Climate Resilient Green Growth Strategy for Himachal Pradesh

Towards an Inclusive Development Agenda

Summary for Policymakers

The Energy and Resources Institute

Global Green Growth Institute

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Partners

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FOREWORD

It is a matter of pride that The Energy and the Research Institute, (TERI) have taken up an important initiative on climate resilient green growth for the State of Himachal Pradesh. The State has always been conscious of the need to ensure sustainable development and to maintain ecological balance not only for the benefit of the people of the State but also for country as a whole. The report is therefore highly relevant and opportune and the State government will internalize many of these findings in the State policies for preservation of environment.

The research and analysis in the report, makes a strong case for climate resilient green growth which will need to factor-in impacts of future climate variability on natural resources which will have long-term implications for the development of policies of the State, besides other hill states.

Himachal was fast treading on the path of economic development and socio-economic advancement. Our government has taken pro-active measures to ensure that the growth of the State is socially inclusive and as well as environmentally responsible. Dealing with new emerging challenges as climate change requires leadership and environmental stewardship and Himachal is ready to take up such challenges.

I convey my heartfelt congratulations to all the institutes and agencies and the departments involved in this initiative including TERI and the Global Green Growth Institute.

I sincerely hope that with the help of this report, Himachal will also be the leader for responsible environmental leadership amongst the hill states.

(Virbhadra Singh)

Foreword

The importance of Himachal Pradesh for India's sustainable development is well established. With its lush green forests and associated flora, fauna, and diverse ecological pathways, the State is vital in terms of providing ecosystem services impacting large parts of the country. With its hydropower potential, the State plays an important role in terms of ensuring energy security for India.

However every development path comes with implications that need to be understood and carefully examined from time to time. Added to that, the implications of climate change need to be carefully understood. Climate resilient green growth for the State is not a luxury but a necessity. This initiative carries out an analysis to add to our knowledge in these matters. It uses a rich mix of analytical tools including a climate model, soil and water assessment, and energy analysis. Another component under this analysis is field insights from case studies of hydropower projects. In addition, a sectoral review lists challenges and opportunities related to environment and energy.

The Report finds that the overall climatic warming projected over the State in the near future increase by 1.3–1.9°C for 2021–50 relative to 1971–2000. It is also projected that nearly 11.61 per cent area of the State could face serious soil erosion while surface runoff is projected to increase for Beas and Ravi sub-basins. Through a state-specific energy model and on-ground case studies, the report identifies important issues and pressure points that it is felt are relevant for the energy and environment sectors.

The Department of Environment Science and Technology was happy to provide nodal guidance for this initiative which has been implemented by The Energy and Resources Institute (TERI) and supported by the Global Green Growth Institute (GGGI). The Directorate of Energy provided valuable facilitation for the field visits and the Directorate of Economics and Statistics provided insights on macro-level data. The State is already committed to green growth and inclusive sustainable development, and this report will further help the State in planning for further initiatives. The findings will now be analysed at the state level so that they can be inputs for changes in policy in relevant sectors.

I congratulate TERI and GGGI for their efforts towards the project activities. We value the partnership very much and hope that such initiatives bring about much needed science based policy change at various levels.

Deepak Sanan
Additional Chief Secretary, Forests, Environment, Science and Technology
Government of Himachal Pradesh

Contents

Acknowledgement

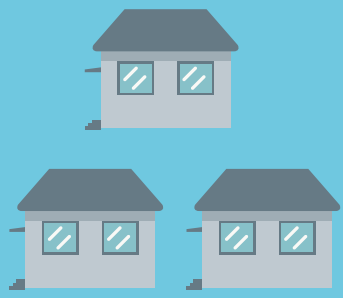
This report is based on close collaboration between the Government of Himachal Pradesh and Global Green Growth Institute (GGGI), in partnership with The Energy and Resources Institute (TERI). The study approach in implementation of the project studies involved series of consultations with relevant stakeholders, information and data gathering processes. A Steering Committee chaired by Mr. BK Chaturvedi and composed of Dr. R. K. Pachauri, Mr. P. Mitra, Mr. Deepak Sanan, Mr. Sarvesh Kaushal, Dr. G Vajralingam, Mr. Per Bertilsson, Mr. Onno Ruhl, The Resident Coordinator of United Nations, Ms. Naina Lal Kidwai, Mr. R. V. Verma, Mr. Prabir Sengupta, Dr. Prodipto Ghosh, Mr. Shri Prakash and Mr. S. Vijay Kumar served as guiding team with supports of technical team. Among the officials from Himachal Pradesh, the team is grateful to Mr. Deepak Sanan, Mr. Ajay Mittal, Mr. Tarun Shridhar, Mr. Shrikant Baldi, Dr. RN Batta, Mr. Priyatu Mandal, Dr. Ajay Lal, Dr. Sharad Negi, Dr. Suresh Attri, Mr. S. P. Gupta, Mr. P. K. S. Rohela, Mr. Pradeep Chauhan, Mr. Anil Vaidya and Mr. Vinod Kumar Rana. The report benefited immensely from the stakeholder interaction and nodal support from Department of Environment, Science & Technology and facilitation from the Directorate of Energy, and Economics and Statistics Department. Mr. Siddarthan Balasubramania (Country Head, GGGI India) and Dr. Suneel Pandey (Director, Green Growth and Resource Efficiency, TERI) provided valuable oversight for the project. The contents were drafted by the technical teams of TERI with Ms. Shailly Kedia, Dr. Prakashkiran S. Pawar, Mr. Anandajit Goswami, Dr. Madhusoodanan M. S. and Mr. Saurabh Bhardwaj as lead authors and Mr. Shyamasis Das, Mr. Jonathan Donald Syiemlieh, Ms. Aastha Sharma, Mr. Kanwal Nayan Singh, Mr. Nishant Jain, Mr. M. K. Bineesan, Ms. Swati Mitchelle D Souza and Dr. G. Ananda Vadivelu as contributing authors. The GGGI project team composed of Mr. Ajith Radhakrishnan and Dr. Prasoon Agarwal as lead authors and Ms. Swathi Sharma, Mr. Ankit Singhvi and Mr. Sahil Gulati as contributing authors.

1 Context

Himachal Pradesh is a mountain state with an area of 55,673 sq. km nestled in the lap of the Himalayas. The state has a wealth of natural resources but is also ecologically fragile, since it is situated in the Himalayan region. Himachal Pradesh has performed well in socio-economic indicators with per capita income, human development index, health and educational income higher than India's average.

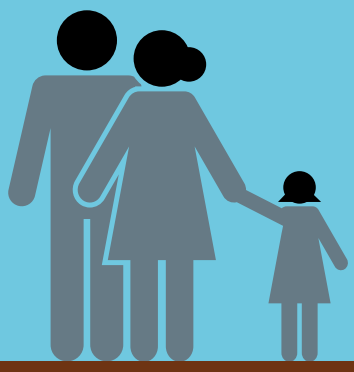
In the wake of climate change, socio-economic and ecological vulnerability increases and risk-based approaches become even more relevant. Thus, greener growth and sustainable development needs to take into account impacts of climate variability while strengthening policy interventions.

With 1.7 per cent share in the country's total geographical area, Himachal Pradesh harbours approximately 7.32 per cent of flora and 7.4 per cent of fauna found in India. This shows the state's richness in terms of biodiversity. The state also has a rich forest cover with 67 per cent of the geographical area being legally classified as forest area.

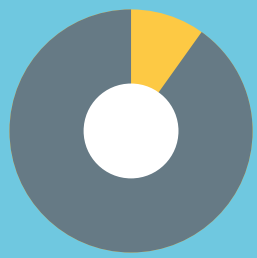


43%
Share of Tertiary Sector in GSDP

6.8
Million People

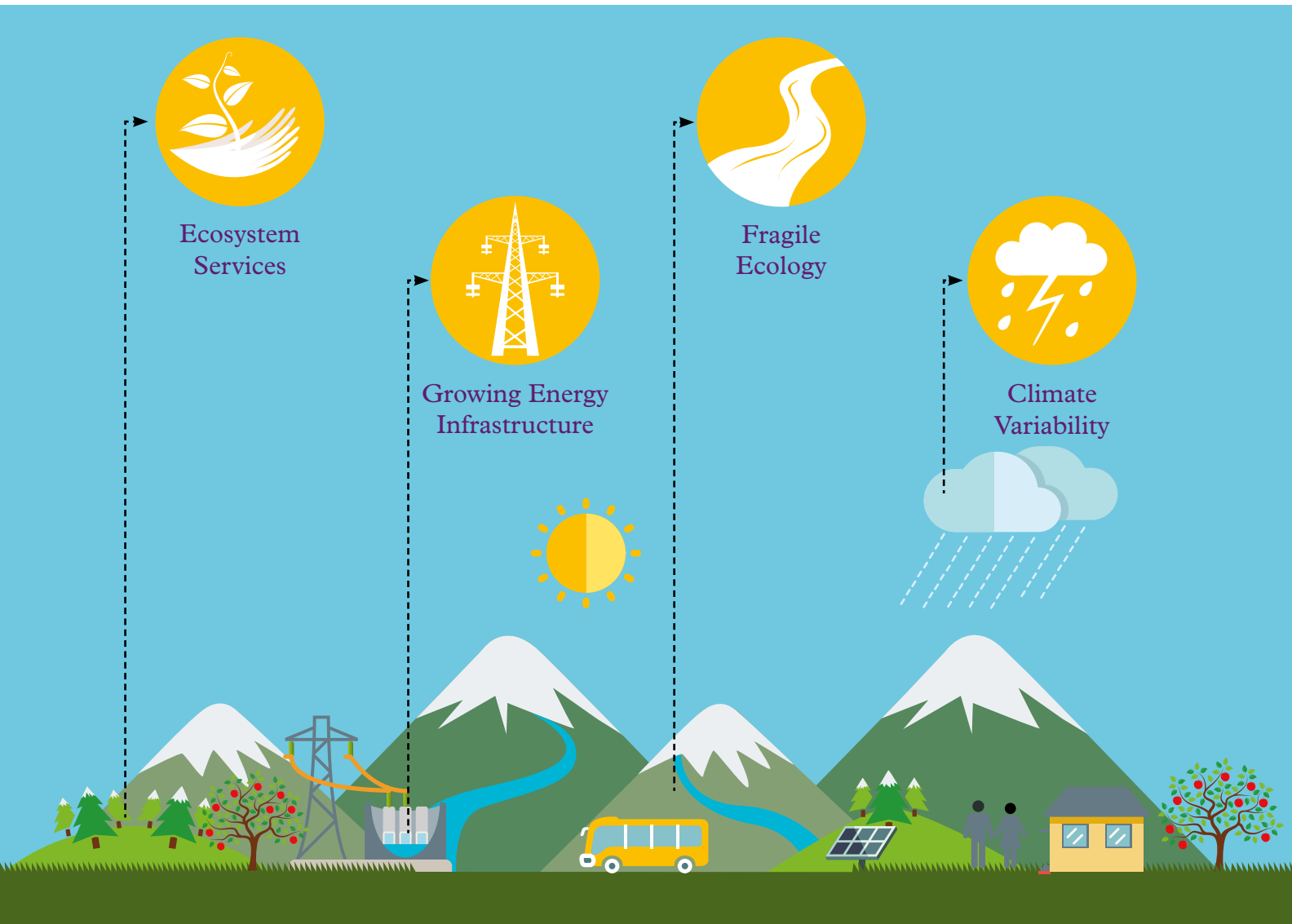


10%
Urbanization



However at higher altitudes, the tree and forest cover is limited as much of the area is barren due to the prevailing geographical and climatic conditions. The state is home to major river basins (which drain into both the Arabian Sea and the Bay of Bengal) that provide ecological services and is critical to the livelihoods of more than two hundred million people in Haryana, Punjab, Uttar Pradesh, and Rajasthan. Himachal Pradesh also has one of the main sources of clean energy—hydropower—for the country that can help address both the energy and peak shortages of the Northern Region.

Himachal Pradesh has rapidly evolved in terms of economic growth. The net state domestic product of the State and per capita incomes has shown a steady increasing trend. The secondary sector showed healthy signs of industrialization and modernization. Tourism is also contributing towards the economy as Himachal Pradesh has the natural capital and resources for being a tourist destination. The structural economic dynamics also has implications for the State's energy demand.

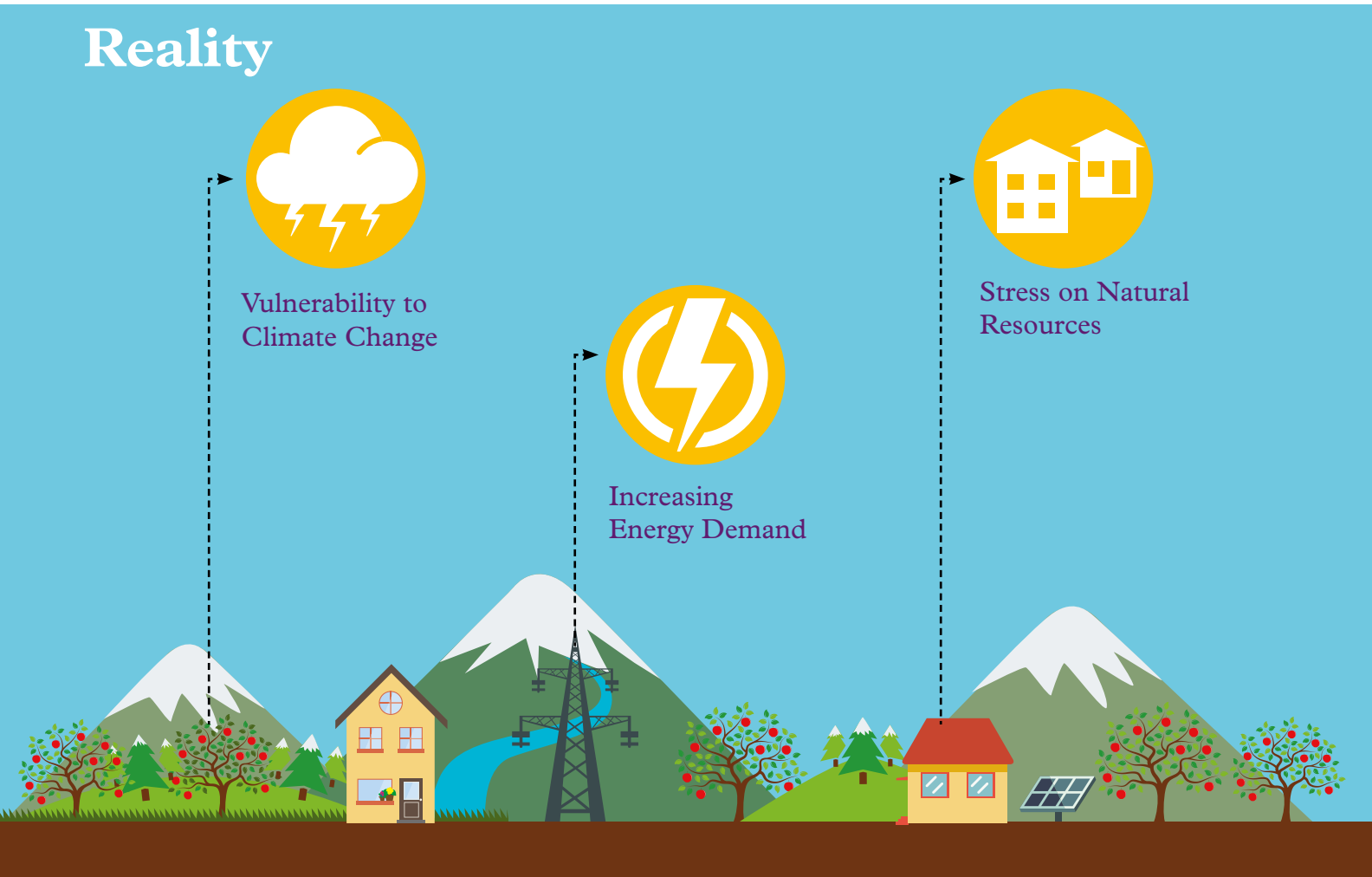


2 Motivation

The key engines of sustainable development for Himachal Pradesh include hydropower, horticulture, forestry, watershed management, less polluting industries, and tourism. In terms of hydropower and green growth, hydropower needs to be seen within a national green growth context rather than only looking at hydro-power as being important to development in Himachal Pradesh. In order to meet the objective of India's energy security and clean energy, hydropower will continue to play an important role.

A forward-looking, unequivocal vision, and policy signal is essential to translate the potential to real opportunities. The Himachal Pradesh government merits special mention here. The State has recognized the importance of greener growth and has been at the forefront of environmental stewardship initiatives which include the initiatives on climate change and disaster management, energy conservation programmes for promoting compact fluorescent lamps, enactment of a blanket ban on plastic bags, mandatory rainwater harvesting in all newly constructed buildings, organic farming policy, payment for ecosystem services policy, ecotourism policy, state tourism policy, solar power policy, and environment master plans.

With regard to hydro power development in the State, the State government has framed the Hydro Power Policy (2006). The policy sets separate guidelines for large (> 5 MW) and small hydro (upto 5 MW) projects, and deals with different aspects



of hydro power development quite comprehensively. To promote small hydro in the State and encourage private investment in the sector, the State government of Himachal Pradesh has designated Himurja as the nodal State agency. The government has also adopted the State Solar Power Policy in 2014.

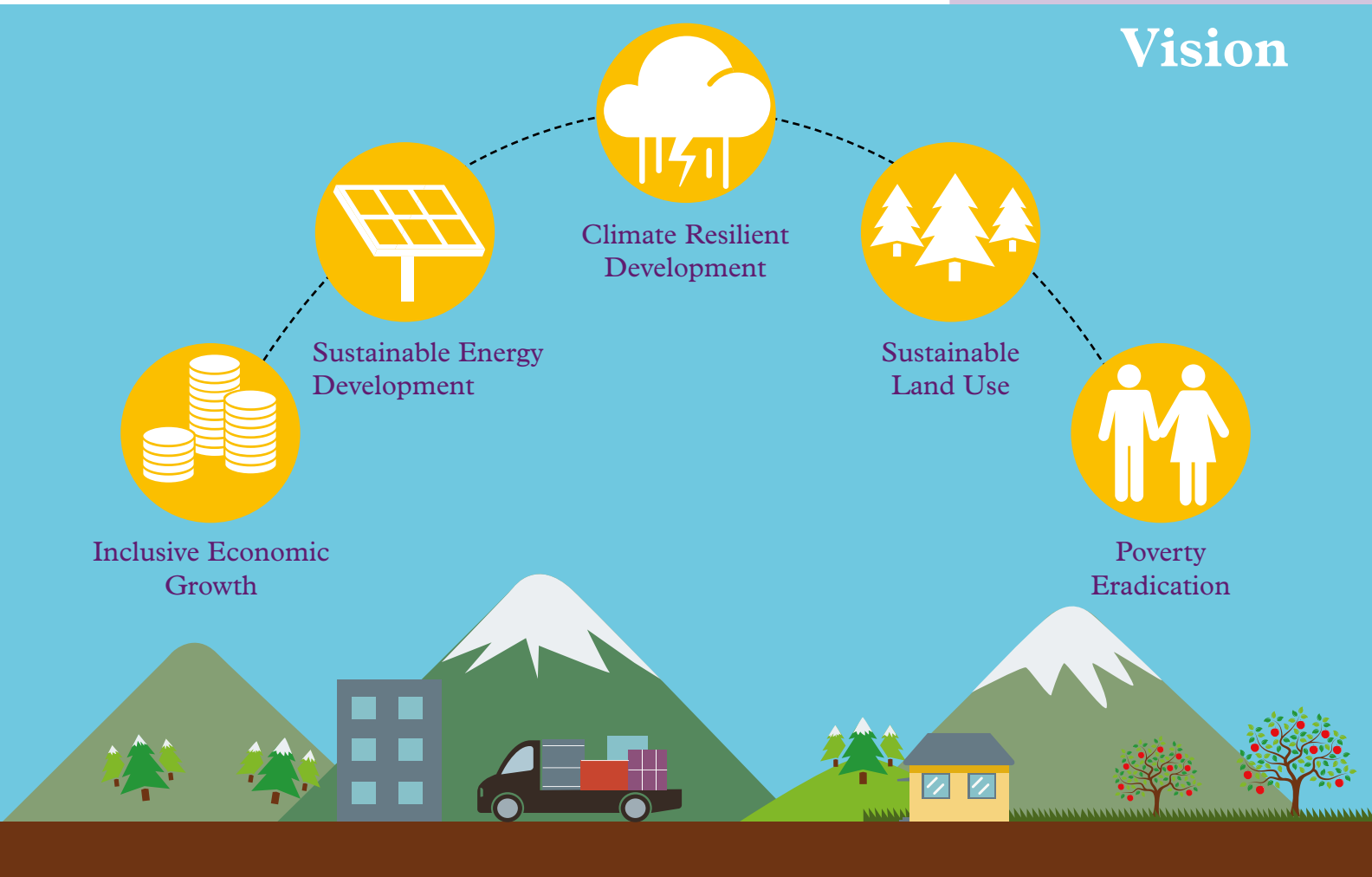
With its progressive policies, the State is poised to take a leadership position among mountainous regions in defining a future strategy of sustainable development rooted in sustainability of natural resources while ensuring future prosperity of its people.

Climate change and the resulting climate variability will have an impact on natural resources in the state. Given that the State's developmental activities are dependent on natural resources, for developing a climate resilient green growth strategy, it becomes important to understand as to what will be the impact of climate variability on the soil and water parameters. In addition, for considering inclusive development aspects, it becomes relevant to understand developmental activities considering socio-economic aspects and perceptions of communities.

What is Green Growth?

Green growth involves rethinking growth strategies with regard to their impact(s) on environmental sustainability and the environmental resources available to poor and vulnerable groups.

(Para 3.15, Thirteenth Finance Commission Report)



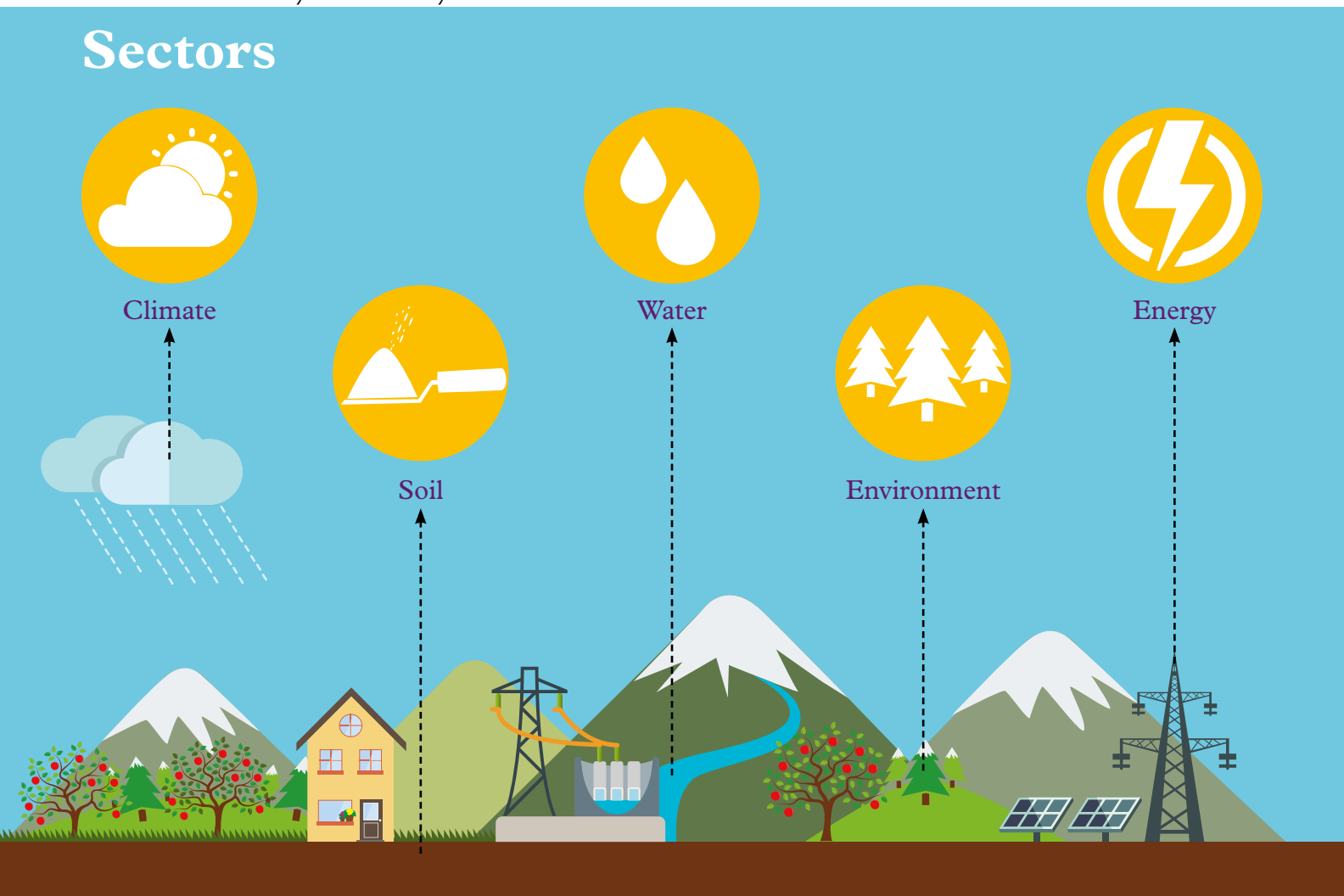
3 Approach

This document synthesizes five analytical components[1] for understanding aspects to inform decision-making for:

- Climate Variability
- Soil and Water
- Power Generation
- Sector-wise Opportunities
- Field Case Studies

The analytical framework included three models (climate modelling, Soil and Water Assessment Tool, and energy modelling), case studies from field visits, and a comprehensive review of sector-wise interventions in Himachal Pradesh.

Climate modelling for Himachal Pradesh provides an analysis and evaluation of observed climatological information of Himachal Pradesh and assessment of near future climate variability over the State. Analyses methods include review of literature, obtaining the observed climatological data for the State and its trend analyses. A high resolution dynamic model is used to simulate (under A1B scenario) a baseline run from 1970–2000, and for near future (2030s: 2020–2050) to arrive at future climate variability over the study domain area.



In this integrated assessment, the Soil and Water Assessment Tool component takes inputs from spatial analysis as well as the climate model. The model takes into consideration parameters like drainage network, land use & cover pattern, soils, elevation, and climatic parameters for simulating water balance (rainfall, surface and ground water quantity, evapotranspiration, base flow and amount of water retained in soil), yield (crop and tree), and indicative soil and water quality of the region.

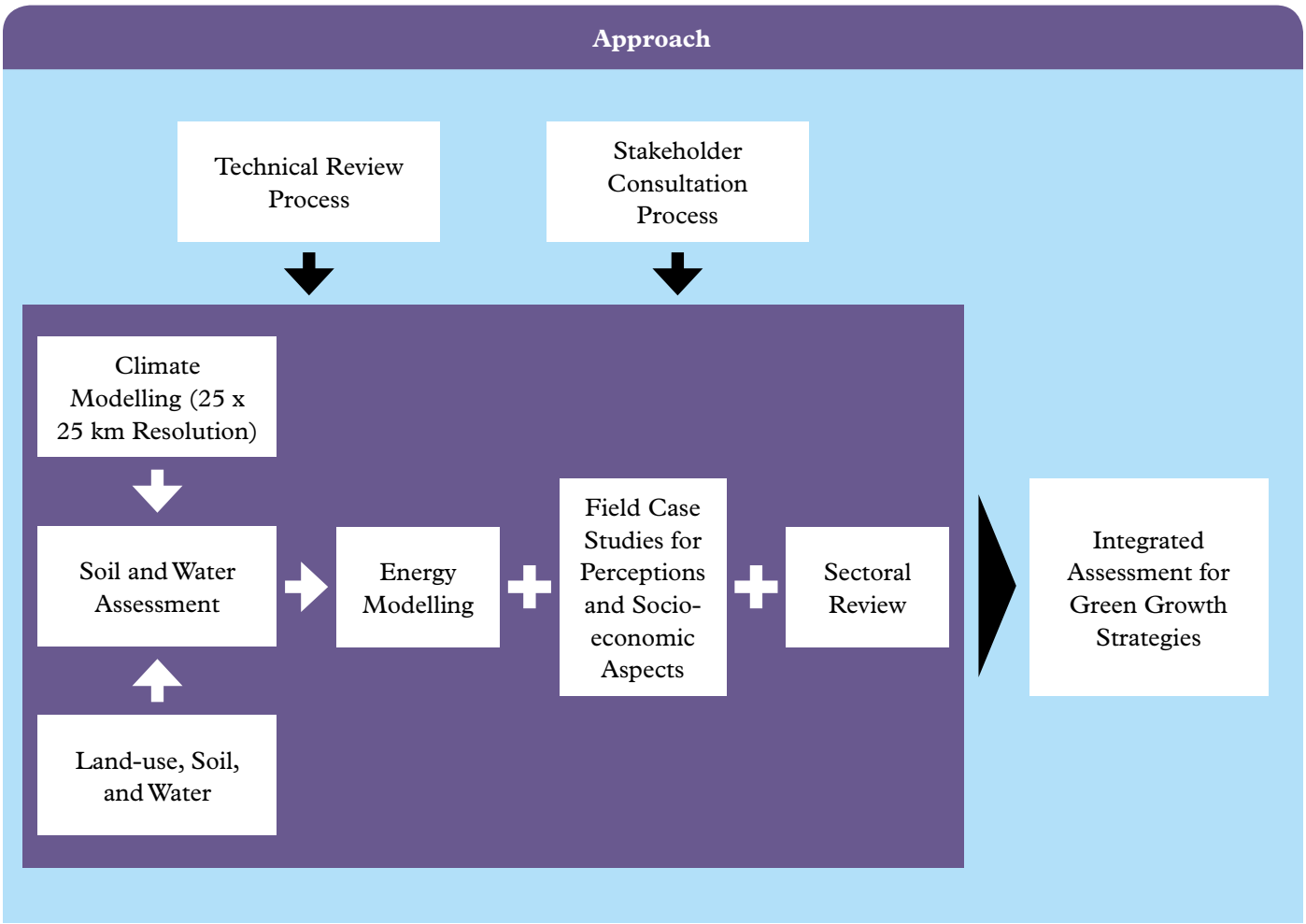
The analysis on Power Sector Scenario in the State intends to project a possible scenario until 2030s associated with the Himachal Pradesh power sector. This will inform the State into the possible implications of existing sector plans and policies on energy security and finance of the State. The analyses attempt to capture a broad range of aspects of the State's power sector, from technical to economic, which will aid in the planning and decision-making process of the State government for the coming Plan periods.

The case studies component examines socio-economic aspects at hydroelectric project sites in the State for further understanding the concerns of the local people with respect to hydro power projects. This understanding aims to assist policymakers in evolving procedures with respect to project planning and implementation of hydroelectric projects.

To achieve the objective, a qualitative field research has been undertaken by TERI researchers at four hydro-electric plants in the State in consultation with the Directorate of Energy. The research involves focussed group discussions and key person interviews using a semi-structured questionnaire to interview hydro developers, villagers and relevant government officials at state, district, and village level.

A sector-wise review was undertaken as an additional analytical exercise to identify areas of policy interventions. The review included developing discussion papers for air quality, water, forestry, biodiversity, waste management, renewable energy, demand side management, transport, industry, agriculture, buildings, and climate change.

The project approach was presented in a workshop and in a meeting engaging government officials and experts. Their feedback was used to refine the scope of the project, research questions, and data consistency. The analyses were conducted in consultation with various departments at the state level. In addition, the case studies component facilitated consultations at the district level and at the village level.



Models Used in the Analysis

The climate model used in the study is PRECIS—Providing Regional Climates for Impacts Studies—developed at UK Met Office Hadley Centre. PRECIS is an atmospheric and land surface model of limited area and high resolution. To analyse the future climate over the State, the regional model simulations at 25 km × 25 km resolution is carried out.

The Soil and Water Assessment Tool (SWAT) model is a process-based distributed-parameter simulation mode. SWAT uses readily available inputs and has the capability of routing run-off and chemicals through streams and reservoirs, and allows for the addition of flows and the inclusion of measured data from point sources.

A separate energy model is developed for the state to analyse the State's future power demand–supply balance, interstate sales, impact of power tariff, and fiscal implications of the State's power sector plans and policies.

An attempt is also made to integrate the three models to understand the inter-dependencies between climate, water, soil, and energy.

[1] Climate modelling for Himachal Pradesh, Soil and Water Assessment for Himachal Pradesh, Hydropower and Green Growth for Himachal Pradesh, Case Studies for Socio-economic Aspects and Perceptions at Hydroelectric Power sites, and Sectoral Review in Himachal Pradesh.

4 Implications for Climate Resilient Development

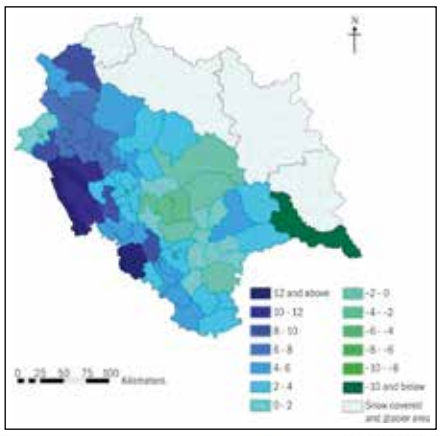
Climate Change

- Spatial variation is seen for precipitation projections for near future for different seasons. The climate model projects the percentage precipitation change for monsoon months between the range of –8 per cent to 12 per cent. This change for winter months of December, January, and February show a much larger variation from less than –10 per cent to over 30 per cent in some areas. The entire State shows a positive change for summer rainfall in the range of 5 per cent and 30 per cent. Post monsoon season also shows a variation in the changes of precipitation percentage in the range of less than –15 per cent in some areas to more than 30 per cent in others.
- Overall warming projected over the State in the near future with respect to the baseline period is projected. Annual mean temperature is projected to increase by 1.3–1.9°C for 2021–2050 relative to 1971–2000.
- Mean Annual Maximum temperature (T_{max}) over the State is projected to increase by 1.1–1.9°C. The Mean Annual Minimum Temperature (T_{min}) is also projected to increase over the study domain area in the range of 1.5–1.9°C. Increase in Minimum Temperature has many impacts not only over plants and crops but over human comfort as well.
- According to the model, the percentage of extremely wet days in future is greater than extremely wet days of the baseline period.

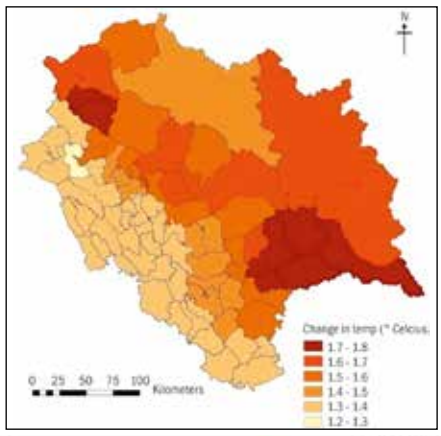
Soil and Water Assessment

- Since the state's developmental activities are dependent on natural resource management, it becomes important to understand as to what will be the impact of climate variability on the soil and water parameters. A Soil and Water Assessment Tool is used for understanding the impacts of climate variability in 2030s as compared to 1970–2000.

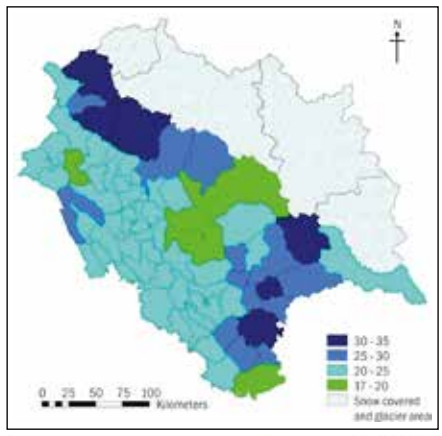
Block-wise Changes in JJAS Mean Annual Precipitation (2020–50 w.r.t. 1970–2000)



Block-wise Changes in Annual Mean Temperature (2020–50 w.r.t. 1970–2000)



Extreme Wet Days Contribution to the Total Rainfall in Near Future (2020–50)



- As compared to 1970–2000, in 2020–35, the water yield is projected to increase in sub-basins of Beas, Ravi, Chenab, and Yamuna. The water yield will decrease for Upper Indus and Sutlej. Development activities involving industry, power generation, and the domestic sector will have to be planned accordingly.
- Water availability for irrigation purposes will vary sub-basin wise. Upper Indus, Sutlej Upper, and Chenab sub-basins might have reduced surface water availability. Evapotranspiration is expected to increase by 6 per cent to 8 per cent across all sub-basins. Considering the delivery, conveyance, and application losses, actual irrigation will be considerably more, depending upon the type of irrigation method. Hence, agriculture and horticulture activities in these sub-basins need attention.
- Apple has emerged as the leading cash crop amongst fruit crops. Based on the model results, it is predicted that as a result of climate variability, especially increase in maximum and minimum temperature and decreased snowfall, apple productivity in Himachal Pradesh will decrease by 1 per cent by 2020 and 4 per cent by 2030.
- Based on model results, it is projected that as a result of climate variability, Lahaul & Spiti, Kinnaur, Shimla, and Sirmour will be affected due to medium to high decrease in total annual surface runoff. As compared to this, blocks in Chamba and Kangra districts will have medium to high increased surface runoff. Hence, hydroelectric projects located in these regions need special arrangements to handle increased surface runoff.
- It is projected that nearly 11.61 per cent area of the state will have catastrophic soil erosion (more than 320 tonnes/ha/year), 65.96 per cent area will have very severe soil erosion (80 to 320 tonnes/ha/year), and 22.44 per cent area will have severe soil erosion (24–80 tonnes/ha/year). Besides soil and water conservation schemes, catchment area development and catchment area development programmes continuous strengthening for long term strategic planning.
- Surface runoff is projected to increase for Beas and Ravi sub-basins while it might slightly decrease or remain stable for Chenab, Upper Indus, Upper Yamuna, and Sutlej Upper.
- Groundwater and subsurface water quantity is projected to increase for Beas, Ravi, Chenab, and Yamuna Upper sub-basins. A decrease in ground and sub-surface water quantity is projected for Upper Indus and slight decrease for Sutlej sub-basins.

Basins Affected Due to Change in Annual Surface Runoff (2030s) and Hydroelectric Projects

Basins Affected Due to Soil Erosion (2030s) and Hydroelectric Projects

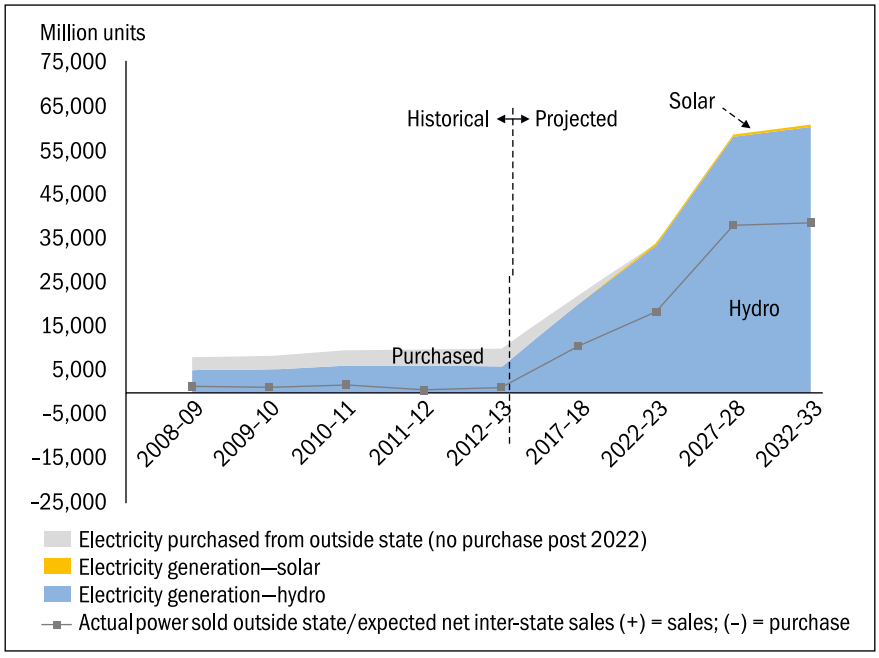
5 Implications for Energy Development

Power Outlook Under Current Policies

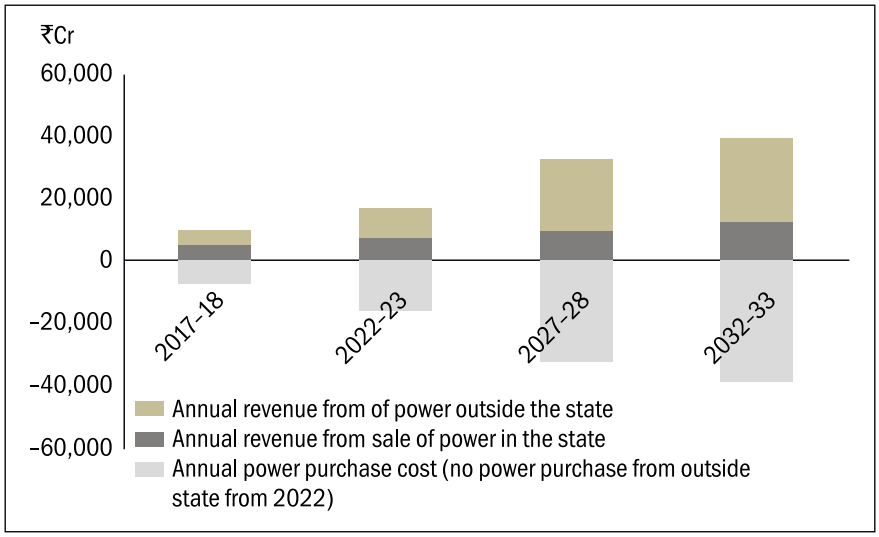
- Having significant potential to generate hydro and solar power in the State, enabled by dedicated power sector policies to attract required investments, the Himachal Pradesh government has set ambitious plans to harness the potential. On the hydro power front, the government is targeting to tap over 70 per cent of the hydro power potential (~23 GW) by 2020 (Department of Environment, Science & Technology 2012) and presumably the full potential of 23 GW by the end of Sixteenth Five-Year Plan period (starting 2032). On the other hand, the State Solar Power Policy envisages solar PV capacity addition of 50 MW by the end of the Twelfth Five-Year Plan period and another 250 MW by the Thirteenth Plan period.
- The current exercise intends to project possible scenario(s) associated with HP power sector. This will not only offer the State actors, the information of key sector parameters, but also will provide them useful insights into the likely implication of the existing sector plans and policies on energy security and finance of the State. The analyses attempt to capture a broad range of aspects of the State's power sector, from technical to economic, which will aid in the planning and decision-making process of the State government for the coming Plan periods. If the State realizes the capacity targets in the set timeline, the aggregate electricity availability in the State may reach 53,000 million units (MU) by 2032 at a CAGR of more than 11 per cent from the 2012 level. In terms of generation, 499 MU would be from solar.
- For the electricity demand scenario, the State is expected to witness a two-fold rise by 2032 from the 2012 level; the total electricity demand is projected to be about 14,400 MU with average per capita electricity consumption around 1,800 units.
- If the State does not purchase power from outside from 2022, HP may have potential to realize per annum inter-state sales to the tune of 18,000 MU in the Fourteenth Plan period (2022–27) which may reach 38,000 MU by 2032.
- Looking at the current hydro projects at different stages of development, a total of around 11 GW of hydro projects are in pipeline; however, investments for further 2,400 MW of hydro power are required. To realize the additional 2,400 MW, ₹29,000 crores would be required over the Thirteenth to Fifteenth Plan periods (escalation in cost is accounted), 45 per cent of which has to be tapped in the Thirteenth Plan period. On the other hand, the required investments to implement state solar power plans are estimated to be more than ₹2,000 crores over the Twelfth and Thirteenth Plan periods.
- The analysis finds that the total revenue from sale of power exceeds total power purchase cost throughout the period (2017–32) if HP continues purchasing power (~1982 MU yearly) from outside at a rate of ₹3.21 per unit (this is as per the tariff guidelines). However, in a no outside State power purchase (from 2022) scenario, though Himachal Pradesh may save a part of the power purchase cost, a corresponding decrease in revenue is envisaged to outweigh the saving. Moreover, the study predicts a negative net monetary flow during the Fifteenth and Sixteenth Plan periods in this scenario while assuming current tariff guidelines.

- The average power purchase cost is expected to increase by around 4 per cent annually till the Thirteenth Plan period compared to 2012 level (cost escalation accounted), largely because of the greater share of new power plants, both hydro and solar, which will possibly have higher production tariffs. At this stage, solar power may not seem economically attractive, however, with the improvement in capacity utilization factor, this option may become competitive. Moreover, development of hydropower does entail aspects such as displacement of local population with corresponding compensation and procedures related to land acquisition. Hence the state government can look to expand the ambition for solar power development in the State.
- The additional funds from hydro power projects in the State in the form of royalty would amount to approximately ₹30,000 crores over the next four Plan periods.
- The corpus for local area development (LADF) would be approximately ₹13,000 crores over the aforesaid period.
- It is found that the power output from a hydro power facility may decrease or increase by 6 per cent if mandatory minimum discharge level is raised to 20 per cent or reduced to 10 per cent, respectively. It is envisaged that if mandatory minimum discharge level is raised to 20 per cent, electricity generation from existing hydro power capacities may drop by about 2200 MU annually. Thus the State may lose ₹1,869 crores in royalty over the next four Plan periods. The State can realize additional financial resources of similar amounts in case the required discharge level decreases to 10 per cent. This number however does not account for ecosystem services lost or generated upstream and downstream.
- An investigation into the possible consequences of climate change on the precipitation, it is observed that precipitation is likely to vary from –8 per cent to 12 per cent over different regions of Himachal Pradesh. It is also seen that 15–40 per cent of total rainfall will be concentrated within short duration of period. As a result of climate variability, the average flow rate observed in the base period (2.98 to 3.92 m^3/sec) will be increased to 3.06 to 4.71 m^3/sec in the near future (2030s). The performance of hydropower projects could be affected due to factors, such as surface runoff and soil erosion, which could cause increase in silt transport.
- The loss from forestry sector and tourism sector, for every 1 GW hydro capacity addition, is estimated to be ₹123 crores. This valuation does not include aspects relating to riparian rights and aspects such as drinking water, health, upstream and downstream livelihoods. This valuation also does not consider monetary valuation of biodiversity as the principle of incommensurability, used in ecological economics, applies. The National Environment Policy of 2006 also talks of entities with 'incomparable value' that may be applicable to aspects involving biodiversity and rare species. Even so, it is worthwhile for the State to consider the various trade-offs (monetary and non-monetary) involving hydropower, forests, tourism sector, livelihoods, and biodiversity.

Projected Electricity Supply Dynamics in HP (2017–32)



Projection of Monetary Flows from Purchase and Sale of Power by HP (2017-32)



Perceptions from Hydroelectric Power Sites

- Based on the field case studies, some of the major issues highlighted pertain to the Local Area Development Fund, employment, compensation, impact of blasting and tunnelling, and impact of the construction phase and operations phase on the environment.
- The solutions for the issues identified in the case studies have implicitly or explicitly been mentioned in the Hydro Power Policy of Himachal Pradesh (2006). However, inadequate implementation practices have led to some discontent among both the developer as well as the village communities. A lot of these issues need to be tackled at project level, rather than only formulating a policy change at a macro level.

- The case studies show that distribution and utilization of Local Area Development Fund is a major issue on both sides—the developer as well as villagers. At this point, it would be appropriate to have an independent performance audit of the LADA funds (district-wise) by the State government with results being communicated via various mediums (one-to-one communication, group meetings, websites, etc.) to all the stakeholders involved. Moreover, it will also provide information on the development activities accruing from these funds carried out by the villagers.
- The government along with the developer could set up a website that would aid in documenting the impact of tunnelling and blasting activities. This website should be set up before the tunnelling and blasting activities take place. Also, SMS-based communications and use of local AM channels in Radio to educate and notify can be popularized.
- The State government along with project developers can include skill training and livelihood development opportunities as part of the project plan. These skill building and employment opportunities should not only be centred around hydroelectric projects but should be aimed at facilitating local enterprise. This will help in sustaining socio-economic development of project affected communities as the HEP gets commissioned and employment opportunities dwindle.

6 Sectoral Review

Challenges

50% State Target for Forest Cover

14% Increase in Water Requirement by 2020

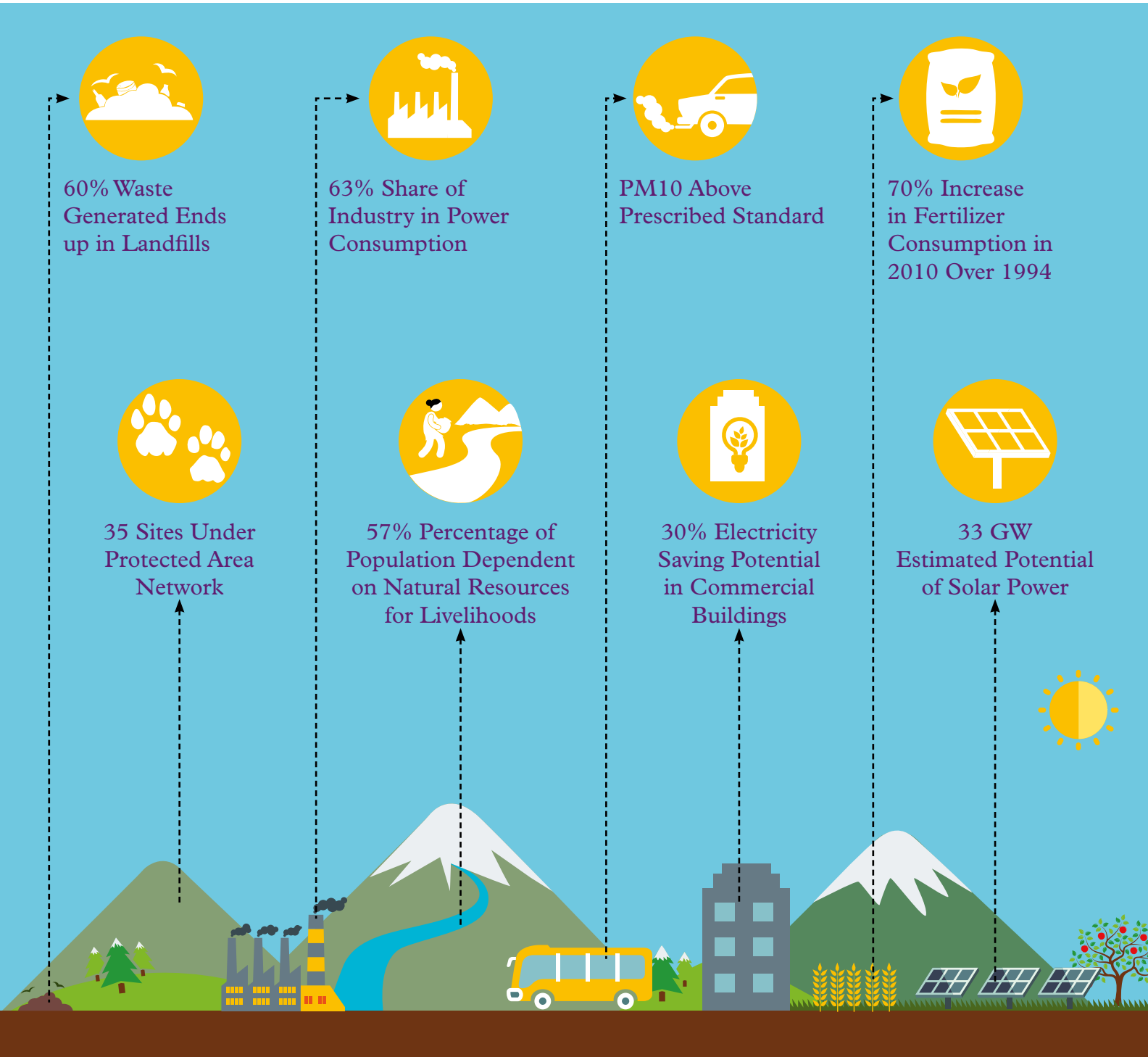
More than Three-fold Increase in Area Under Apple Cultivation in Last four Decades

43% Villages without Proper Road Connectivity

81% Share of Rain-fed Agriculture in Total Cultivated Area

23 GW Economically Exploitable Hydropower Potential

25% Electricity Saving Potential in Residential Buildings


60% Waste Generated Ends up in Landfills
63% Share of Industry in Power Consumption
PM10 Above Prescribed Standard
70% Increase in Fertilizer Consumption in 2010 Over 1994
35 Sites Under Protected Area Network
57% Percentage of Population Dependent on Natural Resources for Livelihoods
30% Electricity Saving Potential in Commercial Buildings
33 GW Estimated Potential of Solar Power

Opportunities

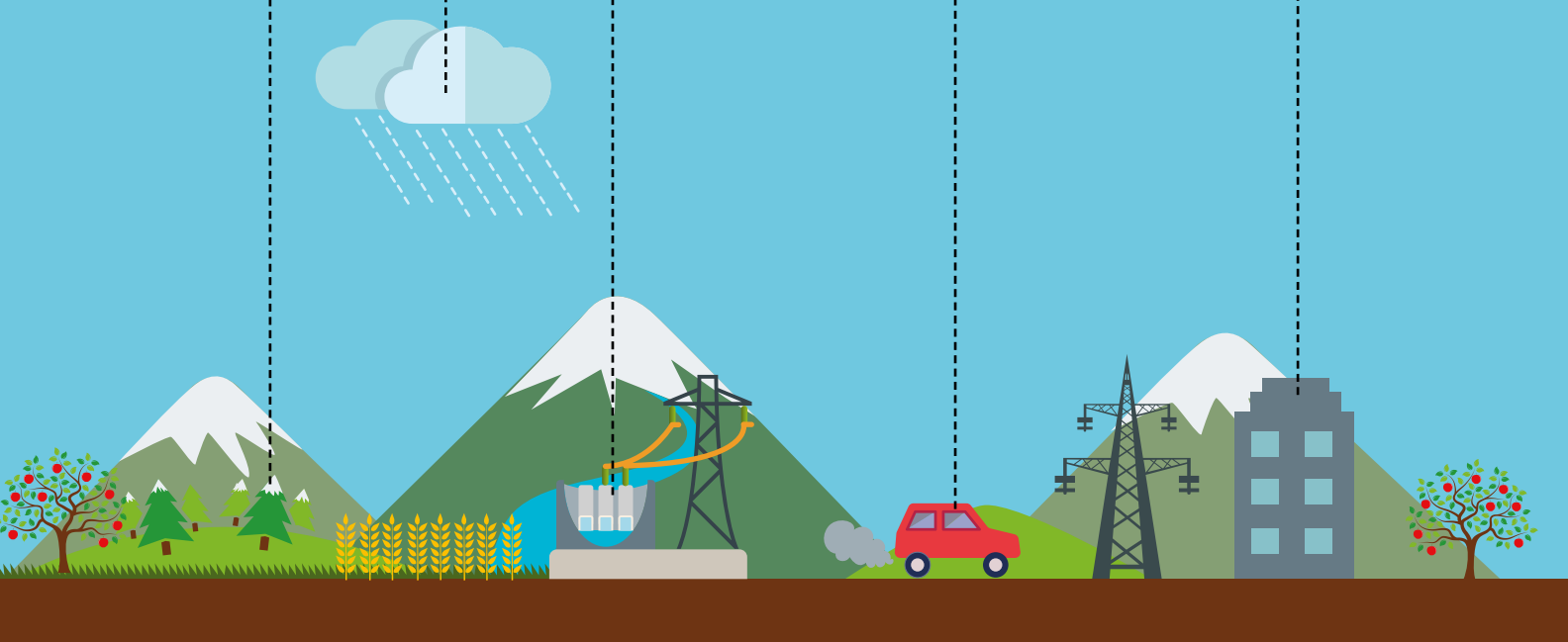
Forestry & Biodiversity
- Strengthening local community institutions
- Land records
- Improved cookstoves
- Contribution made to National Biodiversity Targets

Power
- Sustainable hydropower
- Small hydro
- Biogas
- Solar
- Energy Service Companies
- Research & Development

Buildings
- Incorporation of green building features in municipal bye-laws
- Vernacular architecture
- Retrofit measures
- Disaster risk reduction and management
- Low impact development

Climate Change
- International mechanisms
- Climate adaptation

Air Quality
- Instalment and Maintenance of Air Pollution Control Equipment in Industry
- Implementation of Bharat Stage V and VI emission norms
- Increase air quality monitoring stations



Waste Management
- Waste database
- Sewage treatment
- Waste recycling
- Enhanced acidification and methanation technologies

Water
- Integrated water resource management
- Water monitoring stations
- Irrigation water use efficiency
- Service delivery of water supply and sanitation

Industry
- Energy audits
- Fuel switch
- Cogeneration
- Energy efficiency
- Best operating practices
- Best operating technologies

Cross-cutting issues
- Rural-urban transitions
- Role model for hilly states
- Socio-economic drivers
- Employment and livelihoods

Transport
- Connectivity to remote areas
- Public transport
- Electric vehicles

Agriculture
- Integrated land use policies
- Improved farm technology
- Climate resilient agriculture

Forests & Biodiversity

Challenges

- The open and scrub forests constitute 35 per cent of the forest cover of Himachal Pradesh which is largely degraded. One of the main reasons for this large scale degradation is the over exploitation of fodder, fuel wood, timber, and non-timber forest products (NTFPs) beyond their sustainable limits. Other factors include forest fires and encroachments.
- Even under a moderate climate change scenario forests in 56 per cent of the grids in the state are vulnerable to climate change. The forest types and species composition is likely to change as early as by 2030 in these areas. In the long term i.e., by 2080, more than 80 per cent of the state forests are vulnerable to change. These changes might affect forest composition and productivity.
- Himachal Pradesh is bestowed with endemic flora and fauna. The wild flora and fauna are getting endangered due to disturbance and loss of habitats. The overall degradation of habitats is evident from the increase in non-forest area by 26 sq. km and increase in open forests by 4 sq. km. according to the Forest Survey of India (2013).
- The state has most forward looking policies such as on Payment for Environmental Services (PES), Organic Farming, Medicinal Plants, etc., and the challenge is to implement these policies at the field level. Generally, in case of PES, there is a need of regulated transactions between parties associated with the resources and defining the nuances of the regulations is a major challenge.
- Himachal Pradesh is contributing to the achievement of National Biodiversity Targets but at the state level, there is no mechanism to quantify the contribution being made by the State to the national efforts. In absence of quantification, the state may lose the opportunity to bridge the gaps for achieving the final outcome.

Opportunities

- Himachal Pradesh aims to increase its area under forest and tree cover from 26.52 per cent to 35.5 per cent. Based on geographical and climatic conditions, mixed plantations of locally useful species such Oak, Deodar, Kharsu, Kail, and Walnut can be undertaken. There needs to be strengthening of focus on restoring degraded forest, through natural regeneration where possible and mixed planting of local species/varieties in other cases.
- The productivity of planting material can potentially be increased manifold by using superior planting stock raised through tree breeding programmes, as well as through clonal technology and tissue culture.
- Himachal forestry sector has enormous scope for establishing and promoting forestry enterprises. There are various NTFPs viz. seeds from horse chestnuts, Deodar and Kail cones; resins from Pine spp; Katha from Acacia catechu; wild fruits like Berberis and herbs like Dhoop, Patish, and Dioscorea. Medicinal plants-based enterprises have huge untapped potential in the State. State's annual current trade of ₹1 million is minuscule compared to world trade of US$ 1.03 billion considering the fact that the State has more than 800 species with medicinal use.
- Encroachments can be addressed by strengthening local community institutions and educating them of the value of the common resource, so as to prevent individual encroachments and to inform the administration when they occur.
- In Himachal, around 71 per cent of the forest land area has not been surveyed and entered into revenue records. These lands need to be surveyed through Forest Settlement processes. Developing efficient fire detection and management system is another very important measure. The state forest department can work with the National Remote Sensing Agency for operationalizing this. Ensuring proper sanitation measures to prevent incidence of fire is also very crucial. Local community involvement is also important, both in preventing fires by ensuring that accidental combustion does not take place and by creating a stake in removing combustible material where feasible; and also in detecting and dealing with natural fires at an earlier stage.

- There is need for research and developing local processing-based business models where pine needles, which are a major source of combustible material can be used as a source of energy. Improved cookstoves also needs to be promoted to minimize stress on forest resources.
- Climate mitigation and adaptation measures need to be built into the working plan prescriptions of state forest department. At the same time, the capacities of forest department to understand the vulnerability of forest ecosystems to climate change need to be enhanced.
- Develop a mechanism to quantify the contribution being made by the state to National Biodiversity Targets.
- Himachal Pradesh has responded proactively to the situation concerning its biodiversity by formulating desired policies and setting targets to achieve the objectives. But there is a need of assessing the requirement of staff on the field so as to fulfill the objectives and also assess the capacities of the staff to undertake the desired activities.
- Mainstreaming the provisions of State Forest Policy, Medicinal Plant Policy, and State Payment for Ecosystem Services policy of Himachal Pradesh is needed. The Aichi targets and national targets thus become an opportunity to evolve roadmaps.
- There could be three major areas where the states can immediately develop a collaborative research programmes with national and international agencies namely valuation of ecosystem services, threatened flora and fauna, and sustainable and equitable utilization of biodiversity.

Air Quality

Challenges

- Particulate matter (PM10) is above the annual average standard of 60 $\mu g/m^3$ in all the cities (where monitoring stations have been set up) of Himachal Pradesh.
- Number of vehicles in the State has increased more than double (2.4 lakh to 7.3 lakh) from 2001 to 2012. Cars and two-wheelers are contributing the most in this increase in number of vehicular fleet.
- Both small-scale and medium-/large-scale industries show an increase in growth rate.

Opportunities

- Looking at the growth rate of vehicles in the state, there is an increasing need to boost public transport and to promote cleaner fuels such as electric vehicles for both personal and public transport.
- Tourism activities should be managed properly to control the vehicular movement.
- Government should emphasize on adoption of cleaner technologies, such as Vertical Shaft Brick Kiln and tunnel kilns in brick sector. Due to the mobile nature of few brick making technologies, the exact number of brick kilns is never accurate. Registration of brick kilns should be made mandatory in order to monitor these.
- Installment of Air Pollution Control Equipment (APCE) in all industrial units should be made mandatory for all the industries including cement.
- Efficiency of installed APCE's should be checked at regular levels and maintenance must be done.
- In order to have more regular control, number of air quality monitoring stations in the state should be increased.

Water

Challenges

- The need for better coordination between the water agencies and the need for an apex nodal agency to coordinate water resources planning has been widely seen as an important requirement.

- In urban water supply, there is need for rationalizing the network to meet expansion of urban areas.

Opportunities

- Integrated water resource management for water conservation using rainwater harvesting, groundwater recharge and rejuvenation of lakes and ponds in the river basin catchment.
- Water quality and flow (quantum variations) monitoring in streams and rivers to establish a database for the future for planning and interventions needs to be strengthened.
- Service delivery of water supply and sanitation schemes in both rural and urban areas is low and cost recovery is negligible. In the rural drinking water supply and sanitation sector, community ownership and maintenance should be strengthened. There is need for renovation, upgradation, and expansion of water and sewerage systems in towns and peri-urban areas.
- Upgrading levels of service delivery and sustainability of potable water is urgently required.
- There is need to review the limiting factors and existing gaps in wastewater treatment in river basin, such as technical, social, financial, institutional, and regulatory aspects in order to reduce future challenges.
- Irrigation water use efficiency and uptake is quite low—especially critical for pumped irrigation. Upgrading the existing system for long-term sustainability of pumped irrigation is vital.

Agriculture

Challenges

- The percentage net cultivated area to total geographical area decreased consistently over the years from 19.07 per cent in 1972–73 to 11.81 per cent in 2009–10.
- Erratic climatic conditions have posed challenges to the economic viability of farming in the state. Farmers have switched over from the agricultural profession leaving the land uncultivated. As a consequence, a significant portion of farm land gets abandoned. This has led to land degradation.
- Vegetal degradation observed mainly as deforestation/forest-blanks/shifting cultivation and degradation in grazing/grassland as well as in scrubland is the most significant process of land degradation in Himachal Pradesh.
- Abnormal pattern of rainfall and non-availability of water sources due to hilly terrain results in frequent crop failures and low productivity.

Opportunities

- Development and implementation of land use policies and its integration to the policies on forest and water so as to provide coherence in management of these resources needs to be undertaken. Further, there should be laws related to land use so that the incidence of degradation of agricultural land and the shifting of agricultural land to non-agricultural uses could be checked.
- Demonstration and effective dissemination of improved farm technology that maintain a balanced use and conservation of mountain resources such as micro propagation, drip irrigation, greenhouse cultivation, plastic mulching, fertigation, use of biofertilizer and biocontrol agents, vermiculture, and organic farming.
- Adherence to crops and cropping systems in line with soil fertility status in different agro climatic zones as per their suitability.
- There is a need to identify crops which can adapt to climate change suitability and awareness campaigns to educate farmers for promotion of bio-pesticides, organic farming, integrated pest management technology, and soil conservation measures.

Waste Management

Challenges

- Managing waste is already a challenge for the State. The bottle neck of lack of source segregation is, however, yet to overcome.
- The towns in Himachal Pradesh are small and are located far away. Establishing waste-to-energy facilities for each town individually requires huge investment and is financially unviable. Developing a regional waste treatment facility is a common solution to this problem but in HP even that is a challenge since towns are located at distance and transporting waste on hilly terrain could be a challenge.
- Getting the most credible waste inventory data is a problem. In absence of dynamic waste inventory, long-term planning for waste management becomes difficult.

Opportunities

- For better planning of waste management and application for recycling and sewage treatment, information is crucial. Each municipality should maintain a complete database for its waste management activities, particularly generation of waste (daily data), characteristics of waste (monthly data), processing facilities actually installed and operated, and their performance (monthly data), and final disposal in a sanitary landfill (monthly data).
- The aspects of waste management which the municipalities can handle efficiently must be identified and private players must be given a chance to manage the remaining aspects. The government must promote policies in such a way that private sector is encouraged to invest, establish, and operate facilities in the waste management sector.
- Economic incentives and disincentives serve to motivate consumers and businesses to reduce waste generation and dispose of waste responsibly, thereby contributing to increased demand for greening the waste sector. The incentives commonly prevalent in the waste sector include: taxes and fees; recycling credit and other forms of subsidies; deposit-refund; and standards and performance bond or environmental guarantee fund. Pay-as-you-throw is another way of discouraging waste generation.
- Himachal Pradesh, being a tourism and horticulture rich state has generation of organic waste. Technologies, such as enhanced acidification and methanation, can be used for utilizing waste. Sectors that generate organic waste in large amounts, such as food and fruit processing industries, hotels, community kitchens, and vegetable markets, can make the best use of the technology.

Renewable Energy

Challenges

- Evacuation is a problem affecting wind, solar, and the small hydro sector. Lack of adequate evacuation facilities has led to scaling back the commissioning and partial commissioning of new generation and the reduction of generation during peak periods. This issue is constraining the development of small hydro projects and solar development in the remote areas of Himachal Pradesh. Banks and financial institutions are more cautious lending to renewable energy (RE) projects given the poor state of the evacuation networks.
- Himachal Pradesh has adopted a single window project approval and clearance system for renewable energy. However, the effectiveness of this system needs to be strengthened. A robust system needs to be developed that sets a time bound target for getting all approvals and renewable energy developers to not have to follow up with different State government departments.

- The creditworthiness of the distribution companies is a critical issue and plays a key role in determining the bankability of a Power Purchase Agreement. Very few discoms are in good financial health. When discoms have poor financial health, the risk of off-taker default and delayed payments is high. Weak financials of discoms can keep them from meeting commitments and affects the effectiveness of instruments that have been put in place for deployment of renewables, such as the renewable purchase obligations.

Opportunities

- Realize the trajectory of renewable power purchase obligation to reach 19 per cent, including 3 per cent solar by 2022.
- Develop policy and regulation for Net-metering through which consumer would able to sell the extra power generated through rooftop solar plant to the grid. There is a need for estimation of potential of solar rooftops for hotels.
- Promote solar cookers, solar-based room heating technologies, solar water heaters, solar dryers, and photovoltaic for residential as well as hospitality, commercial, industrial, and agricultural sectors.
- Increase deployment of family and community size biogas plants run on cattle dung and alternate feedstocks.
- Promote 'farm level solar power generation' where land-owning farmers can install solar power projects of 2–3 MW capacity. Such projects can have multiple purposes of generating clean energy, tackling the issues of land scarcity, result in additional income for the farmer as well as foster skill development. Up to 500–1,000 MW power generation can being targeted.
- Facilitate delivery of bank credits through low-interest loans, particularly for small-capacity systems.
- Conduct training and capacity-building programmes for local technicians, dealers, and manufacturers, in order to ensure proper installation and maintenance of heating appliances, such as solar water heaters.
- Provide further regulatory support to small hydro power projects in terms of providing evacuation arrangement, grid connectivity, open access, and equitable wheeling tariff to make them competitive and provide level playing field to all the developers.
- Develop the vast Spiti cold desert into a renewable energy hub by setting up a 1,000 MW renewable energy facility. Spiti has abundant sunshine and wind to generate energy.
- Target energy generation from agro-residues (briquetting of crops residues) and gasifiers run on wood billets, crop and processing residues. Standalone power units run on small hydro and crop residues can be useful in promoting rural agro-processing industries.
- Support pilots for demonstration of renewable energy technologies.

Demand Side Management

Challenges

- It has been forecasted that the demand and energy requirements in the state are expected to increase by two and half times in the next 15 years.
- Industrial consumption accounts for around 60 per cent of the total electricity consumption; domestic category contributes to 22 per cent of the energy sales while the agriculture category accounts for only 7 per cent of the total energy sales in the State.

Opportunities

- Special focus is needed for promotion of EE appliances in domestic households, street lighting, government and private establishments, and water pumping needs in agriculture sector.
- There is need to increase the State Energy Conservation Fund and monitor its utilization.

- Creation of adequate resource pools, Energy Service Companies (ESCOs), and business models for implementing DSM programmes.
- Develop Centre for Excellence to address R&D and demonstration issues related to demand side management and energy efficiency.
- Impact analysis of the DSM regulations and incorporate modifications to make it effective should be conducted along with impact analysis of business models developed for implementation of DSM programmes. Regulatory impact studies on tariff-based interventions need to be commissioned.

Buildings

Challenges

- The state has introduced several appropriate legislations/ policy/ programmes/ 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. Slope protection, water, wastewater management, storm water management, and solid waste management are increasingly important. However, in spite of the appropriate legal framework, the sector faces several barriers to greening the building sector.
- The regulatory frameworks for implementation of Himachal ECBC code and its subsequent integration in the building bye-laws and specifications of materials/rates in the state public work departments 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.
- 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.

Opportunities

- Incorporation of green/energy efficiency features in municipal by-laws and all related documents followed by the State government.
- Promotion of vernacular architecture (at least in the rural and less urbanized areas). Certain policies promote it but adoption needs to be taken in a more integrated and intense manner. It could involve incentivizing designers, enabling workmanship, and creating a sense of cultural pride amongst the people.
- At least 50 per cent 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; and revision and further customization of state ECBC as per the requirements of the state.
- Need to integrate the principles of low-impact development (such as sustainable urban drainage systems, erosion control, development conducive to slopes, green cover, application of renewable energy, etc.) at all zonal plans, neighbourhood plans (new and retrofit) on a priority basis in more vulnerable areas. To begin with, few pilot areas in the state could be taken for implementation.
- Retrofit measures to make the existing building stock energy efficient and to overcome the various environmental challenges posed by the sector.

- Capacity building needs to be carried out at various levels for enabling green construction, local and state level government officials in order to implement the green growth strategies in the building sector.

Industry

Challenges

- The industry sector is one of the major consumers of energy. Within the sector, cement sector is a very significant energy consumer.
- The major challenges in the Micro, Small and Medium Enterprises (MSME) sector include among others—lack of awareness on energy efficient (EE) technologies/practices and financing options, lack of off-the-shelf technological solutions, poor quality of local service providers, limited capacities of unit level workers to deploy EE technology, limited channels of communication between MSMEs, technology providers and FIs, and lack of institutional support at the cluster level.

Opportunities

- The State government should promote energy audits in the industries (including MSMEs) to identify the energy saving areas. Benchmarking of specific energy consumption is required to access and compare present status of performance/ technologies in our industrial sectors to best technologies and practices worldwide.
- The concept of 'designated consumers', as in large industries, should be extended to micro, small and medium enterprises (MSMEs). High energy intensive clusters to be classified as 'designated clusters' and cluster level programmes should be implemented for them.
- The state industries (particularly cement) should explore fuel switch. Energy efficient lighting, energy efficient equipment such as IE motors, air compressors and pumps to reap savings of about 10–15 per cent.
- In the long run, innovation will be crucial. The government needs to set up 'incubation centres' and incentivize cluster level fabricators to develop local low cost technological solutions. Public–private participation is required for Research, Development, Demonstration, and Deployment for clean technologies in the MSME sector to invest in cost-effective technological solutions customized to local conditions.
- Blended cement can be manufactured from industrial wastes. Biomass can also be utilized beneficially during clinker burning process. Various substitute fuels need to be explored, depending on their availability locally in the State.

Transport

Challenges

- Road connectivity and accessibility particularly to far flung areas in higher reaches like Kinnaur, Lahaul, and Spiti valley is a major challenge in the State. Mobility of passengers as well as goods is severely constrained making life not only difficult but also costlier. Lack of adequate transport adversely affects movement of agricultural and horticultural products and thereby economic growth.
- With majority of the road network being single lane and increasing vehicle density (particularly private vehicles), the existing road network in the state face capacity issues causing traffic congestion. As a result, problems of heavy traffic jams, pollution, loss in productivity, etc., are becoming increasingly evident.
- Heavy inflow of tourists and tourist vehicles in the State further puts pressure on the road network. Nearly 0.2 million vehicles enter the State during the tourist season that lasts for almost nine months a year.

Opportunities

- Given the dominant role of the road sector, the State government should give priority to expansion of the road network and strengthening and upgradation of the existing roads. There is also need for ensuring maintenance by providing adequate funding and training local community groups and self-help groups to maintain them.
- Provide 100 per cent connectivity to all the remote areas in the State by all-weather roads on priority.
- Public transport networks should continue to be further strengthened. Use of electric vehicles can be explored for local urban transportation where the terrain permits.
- Use of electric mobility will have twin benefit of reducing local emissions and also replacing diesel with clean hydro power.

Electric Buses: A unique opportunity for Himachal Pradesh. Electric buses offer multiple advantages over Internal Combustion Engine (ICE) buses, specifically in the case of HP.

Technical Benefits:

- *Superior torque to power output at low speeds:* Unlike IC engine buses, e-buses are can provide greater torque at lower speeds, to sustain steep slopes for long durations.
- *Regenerative braking mechanism*: IC engine idles on downhill slopes leading to irrecoverable loss of energy whereas e-buses can partly recover energy using the regenerative breaking mechanism to charge batteries.
- *Reduced wear and tear*: It is observed, that scheduled servicing of buses in Shimla occurs at a lower value of cumulative km (15-18000 km) than that recommended by the manufacturer (25000 km), due to greater wear and tear. E-buses have an advantage, owing to the absence of a mechanical drive train and significantly less moving parts.
- *Superior performance at high altitudes:* Unlike electric motors, IC engines show a significant drop in performance at high altitudes due to lower oxygen partial pressure.

Environmental Benefits:

- *Reduced air pollution:* E-buses release zero tail pipe emissions, having direct impact on limiting air pollution.
- *Reduced noise pollution:* E-buses operate at over 30 % lower noise levels, thus favorably impacting stress levels, sleeping disorders and productivity of commuters and locals.
- *Utilization of state produced hydro power:* HP produces surplus Hydro power for majority of the year which can be suitably utilized to operate e-buses.

Socio-Economic Benefits:

- *Greater energy security:* Achieved due to lower energy consumption & lower price volatility in electricity required for of e-buses in comparison to high speed diesel.
- *Job creation*: The NEMMP anticipates a demand for ~3000 e-buses by 2020, leading to a creation of 1200-1300 direct jobs and additional 4 indirect jobs for every direct job.
- *Reduced fatigue factor & increased road safety*: The automatic drive of e-buses can significantly relieve stress on the driver, driving long hours on harsh terrain.

Climate Change

Challenges

- With high dependence of economy and livelihoods on natural resources and ecologically fragile ecosystems, Himachal Pradesh is highly vulnerable to climate change. The state has been facing environmental issues, such as deforestation, landslides, land degradation, and desertification which have added to the vulnerability of the State.

- According to the State Action Plan on Climate Change of Himachal Pradesh, financial constraints and limited resources have aggravated the challenges being faced due to these environmental issues. Climate change and its impacts being manifested on different sectors in the state are posing additional challenges for the State.
- Himachal Pradesh has established the inventory of greenhouse gas (GHG) emissions for its sectors and sub-sectors. The major source of GHGs emissions is bulk demand of energy from industry, commercial, tourism, and development activities. Energy demand from the residential sector is also showing need for mitigation measures in the state. Awareness generation among the people is critical. Cement industry in the state is also a major source of GHG emissions. Strategies to strengthen mitigation in this sector are needed.

Opportunities

- Tapping funding opportunities from international mechanisms such Adaptation Fund and models involving private funding sources can assist in addressing financial gaps.
- The adaptation fund is an example of direct access. In each country, there is a National Designated Authority (NDA) for recommending or endorsing project proposals for funding the Adaptation Fund Board (AFB). In India, the NDA for AF is Ministry of Environment, Forest and Climate Change (MoEFCC). The responsibility of overall management of projects and programmes financed by the AF, however, lies with the National Implementing Entity (NIE). For example, in case of India, National Bank for Agriculture and Rural Development (NABARD) has been designated as the NIE.
- The Green Climate Fund (GCF) has been set up under the Convention to support the developing country parties on combating climate change through adaptation and mitigation activities. Recently, NABARD has been selected as the first NIE in India for the GCF for climate change adaptation and mitigation primarily in agriculture and rural sector.

Cross-cutting Issues

Challenges

- There has been a significant decline in the contribution of the primary sector in the state, with a decline from 58.56 per cent in 1970–71 to 17.79 per cent in 2012–13. However, the proportion of the working population involved in agricultural activities (either as cultivators or as agricultural labourers) has not shown a commensurate decline.
- While the contribution of the primary sector to the GSDP declined, more than 55 per cent of the working population are dependent on this sector for livelihoods. This indicates that while there has been a transition of the economy from an agrarian economy to an economy with greater contribution from the tertiary and secondary sector, a significant proportion of the population continues to be dependent on the primary sector as an occupational choice. Ensuring the viability of agriculture as a feasible livelihood option is a challenge faced by policymakers in the State.
- Moreover, livelihoods in mountain areas are more susceptible to environmental and economic changes than those in lowlands because of rough topography, remoteness, and poor socio-economic infrastructure.
- While Himachal Pradesh is considered largely rural, the aspirations of people for urban opportunities cannot be ignored. The criterion for giving assistance to cities for infrastructure development under the centrally sponsored schemes is based on populations. This criterion does not consider the unique characteristics of hilly regions.

Opportunities

- There is an urgent need to develop a strategy for livelihoods and employment in line with the multiple drivers around growth in the state.
- Himachal Pradesh can play a leadership role along with other hilly states to advocate for different set of criteria for urban development.

- Capacity building needs of urban local bodies need to be assessed so that these can be equipped for sustainable management.
- Growth corridors need to be identified and developed to meet the requirements of rural population with provisioning of services such as health, education, employment, energy, and connectivity.
- A vision plan needs to be developed that clearly identifies the socio-economic and other development drivers in the State as well as livelihood and employment implications.

Financing as a Precursor To Green Growth Strategy

A robust financing ecosystem is critical for sustained development and scaling up of green growth opportunities. Its success is hinged on instruments available for long term financing. Himachal Pradesh, as a special category state operating on revenue and fiscal deficit, has limited headroom for self-financing growth opportunities, especially those with primary focus on asset or capacity development. Accordingly, an effective green growth strategy would need to focus on financing as a precursor to prioritization of opportunities.

The three key financing drivers for green growth deployment are policies with state government budgetary support, central government aid, and external aid, which may include cross border climate finance. These drivers create an enabling environment for private sector participation to increase the availability of funds for green growth opportunities.

Himachal Pradesh, as a special category state, receives over 50% of its share of revenue from central government grants. The high dependency on Government of India (GoI) funds in HP can be assessed from the fact that out of a total 307 Centrally Sponsored Schemes in HP, 79% percent schemes have greater than 75% share of GoI spending. The 14th Finance Commission raised the states' share of central taxes from 32% to 42%, which will increase the amount of funds available to be spent at the state's discretion in the next fiscal year. However, this decision is accompanied with reduction in the state's share of central government supported (Category C) schemes. Overall, the transfer to states through centrally sponsored schemes has reduced from INR 2.52 lakh crores in 2014-15 to INR 1.69 lakh crores in 2015-16, which has negatively impacted the special category states such as HP more than other Indian states. In the 2015-16 budget, HP's fiscal deficit is INR 3,285 crores, which could be significantly attributed to the state losing a grant of more than INR 3000 crores in the form of Normal Central Assistance, Special Central Assistance, and Special Plan Assistance.

Additionally, HP is also running revenue and fiscal deficit with interest payments outgo being 15% of the revenue receipts, one of the highest in the country. This limits HP's capacity to borrow long-term capital through market instruments for development of infrastructure. HP can build on its success of financing development projects through multilateral and bilateral donors and Externally Aided Projects (EAP). Insights from the analysis of the state's current spending priorities make a strong case for HP to seek even more external funding sources to meet its green growth priorities.

A business case for electric mobility has been developed in detail in the form of a pre-feasibility report. The state budget, 2015-16 has announced initiatives such as the Rajiv Gandhi Micro Irrigation Scheme, LED Promotion Program, and increase in the state's hydropower and solar capacity. We also identified the innovative Payment for ecosystem services initiative as an enabling policy that can garner funding from international climate change funds such as the Green Climate Fund and domestic grants such as the National Adaptation Fund, to be taken up in the Himalayan state of HP.

7 The Way Forward

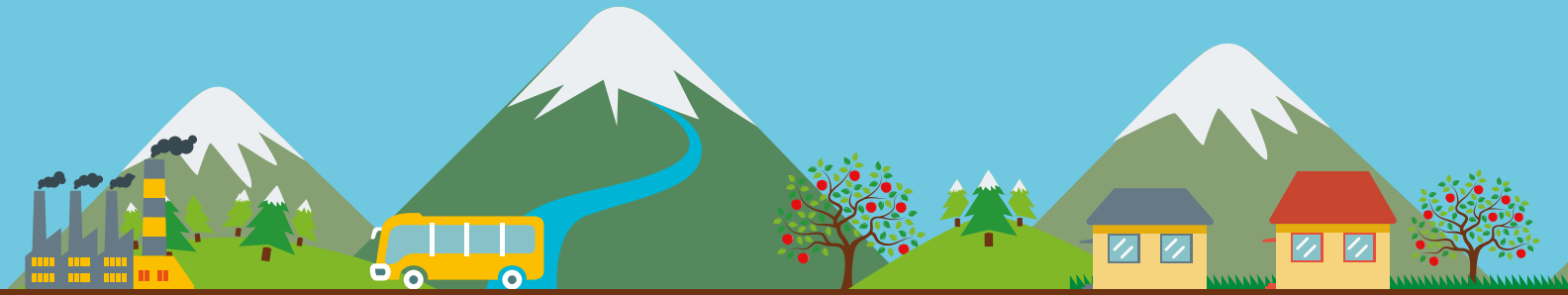
The study provides an assessment of long-term sustainability challenges in the state using a range of analytical tools and field case studies. Implementation of climate resilient green growth strategies requires concerted policy action and interventions. Following key interventions, the following areas are recommended to foster climate resilient green growth in the state:

Information for Risk-based Climate Resilient Interventions: Disaster risk reduction and management related interventions needs to evolve in order to respond to climate change impacts including extreme climate events, soil erosion, and surface water runoff. Himachal Pradesh has a unique topography and climatic conditions. For evolving disaster risk reduction related policies, information on climate impacts and risk management strategies at a finer scale will be required. Monitoring network for all streams and rivers for water quality and quantity parameters are needed. Pilots can be taken up at generate knowledge while engaging with the communities. Social audits of tourism, hydropower, and other developmental activities will promote engagement with communities.

Climate Resilient Interventions

Mobilizing Finance

Data & Monitoring



Addressing Data Gaps: Collecting and synthesizing existing and new data is needed to facilitate preparation of strategies as well as evaluation of existing policy initiatives. The state already has a good infrastructural base for geo-spatial data. Data for other parameters can be collected using existing management information systems.

Mobilizing Finance: Financing is critical to the implementation of climate resilient green growth interventions. In a small state like Himachal Pradesh, public finance needs to continue to be an important source of funding climate resilient green growth projects. Revenues from hydro, industry, tourism sector must be used for green growth, climate resilience and local area development of locations and catchments affected by these activities. Finance needs to be mobilized for strengthening public transport and full maintenance of road networks through local groups. In addition to public finance, the role of private sector and development institutions also becomes important.

Commissioning Pilots and Technology Demonstration: Pilots need to be commissioned in opportunity areas. Technology demonstration should be encouraged in areas of renewable energy, waste management, utilization of pine needles, renewable energy for cold storage applications, and natural resource management. This will help in upscaling of technologies.

Pilot Projects

Mainstreaming Environmental Sustainability in Decision-making Processes

Capacity Building

Capacity Building: Enhancing financial, technical, and institutional capacities of government as well as the voluntary sector is essential for the implementation of climate resilient green growth strategies. A detailed assessment of capacity building needs, sector by sector, becomes essential. A greater engagement between government, research & academia, not-for-profit organizations, and the private sector is needed to support implementation.

Mainstreaming in Decision-making Processes: Climate resilient green growth strategies needs to be looked as a cross-cutting issue which requires policy coherence and inter-departmental coordination. For further mainstreaming of environmental sustainability in decision-making processes, the government can adopt green budgeting for the state of Himachal Pradesh wherein all departments can prepare environmental budget statements—this would encourage proactive mindsets among policy-makers as they would then reflect on activities undertaken in their respective departments.

Understanding Emerging Issues: The state needs to better understand and be prepared for growth drivers including urbanization and change in structural dynamics. According to emerging needs, skill development and vocationalization of education is urgently needed. This is crucial for sustainable and inclusive development.