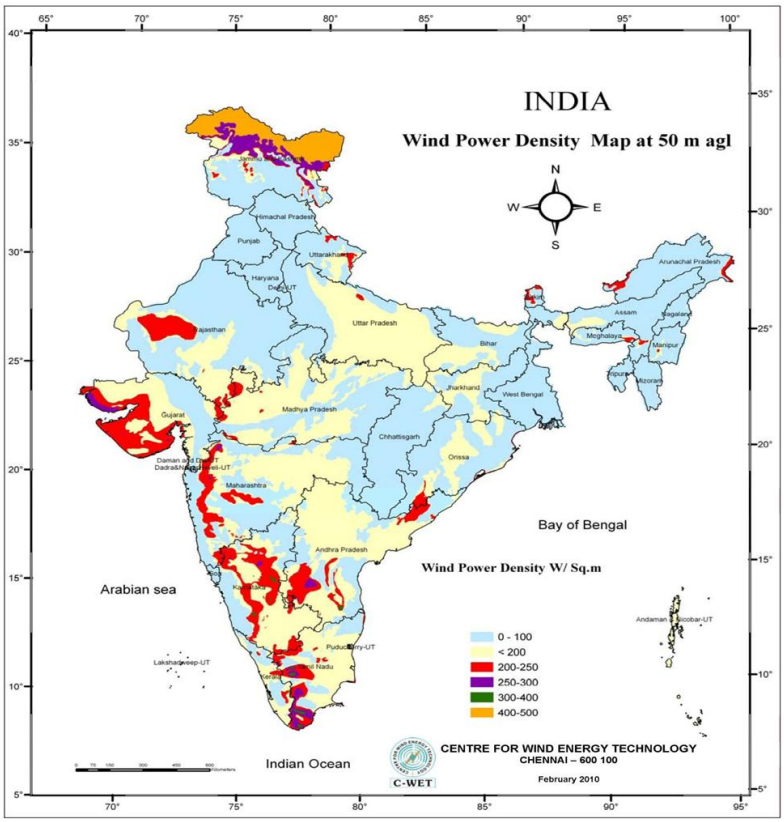
Annexure 3: Detail of Municipal Pumps

Name	Make	BHP	Kw	Total Head	Discharge(Lit/h)	Stage	RPM	Suction Dia	Delivery Dia
Shimla Club	NGEF(M),	75	55	NA	NA	NA	2920	6"(-ve)	3"
Mashorba Pump House	NGEF(M),KSB(P)	20	15	264	8000	2-Stage	2900	3"(-ve)	2.5"
Dhingoo (No.of Pumps -3)	Crompton(M)Kirlosker(P)	40	30	173	30636	6-Stage	2948	2"(-ve)	2"
	NGEF(M) Kirlosker(P)	40	22	173	27000	6-Stage	2900		
	Kirlosker(M,P)	40	30	170	34489	6-Stage	2900	4"(-ve)	3"
North Oak Pump House	Kirlosker(M,)DB(P)	30	22	91	65160	1-Stage	2900	3"(+ve)	2"
Snow Down Pump House(JakhuTemple)	Kirlosker(M)KSB(P)	75	55	250	45500	6-Stage	2900	3"(-ve)	3"
	BTS(M)KSB(P)	45	35	290	27250	10-Stage	2900	3"(-ve)	3"
	NGEF(M)Kirlosker(P)	75	55	247	44640	11-Stage	2920	3"(-ve)	3"
Boileuganj Pump House	KSB(P)Crompton(M)	30	22	123	33100	NA	2900	NA	NA

Annexure 4: Solar Insulation Map of India



Annexure 5: Wind Potential Map of India



Annexure 6: Support Programme for SPV System by HIMURJA

Programme/ Item	Type of Users	Subsidy
SPV Home Lighting Systems.	For State Utilities/Govt. Organization	90% of the cost
	For Private Sector	30% of the cost
SPV Street Lighting Systems	For State Utilities/Govt. Organization	90% of the cost
	For Private Sector	30% of the cost
Dish / Community Type Solar Cookers:	All Users	*60% of the cost*
SPV Standalone/Grid Connected Power plant	For State Utilities/Govt. Organization	90% of the cost or -Rs.243/watt(with battery back-up), -Rs.171/watt(without battery back-up)
	For Private Sector	30% of the cost or Rs.81/watt(with battery back-up), 57/watt(without battery back-up)

Source: HIMURJA

Annexure 6: Subsidy on Solar Water Heating Systems by HIMURJA

Flat Plate Collector's (FPC's)

Sr. No.	Capacity	Type	Rate in Rs.	Subsidy	Net in Rs.
1	100 LPD	i) With HE	30,895.00	13,200.00	17,695.00
		ii) Without HE	26,820.00	13,200.00	13,620.00
2	200 LPD	i) With HE	53,160.00	26,400.00	26,760.00
		ii) Without HE	---	----	----
3	500 LPD	i) With HE	94,839.00	56,903.00	37,936.00
		ii) Without HE	91,689.00	55,013.00	36,676.00
4	1000 LPD	i) With HE	2,19,780.00	1,31,858.00	87,912.00
		ii) Without HE	----	----	----
5	2000 LPD	i) With HE	3,87,300.00	2,32,380.00	1,54,920.00
		ii) Without HE	3,51,300.00	2,10,780.00	1,40,520.00

Evacuated Tube Collector's (FPC's)

Sr. No.	Capacity	Rate in Rs.	Subsidy	Net in Rs.
1	100 LPD	18,614.00	9,000.00	9,614.00
2	200 LPD	31,828.00	18,000.00	13,828.00
3	500 LPD	69,529.00	41,717.00	27.812.00
4	1000 LPD	1,12,370.00	67,422.00	44,948.00

5	2000 LPD	1,90,656.00	1,14,394.00	76,262.00

Annexure: 8 Conversion Factors for Different Type of Fuel to Oil Equivalent

S. No.	Energy Type/year	Units	Conversion Factor(tOe)
1	Electricity	MWh	0.086
2	LPG	MT	1.13
3	LNG/PNG	smc	0.0009
5	CNG	Tones	1.06
6	Kerosene	Kiloliters	0.85
7	Petrol	Kiloliters	0.78
8	Diesel	Kiloliters	0.86
9	Furnace Oil	Kiloliters	0.91
10	Coal(Lignite)	Tones	0.33
13	Fire Wood/Biomass	Tones	0.35-0.38
15	Cow dung cake	Tones	0.31
16	Biogas	Tones	0.50

Annexure: 9 Details of Slum Packets in the Shimla

S.N.	Name of the Locality	Ward No.	Shed/houses in slum area	Population
1.	Below Shankli Road near five house line Lakkar Bazar Shimla	2	30	180
2.	Ruldu Bhatta Near M C Line building Shimla	2	25	150
3.	Near Masjid Building Below Lakkar Bazar, Shimla	2	50	300
4.	On the Valley Side of Cart Road below Lakkar Bazar Bus Stand Shimla	2	50	300
5.	Below Cart Road Lakkar Bazar Bus Stand Shimla	2	20	120
6.	Kot-Hill below P & T Colony Lakkar Bazar Shimla	2	30	180
7.	Near Dill Shant Estate, Bharari Road Shimla	1	33	210
8.	On the hill Side of Cart Road IGMC	1	16	96
9.	Near Govt, Degree Boys College below cart road, Sanjauli	24	8	48
10.	Tibetan Colony opposite Bus Stand Sanjauli	24	55	330
11.	Engine Ghar Near Chotta Masjid Gurudwara Road, Sanjauli	22	30	180
12.	Bangla Colony Engine Ghar Sanjauli	22	70	420

13.	On the hill side petrol pump, Nav Bahar Shimla	-	35	210
14.	On the valley side of Chhota Shimla Sanjauli Road between HP Secretariat. & Petrol Pump	21	25	150
15.	Below Tibetan Scholl Chhota Shimla	21	20	120
16.	Near Gorkhu Lodge Kasumpti Shimla	21	35	210
17.	Below Pantha Ghati Bus Stoppage Shimla	21	50	330
18.	Kasumpti Main Bazar Shimla	21	100	600
19.	On the up hill side of bye road near Kinlog towards Khalini	19	20	120
20.	On the Valley side of bye pass road near the proposed landfill site (opposite cremation ground)	19	30	180
21.	On the up hill side of the bye pass road near HP State Forest Co-op. Sales Dept.	19	50	300
22.	Near Ram Nagar Dhobi Ghat below Rippon building Shimla	10	15	90
23.	Opposite Govt. Primary School Ram Nagar below bye pass road Lal Pani	10	40	240
24.	Below Labour Hostel Lal Pani Shimla	11	50	300
25.	At Darni-ka-Bagicha below bye pass road Lal Pani, Shimla	11	35	210
26.	Near Bal Ram Niwas Sant Albance Cottage Lal Pani Shimla	11	35	210
27.	Near Portmore School Chhota Shimla between Cart road and Mall Road	11	55	330
28.	Dingu Dhar, Sanjauli Shimla	23	27	162
29.	Maha Himalayan Colony Below Bus Stand Phagli Road Shimla	10	30	180
30.	Vishal Kushat Asharam Below bus stand Shimla	10	35	210
31.	Behind Lal Khoti Phagli Shimla	10	40	240
32.	Tuti Kandi Anath Ashram Shimla	8	10	60
33.	Below the bye pass road it is between the Tuti Kandi. Where is meets the Kalka Shimla Road and near to it is a small temple. Tuti Kandi	8	18	108
34.	Near 35 block, Nabha, Shimla	9	20	120
35.	Near Mandir, Nabha	9	30	180
36.	Below Block No. 29, Nabha Shimla	9	10	60

37.	Dhobi Ghat Anadle, Shimla	4	45	270
38.	Below kandhari Niwas on the Police Line Road Kithu	4	60	360
39.	Near MC Building Police Line Kaithu	4	70	420
40.	Lalbagh, Near Tara Hall, Kaithu	3	35	210
41.	On the valley side of the road bifurcating from near Ganga Hotel to Police Line	3	35	210
42.	MD Line Near Bilaspur House Near Railway Station Summer Hill Shimla	6	30	180
43.	MC Line Near Pashu, Boileauganj Shimla	7	11	66
44.	Below Old barrier Boileauganj Shimla	7	40	240
45.	On the Hill side of the Kalka Shimla Road near Petrol pump barrier Shimla	7	9	54
46.	On the valley side bye pass road between Tuti Kandi and AG colony Phagli	8	15	90
47.	On the valley side of the hill near RTO office	8	50	300
48.	Near Govt, Primary School Cholaunity Sanjauli	24	30	180
49.	Satawer Hill near Jakhoo Mandir	16	20	120
50.	Krishna Nagar Shimla	11	100	600

Annexure: 10 Hospitals in Shimla (Urban)

Hospitals in Shimla(Urban)			
Sr.No	**Name of the Health Institution**	**Governed By**	**Number of Beds**
1	DDU Hospital, Shimla	Government	300*
2	Indira Gandhi Hospital, Shimla	Government	626
3	Kamla Nehru Hospital, Shimla	Government	114*
4	Radiotherapy Unit, IGMC, Shimla	Government	35
5	Isolation Hospital, Shimla	Government	6
6	Military Hospital, Shimla	Board	40
7	Sanatorium Hospital, Shimla	Private/Mission	60
8	Indus Hospital, Shimla	Private/Mission	100
9	Tara Hospital, Shimla	Private/Mission	20
10	Primary Health Centre, Anadel	Government	-
11	Civil Dispensary, Chhota-Shimla	Government	-
12	Civil Dispensary, Dhar-Phagli	Government	-
13	Civil Dispensary, Sanjauli	Government	-
14	Civil Dispensary, HP Secretariat, Shimla	Government	-
15	Civil Dispensary, Jakhu	Government	-
16	Civil Dispensary, HP Vidhan Sabha, Shimla	Government	-
17	Civil Dispensary, HP High Court, Shimla-	Government	-
18	Civil Dispensary, Shogi (Ripon)(ESI)	Government	
19	Civil Dispensary, Kait	Private/Mission	0
20	Railway Dispensary, Shimla	Private/Mission	2
21	HP University Dispensary	Private/Mission	0
22	Indian Institute of Advance Study	Private/Mission	0
23	Shriram Hospital	Private/Mission	25

Source: Directorate of health services HP

Annexure: 11 College/Institutes in Shimla

S.No	Name of the Institute
1	Indian Institute of Advance Study
2	Himachal Pradesh University, Summer Hill, Shimla
3	Indira Gandhi Medical College, Shimla
4	Govt. Dental College, Shimla
5	HP University - Institute of Information Technology, Shimla
6	Government Degree College, Sanjaulli, Shimla
7	Rajkiya Kanya Mahavidyalaya (RKMV), Shimla
8	Govt. College, Chaura Maidan (Shimla)
9	Bells Institute of Management & Technology, Knowledge City, Mehli, Shimla-9
10	ITI(W) Shimla
11	ITI Shimla,
12	Agricultural Technology Management Agency, Krishi Bhawan Complex, Boileauganj, Shimla
13	St. Bede's College Shimla
14	Central Potato Research Institute

Source: http://himachal.nic.in/educ/welcome.htm

Annexure: 12 Details of Hostel in Himachal University

Boys Hostels		Girls Hostels	
Name of The Hostel	**Boarders Residing**	**Name of The Hostel**	**Boarders Residing**
New boys Hostel-I	80	Rani Laxmi Bai Girls Hostel	183
New boys Hostel-II	80	Gargi Girls Hostel	154
New boys Hostel-III	80	Mnaikaran Girls Hostel	61
Dr. Y.S. Parmar Hostel	160	Renuka Girls Hostel	215
Tagore Boys Hostel	148	Chanderbhaga Girls Hostel	102
Shrikhand Boys Hostel	75	Saraswati Girls Hostel	243
Saheed Bhagat Singh Tribal Boys Hostel	210	ICDEOL Transit Hostel	172
Total No. of Students	**833**	Total No. of Students	**1130**