Green Growth Background Paper

Draft Final Report

Green Growth and Buildings Sector: Himachal Pradesh

Prepared for

Department of Environment, Science and Technology
Government of Himachal Pradesh

Supported by

Global Green Growth Institute

The Energy and Resources Institute

...towards global sustainable development

Suggested format for citation

T E R I. 2015.
Green Growth and Buildings Sector: Himachal Pradesh.
New Delhi: The Energy and Resources Institute. 38 pp.

Author

Hina Zia, Fellow, TERI; Email

Email: hzia@teri.res.in

Charu Sharma, Research Associate, TERI

Email: charu.sharma@teri.res.in

Reviewer

Mili Majumdar, Director, TERI

Email: milim@teri.res.in

For more information

Project Monitoring Cell
T E R I
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003
India

Tel. 2468 2100 or 2468 2111
E-mail pmc@teri.res.in
Fax 2468 2144 or 2468 2145
Web www.teriin.org
India +91 • Delhi (0)11

Table of contents

Contents

1. Introduction 1

2. Overview of Building Sector 3

2.1 Urbanisation trends and Projected Demand for Real Estate Space 5

2.2 Electricity consumption in the Buildings sector 8

2.3 Per capita water supply and water savings potential 10

2.4 Earthquake vulnerability and slope stability 11

2.5 Impacts of climate change and built environment 12

3. Institutional Framework 12

3.1 Urban Development Department 13

3.2 Department of Environment, Science and Technology 13

3.3 Directorate of Energy 13

3.4 Department of Town and Country Planning 13

3.5 State Centre on Climate Change 14

3.6 Himachal Pradesh Housing and Urban development Authority (HIMUDA) 14

3.7 Himachal Pradesh Energy Development Agency (Himurja) 14

3.8 Public Works Department 15

3.9 Department of Planning 15

3.10 Local Governments 15

3.11 Developers 15

3.12 Electricity Utilities 16

3.13 Financing Institutions 16

4. Polices and Interventions Relevant to Green Growth 16

4.1 Energy Conservation Building Code 17

4.2 Development of Solar Cities programs, Ministry of New and Renewable Energy 17

4.3 Interventions on Rainwater harvesting (storage and recharge), storm water management through Sustainable Urban Drainage Systems (SUDS), integration of biodiversity with built-up area 17

5 Barriers in greening the building sector 25

6. Ways forward 26

7. References 29

Annexure 1 Vernacular techniques in different regions of the State 31

Annexure 2: Case Studies 38

List of Tables

Table 1 Level of Urbanisation in 2026 5
Table 2 Per capita availability of water in various towns 10
Table 3 Review of key policy/ programs/ guidelines, Himachal Pradesh 19
Table 4 Review of development plans of the state with respect to sustainability 25
Table 5 Vernacular techniques in different regions of the State 31

List of Figures

Figure 1 Political map of Himachal Pradesh 1
Figure 2 Vulnerability Index Map-Himachal Pradesh (Source: Environment Master Plan, Himachal Pradesh 2013) 4
Figure 3 Urbanization trends in Himachal Pradesh (Source: Based on HP, 2002) 6
Figure 4 Level of Urbanisation in Himachal Pradesh 6
Figure 5 Regional disparities in the level of urbanisation-Western Himalayas 7
Figure 6 Electricity sales sector wise, Himachal Pradesh (CMIE, Nov 2011) 8
Figure 7 Anticipated Electricity demand v/s availability for Himachal Pradesh 8
Figure 8 Electricity consumption by end-use (Source:HSEB) 9
Figure 9 Energy consumption pattern in Domestic sector 9
Figure 10 Construction on Steep slopes 11
Figure 11 Climatic classification of Himachal (Based on IMD, Pune) 37

1. Introduction

Himachal Pradesh is a northern state in India located in the western Himalayas with an area of 55,673 sq. km. The State is bordered by Jammu & Kashmir on the north, Punjab on the west and south-west, Haryana on the south, Uttarakhand on the south-east and China on the east. It is a mountainous state with elevation ranging from about 350 meters to 6000 meters above the mean sea level. As of 2011, Himachal Pradesh (HP) has 12 districts and a population of 68,64,602 persons. Lahaul & Spiti is the largest district of the state and Hamirpur is the smallest district, in terms of area whereas population density per sq km is highest in Hamirpur (406) and smallest in Lahaul & Spiti (2).

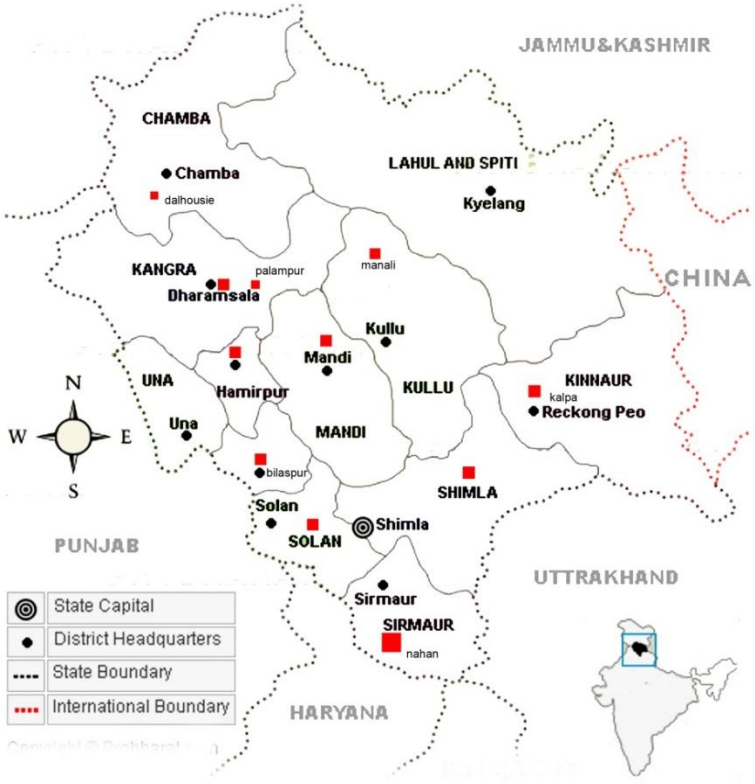


Figure 1 Political map of Himachal Pradesh[1]

Himachal Pradesh is the least urbanized state of India with a meagre 9.8% of its total population residing as its urban population (Census 2001). Some of the factors responsible for low level of urbanization include irregular topography, inaccessibility and climatic factors of the region. It is for this reason that Himachal Pradesh has only one Class I town (Shimla), 6 Class III towns, 7 Class IV towns, 17 Class V towns and 26 Class VI towns (Urban Development, Planning Commission).

In terms of the projected urban population in the State, Himachal falls in the third category of low urban states, along with Bihar, Orissa, the north-eastern states of India and the union territories (UTs). By 2026, the state is expected to have only 13.2% population as urban which is 0.2 % of the total national urban population in 2026 (Vaidya 2009).

[1] http:/ / www.probharat.com/ india/ states/ maps/ himachal-pradesh-political-map.php

In spite of the sparse urbanisation, the provision of drinking water, electricity and road connectivity in the state can be said to be satisfactory, especially given the large rural population in the state and the scattered habitation pattern in difficult terrain. Piped water supply schemes have been implemented in all urban centres and fully or partially cover 100% of the rural settlements (Annual report, Govt. HP, 2006). All urban households have access to electricity, and 97% of all rural households are connected to a dependable electric supply system. About 99% of gram panchayats and 60% of the villages are connected by road, which is significantly higher than in any other hill state in the country. Maintenance of basic services, however, is a big challenge and continually require remedial actions (Sanan, D. 2008).

Himachal's financial indicators, however, state a different tale. The fiscal deficit in 2013-14 grew to - 5.76% of Gross State Domestic Product from - 4.04% in 2012-13 and it is the fourth state in the country in highest fiscal deficit.

Himachal Pradesh faces annual power demand of around 9,000 million units. During the peak summer season, hydropower generation dips in units and this results in power shortage of around 1,000 million units (Electricity board, Himachal Pradesh). In winters, the state relies on power from other states but this too does not help much as power cuts take place to fill the gap between demand and supply. The industrial sector in the state remains the worst hit with power cuts directly hitting the production.

The average annual rainfall in the state is 1600 mm. The climate varies from place to place depending on the altitude. It varies from hot and sub-humid tropical (450-900m) in the southern low tracts, warm and temperate (900-1800 m), cool and temperate (1900-2400m) and cold alpine and glacial (2400-4800m) in the northern and eastern high mountain ranges. Thus, it is hot and humid in the valley areas and freezing cold in the areas of perpetual snow. The state has many glaciers and permanent snow fields. There are many rivers in the state which are mostly glacier and snow melt fed. Changes due to climate change are having and will have far reaching consequences and impact both rural and urban areas in several ways.

Vision for Building sector in Himachal Pradesh

Following is envisioned for the state from building sector perspective:

- Optimal utilisation of land resources for settlement purposes considering the ecological sensitivity of the slopes
- Nearly net zero buildings (in terms of their consumption of energy, water and waste) by 2047 for both new and existing buildings with special emphasis on water and waste given that this is an energy surplus state having a large share of renewables (if large hydro is also considered as a renewable source).
- Supply of alternative materials which are durable and low-cost as compared to conventional energy materials that have higher embodied energy such as steel, cement, bricks and glass..
- Optimal use of design measures to ensure thermal comfort.
- Adoption and adaption of alternative construction technologies with a focus on local and relevant construction technologies and materials.

- Apart from the above, sustainable regional development is a pre-requisite and should be aimed for.

2. Overview of Building Sector

Himachal Pradesh has seen an upsurge in construction projects. It can partly be attributed to the government initiatives to boost investment in the real estate sector in the state. This is also attracting developers from overseas (South Africa, UK and France). Places like Shimla, Baddi, Manali, Solan, Mandi and Dharamsala have several ongoing real estate projects. By removing the bar from purchase of property by non-natives of Himachal Pradesh, the government has done away with what could be termed as a closed-door system and has opened doors for outsiders (non-Himachalis) to buy property in the state. The Himachal Pradesh Apartment and Property Regulation Act 2005 permits non-Himachalis to buy plots of land or apartments from a licensed builder without seeking any approvals from the government. Himachal Pradesh Apartment and Property Regulation Act 2005 has specially been promulgated to encourage participation of private builders for ensuring planned housing development in the state. While builders and developers are being issued licenses to build housing infrastructure, individual non-resident property buyers have been exempted from seeking any government approvals.

In the wake of this liberalized housing policy, developers are looking at Himachal Pradesh as a new potential market and are drawing up various plans. Particularly, the bustling industrial townships of Baddi, Barotiwala and Nalagarh in the Shivalik foothills close to Chandigarh have attracted developers in a big way. Baddi, one of the prime industrial belts in the state, is about to witness the development of shopping malls, multiplexes and large commercial spaces alongside the upcoming IT, pharmaceuticals, textile and automobile industries.

During 2012-13, the percentage contribution of primary sectors to total Gross State Domestic Product (GSDP) of the State was 19.72 %, contribution of secondary sectors was 38.35 %, that of community and personal services was 18.46 %, that of transport, communications and trade was 15.17 % and that of finance and real estate was 8.30 % (Economic survey of Himachal Pradesh, 2013-14). The finance and real estate sector witnessed a growth of 4.8 % during 2012-13. The sector has forward and backward linkages that contribute to capital formation, generation of employment, income opportunities and also to the overall economic growth. Estimates have shown that every rupee invested in housing and construction adds 78 paise to the GDP (Union Budget, 2014). None of the cities/towns of Himachal Pradesh are monitored as part of the National Housing Bank's RESIDEX index. .

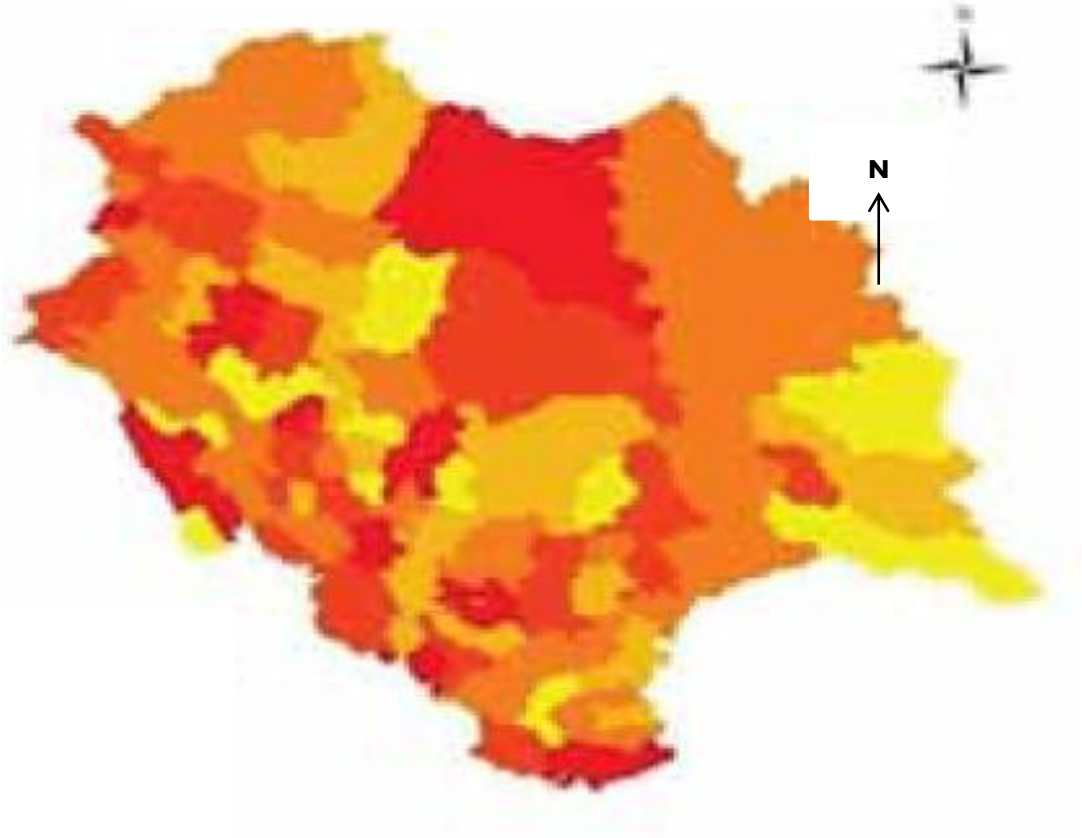
The state faces increased pressure from the various facets of urban development; population increase, infrastructure development, , industrialization, establishment of mega hydro power projects, industrial projects, mining, tourism, encroachment of forest land, deforestation, excessive agricultural and horticultural activities. All these activities are taking a toll on the fragile mountain ecology and the vulnerable hill environment of the state.

Housing board has not projected any physical or financial targets for the construction of houses for the economically weaker sections (EWS). That could also be because a large number of houses in towns that are constructed by the board have no takers. Homelessness

is not a very apparent issue in the state. Also, the growing towns with a small portion of homeless population can take benefits from Valmiki Ambedkar Awas Yojana (VAMBAY).

The developmental challenges associated with difficult terrain and vulnerability has been recognised by the Government of Himachal Pradesh. The Environment Master Plan, Himachal Pradesh 2013 has attempted to do a detailed vulnerability assessment for the state, both sectorally and geographically. Sectoral vulnerability has been assessed at tehsil level with respect to water, air, land, natural critical habitats, climate change, hazard susceptibility, spatial areas of conflict, quality of life in terms of health and education.

Vulnerability Index Map- Himachal Pradesh



Vulnerability Index Range	Vulnerability Index Category	Color Code
Up-to 1.5	Very low vulnerability	
1.51- 2.5	Low vulnerability	
2.51- 3.5	Moderate low vulnerability	
3.51-4.5	Moderate high vulnerability	
4.51-5.5	High vulnerability	
≥5.51	Very High Vulnerability	

Figure 2 Vulnerability Index Map-Himachal Pradesh

Source: Environment Master Plan, Himachal Pradesh 2013

As given in the figure, there are several tehsils in various districts falling under the category of very high to high vulnerability. The top 5 highly vulnerable districts and tehsil fall in the districts of Mandi, Bilaspur, Sirmaur, Shimla and Hamirpur.

In lieu of above challenges, several sectoral guidelines have been proposed for implementation in 2014-15. Guidelines that are green growth related are:

- planning strategies to decongest the high tourist areas and develop new tourist places
- use of bio-engineering techniques for protection of slopes in hill areas and reducing risks of landslides
- mandatory water audits for high water consuming industries and utilities
- adoption of 'polluter pays principle' by industries
- use of 'carrying capacity principle' of river basins for energy sector development
- frequent sampling of river water used for drinking
- provision of sewage treatment facilities for all towns especially those located on river basins
- all hotels and tourist resorts to have proper sewage treatment plant and decentralised solid waste management.

During the year 2014-15, the sectoral guidelines prepared under this plan shall be adopted and implemented in the State.

2.1 Urbanisation trends and Projected Demand for Real Estate Space

Urban population in India grew from 290 million in 2001 to an estimated 340 million in 2008 and is likely to increase to 590 million by 2030 (McKinsey Global Institute, 2010). Himachal Pradesh is expected to be amongst the few states in India that are likely to be less urbanised with only 0.2% of the urban population projected to reside in this state out of the total national urban population by the year 2026 (Table 1 Level of Urbanisation in 2026) (Vaidya, C 2009). This is very low compared to the average urban states or highly urban states. From 7 % urban population in 1971 to 11% in 2011, the urban population is likely to increase to 12.5% by the year 2021 and 13.6% by the year 2026.

Table 1 Level of Urbanisation in 2026

States/UTs	% Urban-2026	% share of total urban population-2026
Bihar	11.61	2.47
Himachal Pradesh	**13.62**	**0.19**
Orissa	21.24	1.8
North Eastern States	22.72	2.19
Other UTs	53.81	0.17
Sub-total for **Low Urban States/UTs**	15.46	6.83
Sub-total for **Average Urban States/UTs**	28.59	24.52
Sub-total for **Highly Urban States/UTs**	50.91	68.66

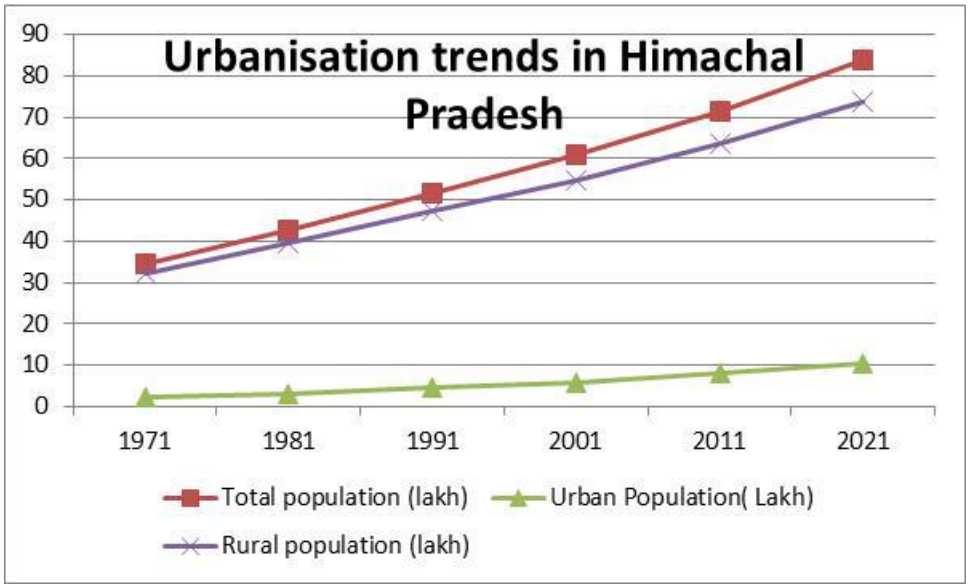


Figure 3 Urbanization trends in Himachal Pradesh (Source: Based on HP, 2002)

Two districts in Himachal Pradesh, i.e., Lahul & Spiti and Kinnaur, are entirely rural. The only Class I town (Shimla) accounts for 23.1 % of the state's urban population, there are two Class II towns which occupy 14.7 % urban population, and twenty eight Class VI towns contain 11.4 % of urban population of the state.

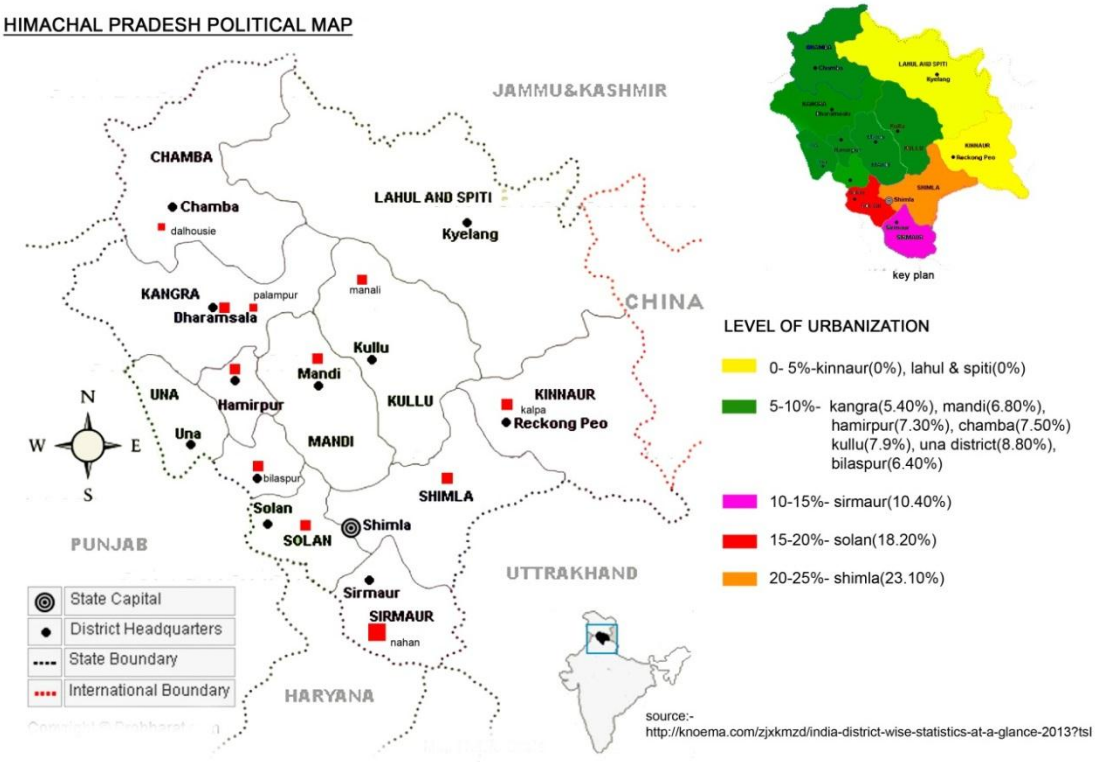


Figure 4 Level of Urbanisation in Himachal Pradesh

Source: Based on information available at http:/ / knoema.com

Regional disparities are observed in the state depicting varying levels of urbanisation and development. Shimla is the most urbanised district followed by Solan and Sirmaur amongst the districts of HP (Figure 5).

Even among the Himalayan states, all the districts except for Shimla show very low percentage of urban population as can be seen in the figure.

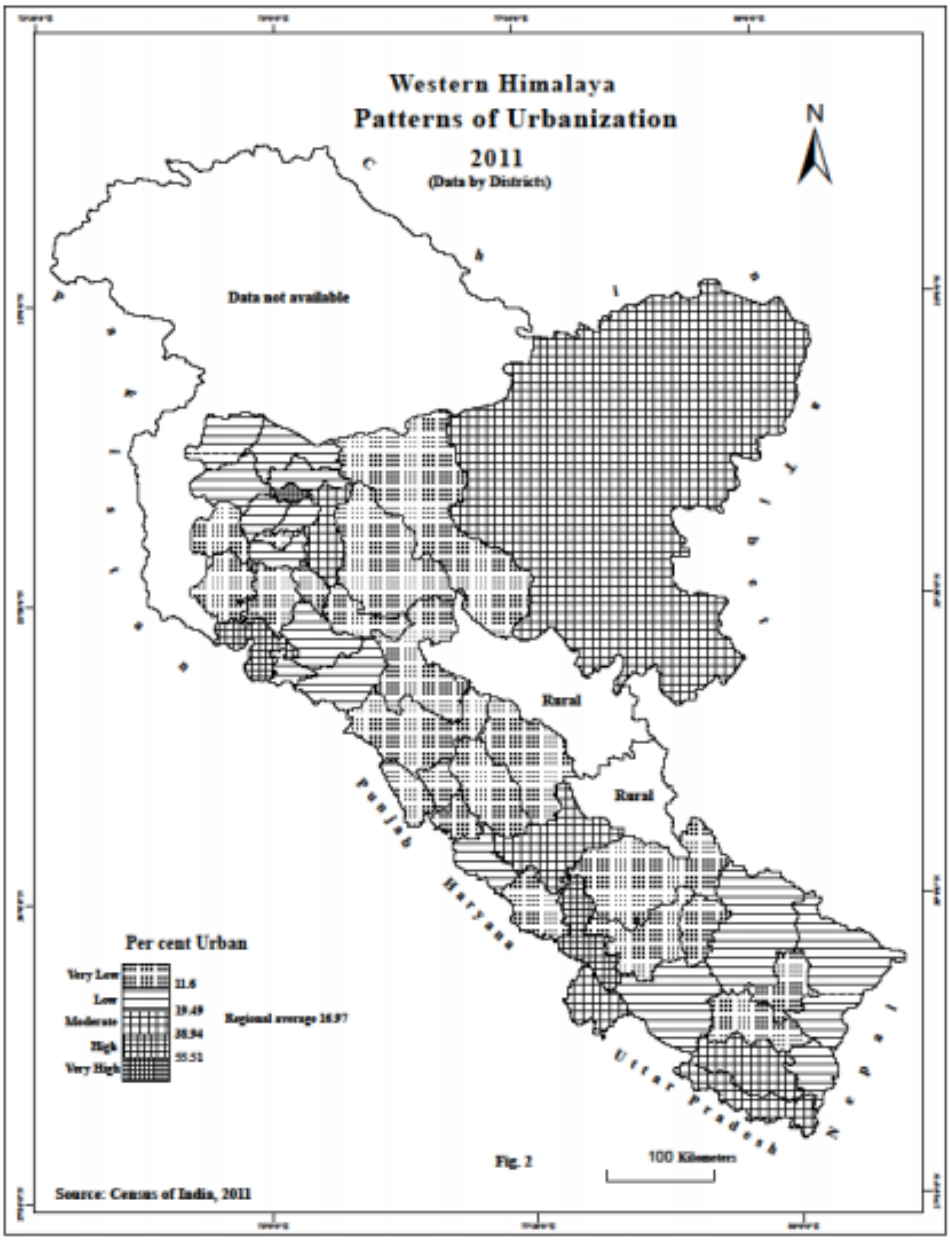


Figure 5 Regional disparities in the level of urbanisation-Western Himalayas

Source: Kalotra, G and Kumar, S. Levels of Urbanization in Western Himalaya Region, IJSR, Vol 3, Issue -10 , October 2014

2.2 Electricity consumption in the Buildings sector

The electricity consumption in the state grew at an average rate of 13.2 % between 1981 to 2010. (Refer Figure 6 Electricity sales sector wise, Himachal Pradesh). If it is assumed to grow at the same rate annually, the power consumption in the state is likely to increase from 9000 Million kWh in 2013-14 to 24000 Million kWh by 2021-22.

The electricity demand is rising sharply on account of increasing industrialization, urbanization, increasing affluence and intensive rural electrification programme.

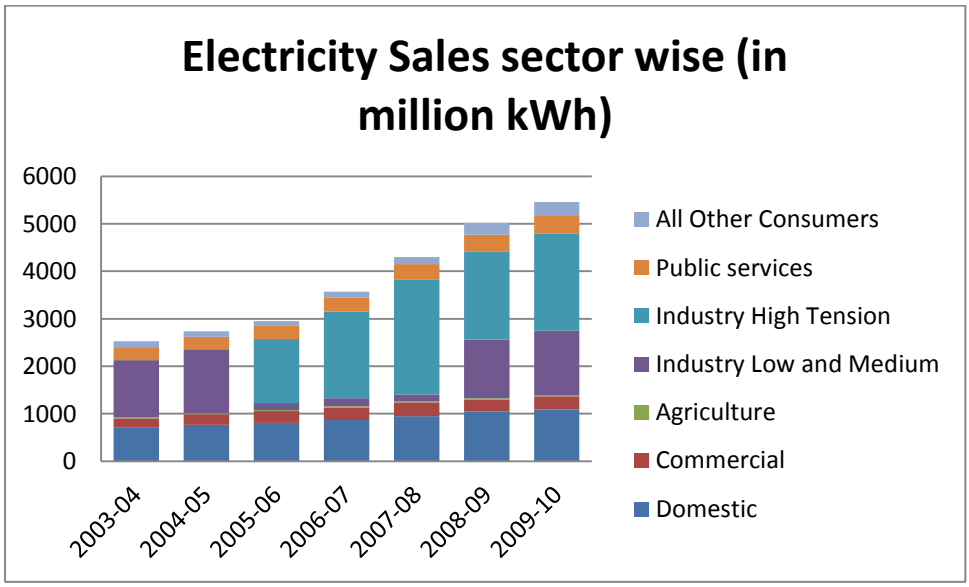


Figure 6 Electricity sales sector wise, Himachal Pradesh (CMIE, Nov 2011)

Himachal has surplus of hydro energy during the monsoon period, while it faces severe shortage during the winter months when the generation from hydro schemes dwindles to the minimum. The state faced electricity shortage of 2.3% and a peak demand deficit of 10.8% in the year 2013-14. The anticipated electricity requirements and peak demand for the year 2014-15 as predicted by Central Electricity Authority (CEA) is shown in Figure.

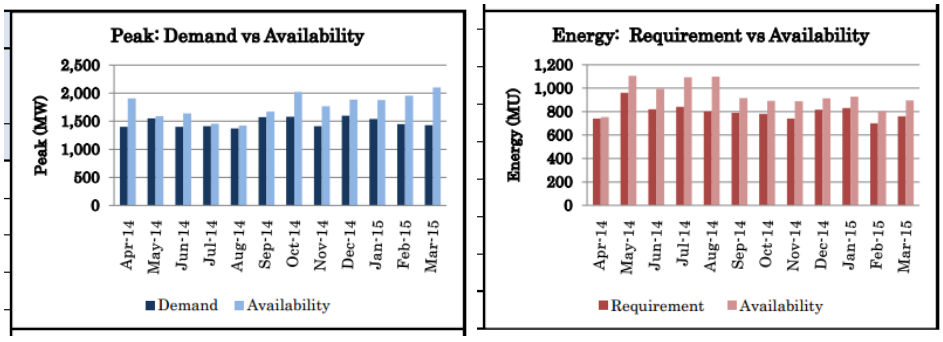


Figure 7 Anticipated Electricity demand v/ s availability for Himachal Pradesh

Source: http:/ / www.cea.nic.in/ reports/ yearly/ lgbr_report.pdf)

2.2.1 Electricity consumption by end-use

Buildings are considered to be a major consumer of electricity and are estimated to be the second largest consumer after the industrial sector, Figure 8). Within the building sector,

domestic sector forms the bulk consumer and has been growing consistently (21% in 2011-12 to 24% in 2012-13).

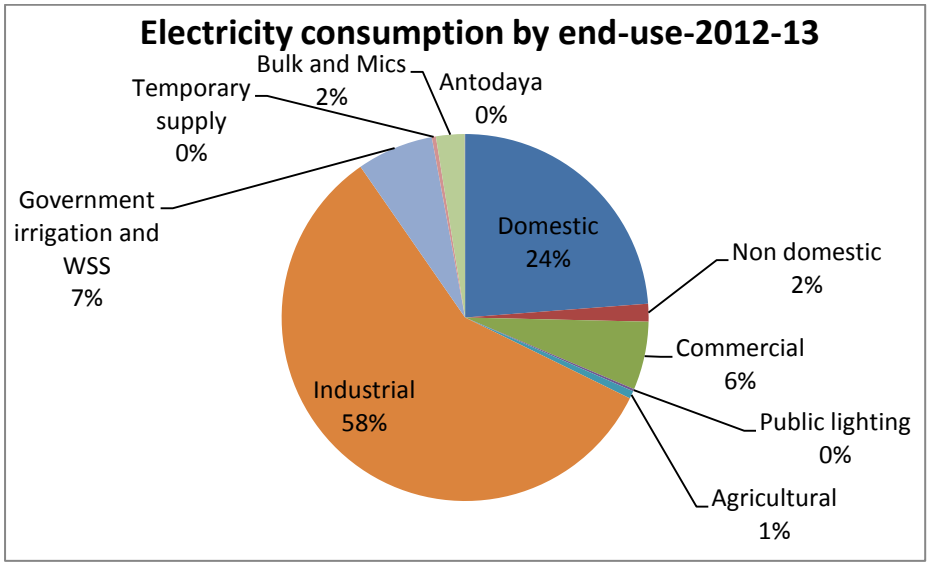


Figure 8 Electricity consumption by end-use

Source: Himachal Pradesh State Electricity Board, Government of Himachal Pradesh

The residential sector accounted for 24% of the total electricity consumption in 2012-13. The electricity consumption varies with respect to rural and urban segments and climatic seasonal variations. In the rural segment, major use of electricity is towards lights & fans. In the urban segment, lights,fans, AC & refrigeration form the bulk of consumption (Figure 9). This however, does not reflect extensive consumption of fossil fuel (firewood) for space heating application in the state and should be considered given the contribution of fuelwood burning to GHG emissions and the effect of resultant air pollutants on human health.

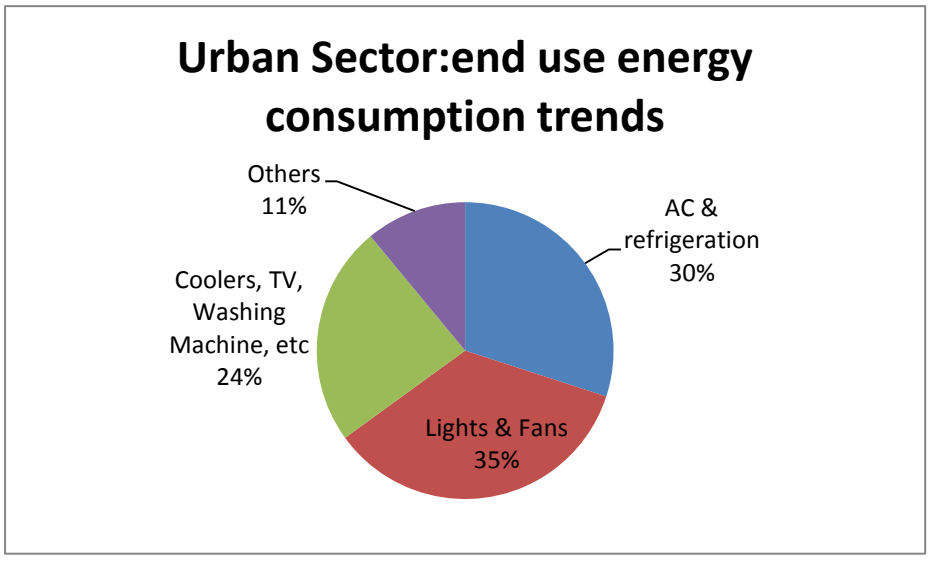


Figure 9 Energy consumption pattern in Domestic sector

Source: Himachal Pradesh State Electricity Board, Government of Himachal Pradesh

2.2.2 Electricity saving potential

The electricity saving potential of each option may vary with building typology, climate zone, space conditioning needs and the initial base design proposed by the client/designer. On an average, however, it is estimated that the implementation of energy efficient options would help in achieving around 25% electricity savings in residential buildings and 30% electricity savings in new commercial buildings. The annual energy savings potential for 15 commercial buildings in Shimla is assessed to be 2.22 MU (BEE, 2009).

The major avenues for energy savings in domestic sector include replacement of incandescent bulbs with LED, adoption of BEE star labeled appliances and promotion of space heating systems (through various programs including standards and labeling program).

For the cold climatic zone, it is comparatively easier than the composite zone to achieve a nearly net zero energy status by having an efficient building envelope, using solar energy for thermal and electrical applications). In the case of composite zones, cooling is required in certain seasons. Himachal Pradesh has both cold and composite climatic zones.

With increasing urbanisation and difficult terrain, there is immense pressure on the land. In such scenarios, apart from recommending energy/resource efficient construction and retrofit measures, the possible approach could be to increase the share of clean energy in the energy mix, achieve energy efficiency in all buildings, utilise all possible open spaces (including available roof tops) for solar PV generation. There is thus, an urgent need to give equal emphasis on the various urban planning issues from a green growth perspective. This includes focusing on energy efficiency, electricity & heat generation, water usage, waste management to target net zero impact of settlements and buildings.

2.3 Per capita water supply and water savings potential

As mentioned earlier, most of the urban centers in the state face water scarcity. The per capita supply varies between 25 liter per capita per day (lpcd) to 120 lpcd (Table 2). With increasing climate change impacts, water scarcity is likely to rise. Estimates from studies in urban centers of the country show that 25-50% of water can be saved by adopting measures such as use of low-flow fixtures and faucets, using native species of plants for landscaping, storing rainwater for potable/non-potable applications and by checking water leakages, within and outside buildings.

Table 2 Per capita availability of water in various towns

Per capita supply of water (CPHEEO standards)	Per capita availability of water (lpcd)	Number of towns	Name of Towns
150 lpcd	80-120	27	Arki, Chopal, Chowari, Chamba, Dehra, Daulatpur Ghumarwin, Gagret, Jogindernagar, Jubbal, Jawalamuki, kangra, Kullu, Kotkhai, Mehatpur, Manali, Nadaun, Nahan, palampur, Rampur, Rohroo, Rewalsar, Santokhgarh, Sujanpur, Sri Naina Devi, Suni and Una

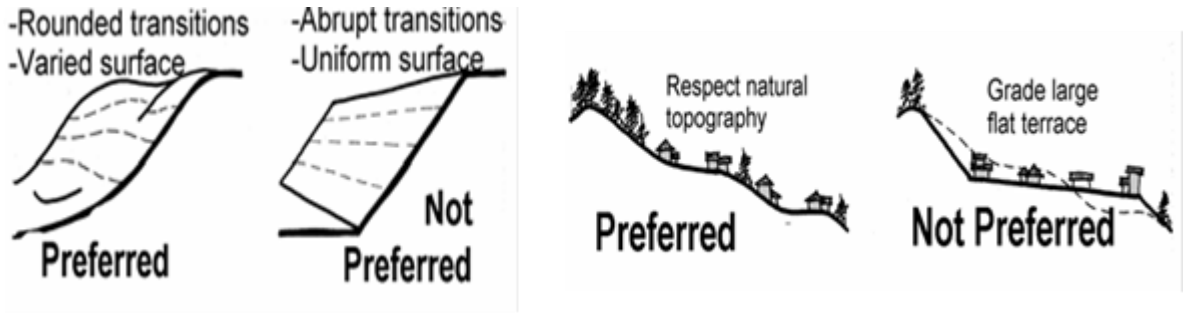
50-80	10	Bilaspur, Dharamsala, Dalhousie, Hamirpur, Mandi, Nagrota, Shimla, Solan, Sarkaghat and Sundernagar
25-50	12	Banjar, Bhuntar, Bhota, Baddi, Mant Khas, narkanda, Nurpur, Nalagarh, Paonta Sahib, Rajgarh, Theog and Talai

[2]**Source:** Irrigation and Public Health Department, Government of Himachal Pradesh

2.4 Earthquake vulnerability and slope stability

Many parts of the state stand in high-risk earthquake zone including the capital city of Shimla. The city of Shimla is witnessing a large-scale expansion. It has recorded high density of population in various pockets (Shekhar, S. 2011). As against the recommended density of 450 persons per hectare in hill settlements, the town's localities have densities ranging from 2,500 to 3,500 persons per hectare. Slope6 violation is a regular occurrence in Shimla planning. Construction on slopes higher than 45 degree has been observed in many areas. Although Shimla Municipal Corporation has prohibited any construction on slopes steeper than 45 degrees, substantial construction has already happened.

As per one estimate, 90 % of central Shimla is built on a 60 degrees slope, and is covered with buildings which are four to five storeys high. In an event of an earthquake, devastation could be enormous with buildings on slopes steeper than 45 degrees collapsing. It is therefore strongly recommended to enforce earthquake resistant structures strictly. Integration and strict implementation of soil erosion and sedimentation control measures should be taken for all new construction happening in hills and vulnerable areas. Planning



and developmental guidelines should include enforcement of strict safer grading measures.

Figure 10 Construction on Steep slopes

Source: Steep Slope Development Guidelines, City of Nanaimo

Storm water management by using locally suitable techniques, preferably sustainable urban drainage systems, that is, softer measures mimicking natural systems of storm management, should be adopted at both individual building level and at neighbourhood scale.

This is very much required given the enhanced likelihood of extreme events which may further increase the issues of sedimentation, intense erosion and destabilisation of slopes.

[2] http:/ / planningcommission.nic.in/ plans/ stateplan/ sdr_hp/ sdr_hpch20.pdf

2.5 Impacts of climate change and built environment

As per the state strategy and action plan on climate change and in light of the likely climate change impacts on the built environment, the below mentioned impacts have been noticeable in Himachal Pradesh (SSAPCC, 2012).

Changes in precipitation pattern that will alter the amount of rain and snow fall, is likely to reduce the average water levels in rivers and lakes and might also cause serious drought like conditions. In rainy seasons, flooding is likely to become more frequent and areas currently flood-free could suffer from occasional floods and flash floods. There is likelihood of lesser spring and summer rainfall that, in the event, could lead to regular water shortages, especially in the mid hills. The changes in rainfall pattern may further cause regular water deficits, leading to accelerated soil erosion and loss of fertility and biodiversity.

Riverbed areas could be at risk due to changes in climate pattern. This would be an additional stress on the riverbeds apart from the existing intense human pressure., Low lying areas of most valleys are highly developed in terms of the different industries that are set up, widespread tourism and residential development along the river. All these urban settlements and development features could potentially be under threat. Protective options include abandonment of ecologically sensitive areas, stronger planning controls, and fiscal disincentives for river side development.

The report categorically notes the declining availability of water in all towns with majority of them facing water scarcity.

The above necessitate the need for adoption and integration of soil erosion control, storm water management through softer measures, developmental control, site management, riverbed protection, water conservation, rainwater harvesting, more utilisation of solar power and construction of energy efficient buildings (adoption of ECBC).

3. Institutional Framework

This section provides an overview of the key stakeholders of the buildings sector with a focus on stakeholders that have a significant role in promoting building energy efficiency in the state.

STAKEHOLDERS	
State Government Ministries/Departments/Boards	Urban Development Department, Department of Environment, Science & Technology, Directorate of Energy, Department of Town & Country Planning, State Centre on Climate Change, HIMUDA, HIMURJA, PWD, Department of Planning, State Pollution Control Board, Baddi, Barotiwala, Nalagarh Development Authority – BBNDA, HPSEB.
Local Governments	Various line departments at district and town level

Private Sector Building/Construction Organisations/service providers	Developers, Architects, Consultants, facility managers, Energy Auditors
Financial Institutions	Housing Finance Companies, Banks, Micro Finance Companies (MFCs)
Research & Academia	National Institute of Technology Hamirpur, IIT Mandi, Jaypee University of Information Technology,

3.1 Urban Development Department

The urban development department of the state, in close partnership with Urban Local Bodies (ULBs) aspire to find innovative and advanced technological solutions to urban problems of the state like; integrated urban transport, sanitation, solid waste management, urban infrastructure, urban poverty, urban housing, urban planning, financial sustainability of ULBs and general urban governance.

3.2 Department of Environment, Science and Technology

The Department of Environment, Science and Technology exercises all the powers vested under the Act and Rules pertaining to protection of environment and control of pollution in the state. The department implements and enforces all environment legislations on behalf of the state government. It also develops, modifies and disseminates new technologies for improvement of scientific intervention in developmental needs in the state. It also undertakes programs that deal with capacity building, awareness generation and biotechnology promotion in the state.

3.3 Directorate of Energy

The Directorate aims to provide conducive policy framework and directions to develop and optimally harness the huge hydro potential of the state. It is also responsible for coordinating and facilitating the programs andpolicies which lead to conservation of energy and maximize the revenue by sale of free/equity power of the state. The Directorate also designs guidelines for energy efficient multi-storey buildings that areprepared at the federal level as part of Indo-Swiss (BEEP) project.. The Directorate is also identified as State Designated Agency (SDA) for BEE.

3.4 Department of Town and Country Planning

This is the nodal agency to encourage planned and systematic urban and rural growth in a comprehensive manner, stop haphazard constructions, make optimum use of precious urban land, create conducive conditions for encouraging planned constructions, create essential urban infrastructure, subserve the basic needs of the poor, upgrade environment for conducive habitat and most importantly to preserve the hilly architecture and rich heritage of the State.

3.5 State Centre on Climate Change

Considering the sensitivity of the state towards the vagaries of nature and changing climate, a State Centre has been set up to understand the dynamics of climate change and to evolve management measures with the active involvement of sector experts. The State Centre falls under the Department of Environment, Science & Technology, Himachal Pradesh and aims at dovetailing the state's initiatives with the Centre's initiatives on climate change (including all eight missions).

3.6 Himachal Pradesh Housing and Urban development Authority (HIMUDA)

HIMUDA was constituted in 2004 by an act of legislation under Himachal Pradesh Housing and Urban Development Authority Act, 2004. It was set up with an objective to plan, develop and create infrastructure to meet with the housing needs of different income groups. The development schemes thereby created would mobilize public and private resources for the promotion of housing colonies and related infrastructure. The authority would create appropriate authority and mechanism for planned development of housing colonies. Erstwhile H.P Housing Board established in 1972 was re-christened as H.P Housing And Urban Development Authority (HIMUDA) in 2004. Main aim of the authority is the development of housing colonies at various places of the state under different housing schemes like social housing schemes, self financing schemes, rental housing schemes for HP government Employees and police personnel. The people can avail the schemes also by taking loans from financial institutions like HUDCO, National housing Bank or through public finances.

3.7 Himachal Pradesh Energy Development Agency (Himurja)

HIMURJA was constituted during the year 1989 and is responsible for promotion and sustainable use of Renewable energy resources. It is also responsible for attending to matters related to energy security and research and development programme within the State in the most efficient and economical manner. The agency aims a)to provide reliable power supply b) to make Himachal Pradesh a power surplus state c)preparation and implementation of accelerated development of renewable sources of energy in the state d) to enhance the contribution of renewable viz. solar, wind, biomass. for meeting maximum rural energy needs. It has taken several initiatives to promote small-scale hydro power projects through private sector participation. It is also the state nodal agency of MNRE for carrying various centrally sponsored schemes and programs. The Himachal Pradesh Energy Development Agency has recently received the award for the best state-based nodal agency in the areas of promotion and market development of solar water heaters from Ministry of New and Renewable Energy (MNRE).

3.8 Public Works Department

Public Works Department (Buildings and Roads) is a premier agency responsible for construction, upgradation and maintenance of roads, ropeways buildings (both residential and non-residential of various Govt. departments) and bridges in the State.

Public Works department has been maintaining material database and has standardized the specifications and common schedule of rates. for adoption by all other departments, boards and corporations of the state government. Revision of rates and schedule of rates to incorporate ECBC provisions is yet to be done.

3.9 Department of Planning

The Department of Planning deals with all matters relating to the formulation, follow up, appraisal and readjustment of annual plans and five year plans. The department conducts business on all matters relating to coordination of plans of the administrative departments besides all matters pertaining to the Niti Aayog, Government of India. The Department of Planning is also responsible for collection, compilation, analysis and interpretation of economic and statistical data and coordination of statistical activities of various departments in the state.

3.10 Local Governments

The local governments at the city/town level, i.e., the municipal corporation/ municipality/ development authorities, formulate the building by-laws for building construction within the city municipal limits.

3.11 Developers

3.11.1 Government

A significant proportion of infrastructure development is also done by the state ministries/ departments who construct buildings for their own usage or as part of their development plans like offices, housing colonies, hospitals, schools and universities. The SDA and state housing board play a significant role in planned and organized growth of towns/city. They are involved in planning, development and management of housing and commercial properties. They also deal with urban restructuring and allotment of sites for public utilities. One of the main objectives of these organisations is to provide housing and basic amenities to the economically weaker sections of the society at an affordable price.

3.11.2 Private Developers and Builders

There are numerous private real estate developers and builders involved in real estate development in HP and are building construction projects in the state. Many of them are developers from the other states in India.

3.11.3 Public Sector Undertakings and Private Companies

A lot of construction is done by public sector undertakings and private companies to build buildings for their own usage. As on March 31, 2012, there were 21 PSUs (government companies and statutory corporations).

3.11.4 Individual Plot Owners

Individual plot owners construct buildings for residential or commercial purposes on the plots owned by them.

3.11.5 Service Industry

The service industry comprises of various agencies and service providers like planners, architects, structural engineers, mechanical engineers, electrical engineers, contractors, energy consultants and energy auditors. Design, construction and maintenance of energy efficient buildings require an integrated effort from all the above mentioned agencies.

3.12 Electricity Utilities

There are several ways in which electricity utilities can contribute towards reducing the end-use electricity consumption in residential and/or commercial buildings. In Himachal Pradesh, the HP State Electricity Regulatory Commission has introduced The Himachal Pradesh Electricity Regulatory Commission Demand Side Management Regulations, 2011 to promote energy conservation and efficiency. Appropriate tariff interventions are introduced to support DSM like time of the day metering, load management and power factor incentive.

3.13 Financing Institutions

Finance institutions includes bank lending, private equity, foreign direct investments, external commercial borrowing and housing finance.

4. Polices and Interventions Relevant to Green Growth

Several policies have been formulated by policy makers to mainstream energy efficiency and green buildings in the state. These policies directly or indirectly address the issue of energy consumption in buildings and green growth principles.

There are a number of policies on managing the energy demand and supplementing supply through the use of renewable energy. These would contribute to climate mitigation by reducing or avoiding GHG emissions. Many of these policies are contained in the Five Year Plans (FYP) developed by the Planning Commission to guide economic policy in India (the 12th FYP covers 2012-2017).

Apart from the programs and missions run by the central government, there are several polices/programs/schemes run at the state and local level for promoting energy efficiency and some green measures (like rooftop solar PV provision and rain water harvesting).

4.1 Energy Conservation Building Code

The Energy Conservation Act (2001) led to the formation of the Bureau of Energy Efficiency (BEE) that started the formulation of the Energy Conservation Building Code (ECBC). The scope of Energy Conservation Building Code is to provide minimum energy standards for buildings having a connected load of 100kW or contract demand of 120kVA. It aims to reduce baseline energy consumption by setting minimum energy performance standards for new commercial buildings, for building envelopes, mechanical systems and equipment (including heating, ventilation and air conditioning (HVAC) systems), interior and exterior lighting system, service hot water, electrical power and motors.

Himachal Pradesh amended the ECBC for the state in the 12th plan period. Implementation and compliance to the code is still under process. The number of buildings which would fall under the purview of ECBC (buildings with a connected load in excess of 100 kW or contract demand in excess of 120 kVA) will be very less in the state.

4.2 Development of Solar Cities programs, Ministry of New and Renewable Energy

The solar city aims at minimum 10% reduction in projected demand of conventional energy at the end of five years, through a combination of enhancing supply from renewable energy sources in the city and energy efficiency measures. The basic aim is to motivate the local governments for adopting renewable energy technologies and energy efficiency measures. As part of this, a total of 60 cities are/have been supported by the central ministry. As part of this, two cities in the state –Shimla and Hamirpur have been approved as solar cities. According to this Solar City Project, street lights, geysers and solar cookes of one million rupees worth will be allocated in Hamirpur City. In Shimla, 1790 solar street lights will be installed at the slum areas for the benefit of the poor. A solar power plant of 20 kW will be installed at Ridge and at the old bus-stand as well as a 15 kW plant will be installed in the building of the Panchayat Bhawan (MNRE, 2015).

4.3 Interventions on Rainwater harvesting (storage and recharge), storm water management through Sustainable Urban Drainage Systems (SUDS), integration of biodiversity with built-up area

There have been efforts in the state towards water conservation and management by the way of rain water harvesting. This is aimed at popularizing and demonstrating a state-of-the-art technology for construction of rain water harvesting structures and for the conservation of rain water in the water scarce and drought prone areas. During 12th five year plan, it is proposed to demonstrate the Ferro Cement Technology/LDPE lined pond and others technologies including rain water harvesting by constructing structures in the villages. The construction of these structures will be carried-out through district administration/NGOs/societies/Gram Panchayats and councils. There have been efforts towards establishment of additional numbers of water harvesting and storage structures, vermi compost units and green houses.

There has hardly been an instance of consciously integrating storm water management through SUDS[3] to avoid the ever-increasing urban flooding problems and alleviate ground water recharging issues.

[3] SUDS mimic nature and typically manage rainfall close to where it falls. SUDS can be designed to slow water down before it enters streams, rivers and other watercourses, they provide areas to store water in natural contours and can be used to allow water to soak (infiltrate) into the ground or evaporated from surface water and lost or transpired from vegetation (known as evapotranspiration).
SUDS are technically regarded a sequence of management practices, control structures and strategies designed to efficiently and sustainably drain surface water, while minimizing pollution and managing the impact on water quality of local water bodies. (www.sudrain.org)

A brief listing and review of some of the key policy/ programs/ guidelines is presented in Table 3

Table 3 Review of key policy/ programs/ guidelines, Himachal Pradesh

Policy document name	Year	Type (Act, policy, guidelines)	Implementation body	General Provisions	Provisions for environmental sustainability
Himachal Pradesh Town and Country Planning Act	1977	Act	Town and Country Planning Authority	• Freezing of land-use and preparation of regional plans • Preparation of developmental plans • Preparation of sectoral plan	• Gives base pointers to introduce in various plans on water supply, drainage, electricity, conservation of natural resources, solid waste management, etc.
Interim Development Plan of Shimla	Notified in the year 1979 TCP has prepared the Development Plan for Shimla, which has been submitted, to GoHP for approval and notification.	Act	Shimla Municipal Corporation	• To provide the legal framework for planning process for Shimla Planning Area • Regularization of unauthorized constructions & land-use • Planned development of tourism activities for sustainable economy • Rational urban settlement system for efficient functioning of capital city • Optimal utilization and development of resources in ecologically sustainable manner	• Mandatory sloping roof for 2/3 roof area • To regulate site drainage • Mandatory (no water supply connection is provided till installed and operationalized) • Solar passive building design mandatory in public and government buildings- orientation, insulated pipelines, passive heating measures, • Mandatory pukka septic tank
Annual Administrative report (2011-12) of Town and country planning Department, Government of Himachal Pradesh	2011-12	Annual Document	Town and country planning authority		The department is working on the following • Amendment in Town and country planning bill 1977 • Policy on urbanization of the state • Single window system for convenience of the public in getting their planning permissions cases cleared under municipal as well as TCP legislations National urban Informatics system: attribute and spatial information base for various levels of planning is being developed on one hand and standards and urban indices on the other.
The Himachal Pradesh	2005	Act	Town and	• Registration & Licensing of	

Policy document name	Year	Type (Act, policy, guidelines)	Implementation body	General Provisions	Provisions for environmental sustainability
Apartment and Property regularization Act			country planning department	Promoters/Estate Agents. • To watch the interests of buyers by way of exercising check on sale agreements between promoters & buyers. • To inspect & audit accounts of Promoters/Estate Agents. • To ensure provisioning of amenities by the Promoters till transfer of area to local Bodies. • To issue completion and occupation certificates. • To ensure proper documentation & enforcement on Registration of Conveyance by the Promoters.	
Environment Policy Guidelines		Guidelines		• To avoid construction of buildings/ settlements on river sides and shift settlements to safer place • To collate, commission and achieve regulation codes for land-use planning, buildings and roads.	• Implementation of Solar passive building technology • Avoid construction of building/ settlements on river sides and to shift current settlement to safer place
Himachal Pradesh Development Report State Plan Division, Planning Commission, Government of India				• The report highlights that the average CAGR of urban population from 1971 to 2001 has been much higher than that of the rural population; because of better employment opportunities. Thus the pressure on ULB is going to increase to meet the growing demand of infrastructure.	• Highlights the need for developments to be monitored and to initiate appropriate action. • Need for a rigorous appraisal of any new construction activity before it is approved. If necessary, the relevant laws may be reformed.
State strategy and Action plan on climate change	2013	Mission	Varies	• This document discusses the implementation plans of the government of Himachal Pradesh for the various initiatives and programmes	• **Himachal Pradesh Solar energy programme**: (2012) Set up Himurja under this program. Gives provision to provide subsidies on

Policy document name	Year	Type (Act, policy, guidelines)	Implementation body	General Provisions	Provisions for environmental sustainability
				to address the eight core national missions.	solar heater, cookers, PV, etc. Conducts awareness programs on solar water heating & street light system. Introduces solar passive building design technology for government and semi government buildings for altitudes above 2000m. • **Himachal Pradesh Energy Efficiency savings program**: Under the Atal Bihari Bachat Yojana free CFL's were distributed; imposes a complete ban on use of coal for space heating, and promotes the use of biogas plants and other solar passive building heating measures. It also targets to harness the entire potential of 22,000 MV of hydro power (even when the states demand is much lesser). This also discourages the energy intensive industries. • **Himachal Pradesh Sustainable Program for rural and urban Areas:** Prohibitions polythene carry-bags, cups, plates, etc. Recycle of waste materials, municipal solid waste management, waste water treatment plants have been made, Highlights that the state disaster management plan is being made Mandates rain water harvesting in new (government/ semi-government) buildings Promotes energy efficient vehicles, good road network, and sustainable rural planning. Promotes ECBC. • **Sustainable water management,**

Policy document name	Year	Type (Act, policy, guidelines)	Implementation body	General Provisions	Provisions for environmental sustainability
					Himachal Pradesh: Under preparation and would focus on basin level water strategies. • **Sustainable Development to save Himalayan Ecosystem:** Emphasizes to maintain two third area under forest cover and setting up of regional centre for glacial monitoring. • **Programme for Greening Himachal**: Protect/restore forest ecosystem, Encourage private investors who sees sustainability as a profitable venture. • **National Mission on Strategic Knowledge for Climate Change:** Promotes community led assessment, awareness, advocacy and action program (CLAP) for environment protection and carbon neutrality in HP has been set up under this; and environment fund has been created.
Himachal Pradesh Town and Country Planning (Amendment) Rules 2009 (Solar Passive Design)	2009	Rules	Town and Country Planning Department	• Solar Passive Building Design shall be required in the buildings as under:- (i) All the Government and Semi-Government buildings. (ii) Public and Semi-Public Institutions including educational, health, community centres, banquet halls, inns and buildings of autonomous bodies. (iii) Urban Local Bodies and Panchayati Raj Institutions (iv) Residential buildings in urban and urbanisable areas. (v) Residential colonies and apartments (vi) Commercial complexes and	• This document talks about site selection, preference of South facing sites, planning of spaces for natural daylight, glazing restriction based on climatic zones, passive solar heating system integration, solar PV integration, solar passive cooling design strategies, use of solar for hot water provision,

Policy document name	Year	Type (Act, policy, guidelines)	Implementation body	General Provisions	Provisions for environmental sustainability
				buildings related thereto including hotels, resorts, lodges and guest houses (vii) Industrial buildings and complexes thereof (viii) Transport buildings such as Airport terminals, Bus terminals, Railway stations etc. (ix) New townships	
Policy on Development of New Townships in Himachal Pradesh		Policy	Town and Country Planning Department	It outlines: • The norms and standards for new townships. • The guide lines for developing a new township. • The guide lines for sale and purchase of property in new townships. • The guide lines for maintenance of new townships. With this policy, the Himachal Pradesh Government invites private participation in development of new townships in Himachal Pradesh.	• Few elements of sustainability inclusion at a township scale to fill the void for areas which do not fall under the purview of Master Plan, Development Plan, etc.
Himachal Pradesh Integrated township scheme (draft 2013)	Draft in 2013	Scheme	HIMUDA	This is applicable to any township Above 40 hectares of land in hill terrain & above 50 hectares in plains. The Scheme will apply to the areas listed below:- (a) Area under the draft/sanctioned master plan of town/region; (b) Area under the peripheral control belt of the master plan of a town/region; (c) All areas covered under Planning and Development Authorities HIMUDA and Municipal Bodies in the State; (d) Any other area notified/approved by the	• Several elements of sustainability inclusion at a township scale

Policy document name	Year	Type (Act, policy, guidelines)	Implementation body	General Provisions	Provisions for environmental sustainability
				Government. In case there is existing Govt. land adjoining to the proposed township land, the Govt. will provide land to HIMUDA. (f) As far as possible barren land will be used for township. Productive agricultural land will be acquired only if absolutely essential	
The Himachal Pradesh Housing and Urban Development Authority Act (HIMUDA Act)	2004	Act		Applicable to the entire state of Himachal, this Act was created to re-enact the law to provide for the creation of a Development Authority to plan and develop land and create infrastructure to meet with the housing needs of different income groups and to provide for development schemes for mobilizing public and private resources for the promotion of housing colonies and related infrastructure and to provide for the creation of appropriate authority and mechanism for planned development of housing colonies.	• No such provision

There are several planning areas within the state which have developmental plans available. These have been reviewed from few sustainability aspects (relevant from the proposed Green Growth in Building Sector perspective) as given in the table below:

Table 4 Review of development plans of the state with respect to sustainability

Planning area	Stage of developmental plan	Promoting local Architecture/ Heritage	Provision for sloping Roof	Regulation of onsite drainage	Rain water harvesting	Solar Passive building Design guidelines
Bharmour	Study on Built Environment	Mentioned vaguely	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Kasauli	Developmental Plan (2021)	Not mentioned	Not mentioned	Specified with guidelines	Not Mentioned	Not mentioned
Shimla	Interim Developmental Plan (2021)	Not Mentioned	Specified with guidelines	Specified with guidelines	Specified with guidelines	Specified with guidelines
Kalpa	Study on Built Environment	Not Mentioned	Not Mentioned	Not Mentioned	Not Mentioned	Mentioned vaguely
Hamirpur	Developmental Plan (2021)	Not Mentioned	Not Mentioned	Not Mentioned	Not Mentioned	Not Mentioned
Manali	Developmental plan (2021)	Mentioned	Mentioned vaguely	Mentioned	Not mentioned	Not Mentioned
Dalhousie	Developmental plan (2021)	Not Mentioned	Specified with guidelines	Not mentioned	Specified with guidelines	Not mentioned
Palampur	Developmental Plan (2021)	Not mentioned	Mentioned vaguely	Not mentioned	Specified with guidelines	Not mentioned
Dharamshala	Developmental plan (2021)	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Not mentioned
Mandi	Developmental plan (2021)	Specified with guidelines	Specified with guidelines	Mentioned vaguely	Not mentioned	Not mentioned
Barotiwala	Interim Developmental Plan (2001)	Not mentioned	Not mentioned	Mentioned vaguely	Not mentioned	Not mentioned
Solan	Developmental plan (2021)	Not Mentioned	Not mentioned	Mentioned	Mentioned vaguely	Not mentioned
Nahan	Developmental Plan (2021)	Not mentioned	Mentioned vaguely	Mentioned	Specified with guidelines	Not mentioned
Bilaspur	Developmental Plan (2021)	Specified with guidelines	Specified with guidelines	Not Mentioned	Not mentioned	Not mentioned

5 Barriers in greening the building sector

The state has introduced several appropriate legislations/policy/programs/missions to address key concerns of the buildings sector. Interestingly, the state has attempted to promote solar passive design instead of shifting the entire focus only on energy efficiency.

At the planning level, the state has drafted regulations for integrated townships for wherever there is no master plan/development plan. This is a very suitable approach for a state like Himachal Pradesh. However, in spite of the appropriate legal framework, the sector faces several barriers to greening the building sector. Slope protection, water, wastewater management, storm water management and solid waste management are increasingly important. The regulatory frameworks for implementation of Himachal ECBC code and its subsequent integration in the building by-laws and specifications of materials/rates in the state PWDs is yet to be done.

The existing capacities of the local authorities to monitor the implementation of the state code are inadequate. Thus a simplified, robust framework needs to be built in to achieve the targets as defined in the Environment Master Plan 2013 and the State Action Plan on Climate Change.

Subsidised energy prices, water prices and basic services provision are some strong barriers, although these subsidies are meant to increase the access for certain population groups, thus creating major obstacles in removing such public subsidies.

Lack of knowledge amongst practitioners, architects, engineers, service providers, inadequate capacities, lack of robust financial systems to facilitate green growth changes, absence of green financial products are some of the problems faced by the state. More financial/non-financial incentives on promoting projects which cater to green buildings need to be given.

6. Ways forward

Himachal is a progressive state and has well laid out climate proofing strategies given the fragile nature of the state which essentially cover many of the parameters proposed for greening of the building sector. The State Action Plan on Climate Change and Environment Master Plan of Himachal Pradesh are well laid out documents and if implemented properly can give a lot of benefits/co-benefits for a liveable healthier built environment.

Since buildings have a lock-in effect, it is globally recommended to have stringent energy and resource efficiency measures in the shortest possible time. Also, it is critical for the state to enforce wide adoption of water/resource conservation at building and neighbourhood scale, protection of slopes, prevention of soil erosion, sediment control during construction, and biodiversity conservation. Some suggested actions could be promotion of soft paved areas or permeable pavers outside the buildings, adoption of appropriate storm water management strategies, listing of native plants in public domain, integrating the same with building regulations. Development of each town and city has to be in lieu of the carrying capacity and vulnerability of the place.

Given the high influx of tourists in the state, it is important and rather challenging to conserve and protect the environment in the state. Recognising this, the state government has spent a part of the 100 million US$ loan under the World Bank Project- Development Policy Loan to Support Inclusive Green Growth and Sustainable Development in Himachal

Pradesh project (World Bank, 2013), on sustainable tourism interventions in one tourist destination (including wastewater treatment and solid waste management).

Few case studies are given in boxes highlighting some of the good practices which need to be replicated and adopted at much larger scale (Annexure 2) .

Some of the key action points with varying time lines which are required in the context of green growth are as follows:

Short-term

Enabling conditions for affordable housing-land and finances to overcome the social barrier for a greener economy.

- Incorporation of green/ energy efficiency features in municipal by-laws and all related documents followed by the state government. This should be a must for achieving the environmental benefits associated with greening of building sector.
- Promotion of vernacular architecture (at least in the rural and less urbanised areas). Certain policies promote it but adoption needs to be taken at a more integrated and intense manner. It could involve incentivising designers, enabling workmanship and creating a sense of cultural pride amongst the people.
  - The traditional vernacular[4] housing techniques of Himachal Pradesh addressed the prevailing topography, extremities of climate and responded well to the natural forces along with utilizing the available manpower and providing them with employment.
  - The indigenous traditional architecture demonstrates excellent sustainable building practices; but faces erosion due to increasing loss of local building skills and knowledge, and displacement of local natural building materials.
- Retrofit measures to make the existing building stock energy efficient and to overcome the various environmental challenges posed by the sector.
- At least 50% of the new stock to be built on the principles of Green Buildings (including Himachal Pradesh ECBC compliance) to accrue social, environmental and economic benefits. This should be accompanied with monitoring of the compliant stock for at least 12 months for various energy/resource efficiency/comfort/health parameters.
- Revision and further customisation of state ECBC as per the requirements of state.
- Adoption of water/energy efficient fixtures/faucets/ appliances. Penetration of renewable energy with special focus on building integrated photovoltaic for thermal and/or electrical applications. This is partly envisaged as part of the various state missions. However, stricter implementation and enabling environment to overcome the various technological/financial barriers is required.
- Need to integrate the principles of low-impact development/sustainable urban drainage systems at all zonal plans, neighborhood plans (new and retrofit) on a priority basis in areas more prone to urban flooding. To begin with few pilot areas in the state could be taken for implementation.
- Strengthening/establishment of centre of excellence. Alternate building materials which perform equal or better than the conventional ones to bring in environmental

[4] For more details on vernacular techniques in different regions of the state, refer Annexure 1

sustainability and build up a database for the entire supply chain to promote such materials.

- Capacity building at various levels including skilled manpower for enabling green construction, local and state level government officials in order to implement the green growth strategies in building sector.
- Attractive financing solutions for developers investing in EE buildings, ESCOs. Communicating through various media the benefits of green buildings at no incremental cost. Life cycle costing of the property and potential savings that can be made on annual electricity bills be made available to the buyers along with the property brochure. Attractive financing solutions for home buyers investing in EE housing. Financial models for affordable housing sector. Access to finance to the under privileged, to overcome the various financial barriers faced in greening of the sector.
- Technological incentives for manufacturers to invest in energy efficiency/water efficient products and mechanisms to promote wider availability of such products;

Mid-term

- All existing and new commercial buildings to be compliant with the state ECBC
- All new residential buildings to follow the revised building bye laws
- New retrofit program for making residential buildings
- At least 25% of all existing and new commercial buildings to be net zero/zero plus energy/waste/water buildings
- Based on experience gained from the pilots done in Phase I, integration of the principles of Low Impact Development/Sustainable Urban Drainage systems at all zonal plans, neighborhood plans (new and retrofit) in the entire state.
- All financial institutions, banks and housing finance and micro-finance companies to be actively engaged in greening of the building sector
- Continued capacity building program evolving with the changing codes/standards requirements
- Continued promotion of vernacular architecture in the new settings and changing lifestyle demands

Long-term

- 100% of all existing and new buildings to be net zero/zero plus energy/waste/water buildings
- Low Impact Development based neighbourhood planning and green master plans executed for all cities and towns
- Lifestyle changes introduced in the masses for a low carbon lifestyle due to intensive awareness building over the years
- The buildings and city/town/zonal plans adopt climate resilience at all levels

7. References

Annual report, Govt. HP (2006). Planning Dept., Govt. of HP (Himachal Pradesh).
Annual Plan (2006–07). Shimla: Planning Department.

BEE (2009). State wise electricity consumption and conservation potential in India, National Productivity Council.

BEE/NPC (2009). State wise electricity consumption and conservation potential in India, Prepared by National Productivity Council for BEE. Accessed from http://www.emtindia.net/eca2009/14Dec2009/CombinedSummaryReport.pdf

City of Nanaimo (2005), Steep Slope Development Permit Area Guidelines, Nanaimo.

Economic Survey of Himachal Pradesh (2013-14). Economics and Statistics Department, Government of Himachal Pradesh. Retrieved from http://admis.hp.nic.in/himachal/economics/pdfs/ESEng2013-14_A1b.pdf

Growing real estate in Himachal Pradesh. Retrieved from http://www.indianrealtynews.com/indian-states/himachal-pradesh

HP (2002) Himachal Pradesh Development Report pp 339, Based on Census of India. Retrieved from http://planningcommission.nic.in/plans/stateplan/sdr_hp/sdr_hpch20.pdf

Kalotra, G and Kumar, S (2014), Levels of Urbanization in Western Himalaya Region, IJSR, Vol 3, Issue -10 , October 2014

McKinsey Global Institute (2010), McKinsey Global Institute, India's urban awakening: Building inclusive cities, sustaining economic growth.

DEST (2013), Environment Master Plan, Department of Environment, Science & Technology, Government of Himachal Pradesh

MNRE (2015). http://mnre.gov.in/file-manager/UserFiles/Status-Note-on-Solar-Cities.pdf (last accessedon 15.1.15)

Sanan, Deepak (2008), Development lessons from the Himachal Pradesh experience, ASCI Journal of Management 37(2): 109–121

Sharma S and Sharma P (2013), Traditional and Vernacular buildings are ecological senisitive, climate responsive designs-study of Himachal Pradesh, IJCEBS, Vol 1, Issue 4

Shekhar, S. (2011). Urban Sprawl and other Spatial Planning Issues in Shimla, Himachal Pradesh, Institute of Town Planners, India Journal 8 - 3, July - September 2011, 53 – 66

SSAPCC (2012) State Strategy & Action Plan on Climate Change Himachal Pradesh, Department of Environment, Science and Technology, Government of Himachal Pradesh

Union Budget (2014, June 26). Chapter 10, Services Sector, pp 186. Retrieved from http://indiabudget.nic.in/es2013-14/echap-10.pdf

Planning Commission (undated). Details available at <http://planningcommission.nic.in/plans/stateplan/sdr_hp/sdr_hpch20.pdf >, Page 340

Vaidya, Chetan (2009). Urban Issues, Reforms and Way Forward in India, 2009, Department of Economic Affairs, Ministry of Finance, Govt. of India.

World Bank (2013). Development Policy Loan (DPL) to Promote Inclusive Green Growth and Sustainable Development in Himachal Pradesh : P124041 - Implementation Status Results Report : Sequence 01: http://www.worldbank.org/projects/P124041/himachal-pradesh-environmentally-sustainable-development-dpl?lang=en

Himachal Pradesh State Electricity Board, Power generation and consumption in Himachal Pradesh, retrieved from Himachal Pradesh State Electricity Board website www.hpseb.com

CSE (2014, March). Urban Rainwater Harvesting-Case studies from different agro-climatic regions, Centre for Science and Environment. Retrieved from CSE website: http://www.cseindia.org/userfiles/Urban%20Rainwater%20harvesting%20report.pdf

High Performance Commercial Buildings in India, retrieved from HPCB website: http://high-performancebuildings.org/case_study_solpass_cold_shimla_HPsec.php

Water Harvesting- Present Practices. Retrieved from Public Health Engineering Department, meghalaya, Government of India website: http://megphed.gov.in/knowledge/RainwaterHarvest/Chap5.pdf

Ministry of New and Renewable Energy. Retrieved form MNRE website: www.mnre.gov.in

Annexure 1 Vernacular techniques in different regions of the State

Classification Based on Climate Pattern[5]					Vernacular techniques	
Climate Pattern Classification		Type/ Nomenclature in map (refer Figure A)	Area/ Districts	Tree species	Construction techniques	Slope of roof
Sub-Tropical Monsoon	Mild dry winter, Hot summer	Cwa	Bilaspur, Kangra, Mandi, Simour, Una, Hamirpur, Solan, Camba, Dharamshala (Slope of land varies from 0 to 30 degrees)	Flora is similar to that of Tarai belt	The orientation of buildings is mostly east and south. Materials available for construction are stone slabs for flooring and roofing, stone and earth for walls and wooden plank supports on wooden joists for intermediate floors. • Innovative construction technique: Bottomless wooden box (0.60X0.90m with height of 0.23m) for filling earth for construction of o.60 thick walls. • Use of locally available slate stone for constructing sloping roof • Jack arch roofing was introduced in the British era for heavy rainfall areas using plain or galvanized iron sheets **Sun Dried mud brick construction** • Especially in Kangra region, buildings raised above ground	Maximum 22.5 degrees

[5] Refer Figure A for climate classification of Himachal Pradesh

Classification Based on Climate Pattern[5]				Vernacular techniques	
Climate Pattern Classification	Type/ Nomenclature in map (refer Figure A)	Area/ Districts	Tree species	Construction techniques	Slope of roof
				with stone, 0.60-0.90m thick walls plastered with mud phuska to avoid erosion, and floors made of wood plastered. **Dry Stone technique** • Especially in Kangra and Kinnaur, interlocking stones compacted without mortar with the interior surfaces mud plastered. **Mud Construction** • Rammed earth construction (as stone and wood is not available). • 0.6m thick rammed walls are built by pouring wet mud mortar Thick flat mud roofs (used for insulation) built over wooden beams with birch bark (to waterproof) laid over wooded planks. **Dry Stone Construction** • Especially in Kinnaur and Kangra region where slate is in abundance. • Interlocking stones with pout mortar, with mud plaster on the	

Classification Based on Climate Pattern[5]					Vernacular techniques	
Climate Pattern Classification		Type/ Nomenclature in map (refer Figure A)	Area/ Districts	Tree species	Construction techniques	Slope of roof
					interior side.	
Sub-Tropical Monsoon	Mild and dry winter, Moderate hot summer	Cwb	Shimla, parts of Chamba (Steeper hills,	Pine in lower altitude; Deodar, Chilgosa and betula in higher	Building materials available are stone and wood (with/ without mud mortar) Typical feature is projected upper floor **Kath-Kunni construction** (earth-quake resistant) • Square sectioned wooden wall beams longitudinally parallel to each other to define the width of the wall. (with alternate layers of wood and stone) • Floors are not more than 2.10m to 2.40m high (for better insulation) **Dhajji Wall Construction** • Especially in hills of Shimla,braced timber frame walls filled up with stone and brick masonry laid in mud mortar is common. • The major components are plinth beams, frame structure, joints, roof truss, walls and bracings, windows and doors,iInfills and plaster. **Wooden construction** • 2-3 story high houses with	Flat roof with earth and willow covering

Classification Based on Climate Pattern[5]					Vernacular techniques	
Climate Pattern Classification		Type/ Nomenclature in map (refer Figure A)	Area/ Districts	Tree species	Construction techniques	Slope of roof
					vertical wooded posts to carry load. • Sometimes the ground floor is built in stone masonry with the upper floors made by wood • Upper floors are cantilevered thus providing living space all around	
Sub-Tropical Monsoon	Without dry winter, with hot summer	Cfa	Chamba, Major parts of Kullu and Mandi		**Wooden construction** • 2-3 story high houses with vertical wooded posts to carry load. • Sometimes the ground floor is built in stone masonry with the upper floors made by wood. • Upper floors are cantilevered thus providing living space all around	
Sub-Tropical Monsoon	Without dry winter, with moderate hot summer	Cfb	Minor parts of Kullu		**Wooden construction** • 2-3 story high houses with vertical wooded posts to carry load. • Sometimes the ground floor is built in stone masonry with the upper floors madeby wood • Upper floors are cantilevered thus providing living space all	Flat roof with earth and willow covering

Classification Based on Climate Pattern[5]					Vernacular techniques	
Climate Pattern Classification		Type/ Nomenclature in map (refer Figure A)	Area/ Districts	Tree species	Construction techniques	Slope of roof
					around	
Humid Continental	Severe and dry winter, warm summer	Dwb	Kinnaur		Dry Stone technique • Especially in Kangra and Kinnaur, interlocking stones compacted without mortar is common with the interior surfaces mud plastered. **Wooden construction** • 2-3 story high houses with vertical wooded posts to carry load. • Sometimes the ground floor is built in stone masonry with the upper floors madeby wood. • Upper floors are cantilevered thus providing living space all around.	
Humid Continental	Severe winter, moist all seasons, short warm summers	Dfb	Lahul & Spiti	Bitula Chilgosa, Willows and Alpine pastures	**Rammed earth construction** • Rammed earth block for walls, beaten earth for flooring and flat roof consisting earth layer over 6-7 layers of Bithula barks (with 0.10m layer of sand between two layers of these barks) placed over wooded planks supported by wooded joists. This technique has been evolved due to absence	Flat roof consisting of earth covering over willow branches, resting on wooden joists

Classification Based on Climate Pattern[5]				Vernacular techniques	
Climate Pattern Classification	Type/ Nomenclature in map (refer Figure A)	Area/ Districts	Tree species	Construction techniques	Slope of roof
				of any other material available for roofing. • To conserve energy, height of room is confined to 2.10m and openings are very small. **Mud Construction** • Rammed earth construction with 0.6m thick rammed walls are built by pouring wet mud mortar (as stone and wood are not available). • Thick flat mud roofs (used for insulation) built over wooden beams with birch bark (to waterproof) laid over wooded planks.	

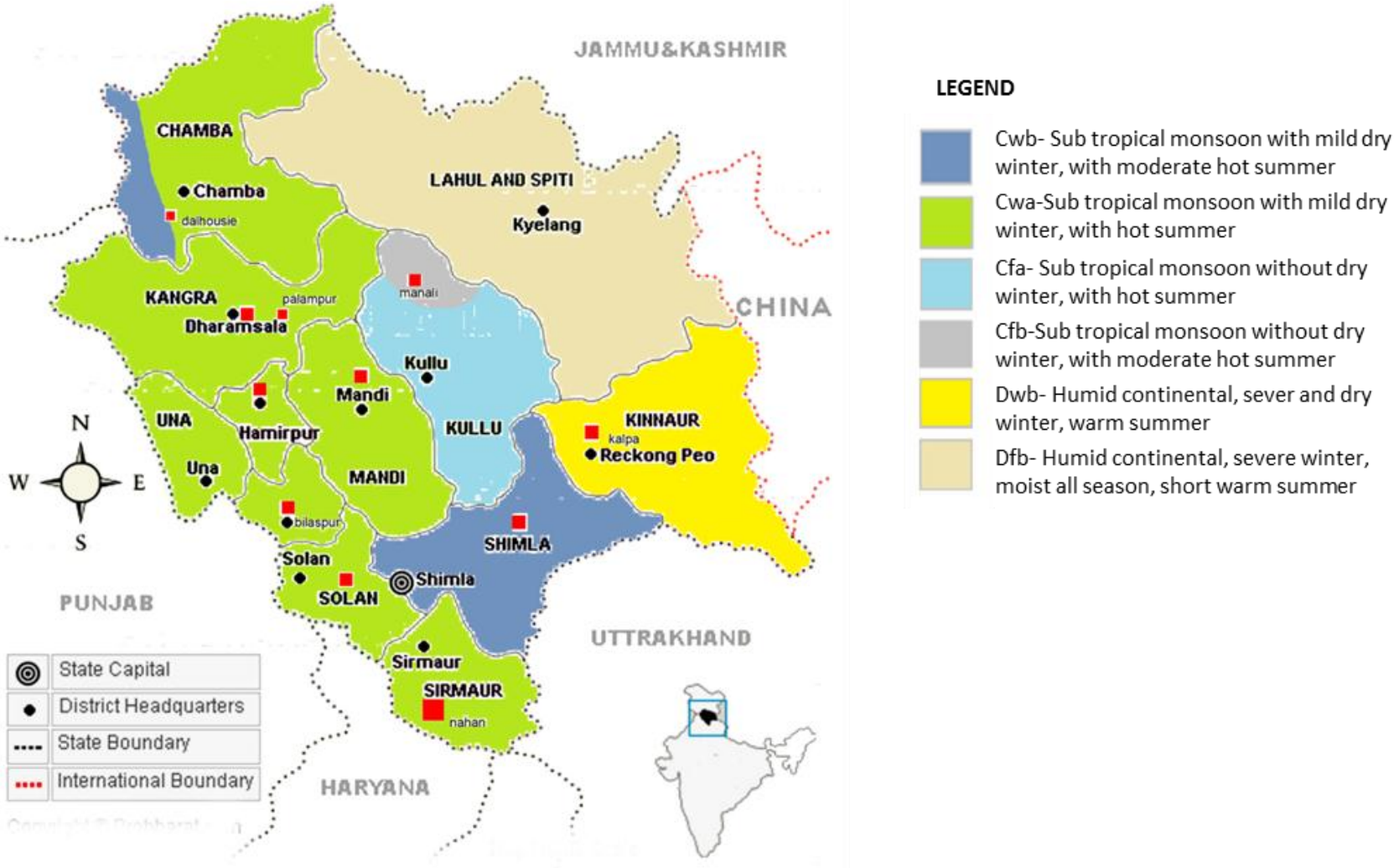


Figure A Climatic classification of Himachal (Based on IMD, Pune

Annexure 2: Case Studies

Case study: Rainwater harvesting scheme, Bishop Cotton School

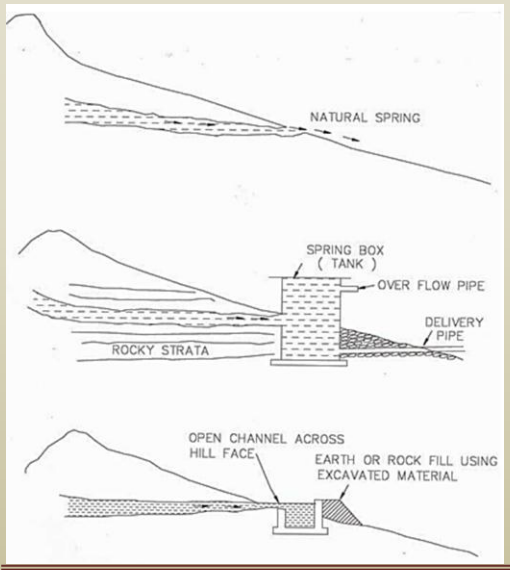
Location: *Shimla, Himachal Pradesh*
Climate: *Cold*
Occupancy*: >500*
Daily Requirement: *80000 liters*
Total roof top area: *1867.30 sq.m*
Total storage capacity*: 555000 liters*
Filtration media layers*: Stone (0.4-.15cm); grits (0.1-0.15cm); chips (0.15 cm); sand (0.15cm)*
Total cost: *Rs 16.65 lakh*
Maintenance: *Rs 10,000/year*
Intent: *In recent years, there has been a huge shortage of water supply. Additionally, during the monsoons, municipal water becomes muddy. Thus, the school harvests rain water for drinking during rainy season, and for flushing, laundry, and swimming pool in the other seasons.*
Source*: http://commons.wikimedia.org/wiki/File:Bishop_cottons_Boys'_school_map.png*
http://www.cseindia.org/userfiles/Urban%20Rainwater%20harvesting%20report.pdf

Case study: Local rainwater harvesting techniques

In the Lahaul and Spiti areas of Himachal Pradesh, water from hill streams are diverted through small excavated channels, called Kuls, for domestic use and irrigation.

One of the ways to harvest such highly desirable spring water is through a device known as a spring box. Built usually into a hillside and deep enough to access the spring-water source, this device allows water to enter from the bottom and fill up to a level established by an overflow or vent pipe. The outflow pipe near the base of the device may be connected via pipe to a larger storage system (such as a tank) closer to the point of use or tapped directly at the location of the box. This device can be constructed using local materials, and if built carefully and protected can provide many years of reliable operation. Depending on local water requirements and conditions, a number of these spring boxes may be constructed to provide year-round supply or used to recharge other community water storage systems.

Source: http://megphed.gov.in/knowledge/RainwaterHarvest/Chap5.pdf



Case study: Green Building, Himachal Pradesh State Government Secretariat, Shimla

Location: *Shimla, Himachal Pradesh*
Climate: *Cold*
Operational schedule: *7 hours, 6 working days in a week*
Energy Performance Index of the building: *70 kWh/m2/yr (Air Conditioned)*
Annual energy consumption due to lighting & air conditioning (kWh): *437,126 kWh*
Lighting Performance Index (LPD) – *28 KWh/Sq.mt./annum*
HVAC Performance Index – *41 KWh/Sq.mt./annum*
Architectural Design: *The longer facades of the building face NE-SW*
Envelope Specifications:
Walls: *Walls of air-conditioned zones– 230mm brick with 12.5mm plaster*
Roofs: *150mm concrete slab with cement tile*
Glass: *6 mm clear single glazed windows (WWR 50%)*
Source: *http://high-performancebuildings.org/case_study_solpass_cold_shimla_HPsec.php*

About TERI

A unique developing country institution, TERI is deeply committed to every aspect of sustainable development. From providing environment-friendly solutions to rural energy problems to helping shape the development of the Indian oil and gas sector; from tackling global climate change issues across many continents to enhancing forest conservation efforts among local communities; from advancing solutions to growing urban transport and air pollution problems to promoting energy efficiency in the Indian industry, the emphasis has always been on finding innovative solutions to make the world a better place to live in. However, while TERI's vision is global, its roots are firmly entrenched in Indian soil. All activities in TERI move from formulating local- and national-level strategies to suggesting global solutions to critical energy and environment-related issues. TERI has grown to establish a presence in not only different corners and regions of India, but is perhaps the only developing country institution to have established a presence in North America and Europe and on the Asian continent in Japan, Malaysia, and the Gulf.

TERI possesses rich and varied experience in the electricity/energy sector in India and abroad, and has been providing assistance on a range of activities to public, private, and international clients. It offers invaluable expertise in the fields of power, coal and hydrocarbons and has extensive experience on regulatory and tariff issues, policy and institutional issues. TERI has been at the forefront in providing expertise and professional services to national and international clients. TERI has been closely working with utilities, regulatory commissions, government, bilateral and multilateral organizations (The World Bank, ADB, JBIC, DFID, and USAID, among many others) in the past. This has been possible since TERI has multidisciplinary expertise comprising of economist, technical, social, environmental, and management.

The Energy and Resources Institute
www. teriin.org