District Development Committee, Dolakha

Final Report on

DISTRICT CLIMATE AND ENERGY PLAN

Dolakha District

Technical Support by Alternative Energy Promotion Center (AEPC)

December

Submitted by :	
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PREFACE

This plan "District Climate and Energy Plan of Dolakha District**"** was prepared between on May, 2014 to December 2014 period. The activities related to the study on information collection were initiated, guided, funded and monitored by Alternative Energy Promotion Centre and District Development Committee Dolakha Jointly.

A dedicated team comprising of Environmental Engineers, Renewable Energy Experts, Environmental / Social Scientist having expertise in the climate change and energy were directly involved in information collection, analysis and interpretation.

The report provides comprehensive information on the state of Energy and climate change situation in district. The report is organized in such a way that can provide background information on Energy and climate change situation in the district. It suggests aspects of and future prospects with Energy and climate change, providing a five year plan.

It is important to note here that this report is compiled within short span of time with limited resources. Therefore, there may be possible to identify some deviations particularly in the figures presented in the report. However, it is expected that the report in present form will serve a basis for future endeavors on the subject.

Acknowledgement

CIAS -Green Jv would like to extend its sincere gratitude to Alternative Energy Promotion Centre and District Development Committee, Dolakha for relying and providing an opportunity for such a gracious work. We are great full to Pr. Dr. Govinda Pokhrel (former Executive Director, AEPC) and Ram Prasad Dhital (Executive Director, AEPC). We like to acknowledge Mr. Raju Laudari, Mr. Rudra Prasad Khanal, Mr. Prem Pokhrel, Mr. Krishna Chandra poudel, Ms. Nigma Tamrakar, Mr. Rajan Rijal, Mr. Laxman Punjali and Mr. Bibek Raj Kandel of AECP for their guidance and inspiration throughout the study period. Their valuable comments and insights in general have helped in improving the document quality.

We would also like to thank Shyam Kishro Yadav, EEO Dolakha for regular support and assistance for preparation of DCEP. We are also very grateful to DEEU for providing district information, organizing site visits and meetings with the stakeholders in the district and arranging enumerators for data collection. We are thankful to all enumerators involved in data collection for their restless effort even during monsoon.

We are thankful to many people whose assistance and cooperation has made preparation of Dolakha's District Climate and Energy Plan possible. First and foremost, we are thankful to all the task force members. We are very grateful for their interest and the openness with which they shared their experiences. We would also like to thank the district stakeholders in renewable energy and more importantly members of the DEEU and DDC for availing themselves during the course of this assignment.

Dinesh Prasad Bhatt

Team Leader for DCEP

CIAS- Green jv

Acronyms and Abbreviations

AEPC	Alternative Energy Promotion Centre
BAU	Business as Usual
BSP	Biogas Support Program
BSP-N	Biogas Sector Partnership Nepal
CBOs	Community Based Organizations
CBS	Central Bureau of Statistics
CDM	Clean Development Mechanism
CFUG	Community Forest Users Group
CRT	Centre for Rural Technology
DDC	District Development Committee
DEEU	District Energy and Environment Unit
DEMI	Decentralized Energy Management Initiatives
DEPP	District Energy Perspective Plan
DFO	District Forest Office
ESAP	Energy Sector Assistance Programme
FDG	Focal Group Discussion
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GHI	Global Horizontal Irradiance
GJ	Giga Joule
GSI	Gender and Social Inclusion
GoN	Government of Nepal
GWh	Giga Watt hour
Ha.	Hector
HDI	Human Development Index
HH	Household
ISRC	Intensive Study Research Centre
ICS	Improved Cooking Stove
INGO	International Non Governmental Organization

IWM	Improved Watermill
Kg.	Kilogram
KII	Key Informant Interview
Km.	Kilometre
kW	Kilo Watt
kWh	Kilo Watt hour
LCC	Life Cycle Cost
LEAP	Long range Energy Alternative Planning
LPG	Liquefied Petroleum Gas
m	Meter
MAS	Medium Adaptation Scenario
MHP	Micro Hydro Project
MJ	Mega Joule
MT	Metric Ton
NAPA	National Adaptation Programme of Action
NEA	Nepal Electricity Authority
NGO	Non Governmental Organization
NPC	National Planning Commission
NTFP	Non Timber Forest Products
NPR	Nepalese Rupees
REDP	Rural Energy Development Program
RET	Renewable Energy Technology
SHS	Solar Home System
sq. km	Square Kilometer
SHS Solar	Home System
SWERA	Solar and Wind Energy Resource Assessment
SWOT	Strength Weakness Opportunity Threat
UNDP	United Nation Development Program
VDC	Village Development Committee
WECS	Water and Energy Commission Secretariat
Wp	Watt Peak

Executive Summary

This District Climate and Energy Plan (DCEP) for Dolakha District is prepared by District Development Committee (DDC), Dolakha with technical support from the National Rural and Renewable Energy Programme (NRREP) under Alternative Energy Promotion Center (AEPC). The main goal of the District Climate and Energy Plan (DCEP) is to create a planning process for accelerating the dissemination of renewable energy technologies at district level, contributing to development goals at national and local level. In addition to energy development, DCEP addresses climate change impacts on energy planning and ensures that women and social excluded and marginalized groups are addressed throughout the planning and implementation processes.

The methodology for preparing DCEP is based on DCEP Preparation Guidelines prepared by AEPC. Methodology for assignment was developed by dividing the works into three phases and nine stages as per ToR. Primary data were collected by DDC social mobilizers through checklist provided to them. Similarly stakeholder/expert consultation has been the basis for collection of information on energy and climate vulnerabilities and impact and gender and social inclusion issues. The collected data was further used to compile climate, gender and social inclusion, technology and institutional assessments. Secondary data were taken from various sources like CBS 2011, DESR report, District Profiles, data from Department of Hydrology and Meteorology (DHM) etc. LEAP software is used for different assessment. Assessments have done for 3 different scenarios- Business as usual, Medium Adaptation and Climate Resilient Scenario for urban and rural settings of the district. The study is more focused on residential sector energy consumption compared to industrial or commercial energy needs as this is the major demand in the district. Limitations to the study include a general lack of recent disaggregated data of Dolakha on GESI especially those relating to renewable energy, which reflects in the study as weakness and needed to be strengthened in coming days. There is also very limited reliable climate data for Dolakha.

Administratively, the district comprises 1 Municipality, 51 VDCs, and 2 electoral constituencies. Charikot is the district headquarters of Dolakha. Total population of the district was 186,557 with 45688 households (CBS 2011) and projected to be 46,738 in 2015. Though verities of Caste and Ethnic groups reside in Dolakh, the Chhetree (33.4%), Tamang (16.8%), Newar (9.4%), Brahmin Hill (9.2%) and Thami (8.9%) are the dominant groups.

As per NAPA ranking for climate change vulnerability, Dolakha district lies in High vulnerability zone with vulnerability index from 0.061 to 0.786. As per the study by Shambhu Chamakar (2010), the overall rainfall in the district has increased in last 21 years. But, the seasonal analysis showed that rainfall in Dolakha district had increased in monsoon and post monsoon season while it had decreased in other seasons. According to the study, the average annual, winter, pre-monsoon and monsoon rainfall in last five year (2004-08) receives very low in comparison of last 16 years (1988-2003) in Dolakha. This fact shows that the prolonged drought, erratic rainfall and unseasonal rainfall is increasing in last five years even average annual rainfall has been increasing in pattern. As per the study by

Shambhu Chamakar (2010), the mean annual temperature for the last 21 years increased by 0.041 degree Celsius in Dolakha.

According to household survey, larger population (89.5%) lives in rural area in comparison to urban (10.5%). Dalits are more in rural area (8%) than in urban area (5.2%). About 51.6% Janajatis live in rural area whereas 34.3% live in urban area. In contrary, 60.6% Brahmin/Chhetri/Thakuri groups live in urban areas and only 38.1% live in rural Dolkha. Only few (2.2%) religious minorities and 0.1% other cate/ethnicity groups live in rural Dolkha.

The residential sector is the largest consumer of energy in the district with a demand of 2.16, 2.19, 2.20, 2.22, 2.23 and 2.24 million GJ in 2014, 2015, 2016, 2017, 2018 and 2019, respectively. Cooking makes up the biggest share of energy consumption in the residential sector. In terms of fuel consumption, biomass has the largest share for cooking making up over 85% of fuel uses. In Dolkha, most of the households (61% in rural and 78% in urban) still use traditional stove for cooking. About 33% households in rural and 2.9% households in urban use improved cooking stove (ICS), and about 3.42% households in rural and 19.1% households in urban use LPG stove. Most of the households in Dolakha use electricity from national grid for lightning purpose (79% in rural and 100% in urban). In rural Dolakha, 16.28% households are using micro-hydro, 2.34% households are using solar energy and 2.62% kerosene for lighting.

The main consumers in the commercial sector of Dolakha are restaurants, hotels, hospitals, schools etc. The energy demand in the district in 2014 is estimated about 0.12 million GJ and no significant change in energy demand is noted up to 2019. The industrial sector is primarily based on the following industries: rice mills, saw mills, workshops, and other factories. The energy demand in industrial sector is found low compared to residential sector or total energy demand in the district. The energy demand for agriculture sector from 2014-2019 are estimated to be 0.133 million GJ in the year 2014 and no significant change in energy demand is noted.

For energy share, different technologies viz. traditional cooking stove, improved cooking stove, kerosene stove, biogas, LPG Stove and Electric stove have been assessed for cooking purpose. For lightning, technologies like kerosene lamp, solar home system, grid electricity, micro hydroelectricity, Biogas light, and LPG light have been assessed. Assessment of energy technologies has been made with relation to their existing use share, cost, resource availability, vulnerability to climate change, potential to adaptation, potential to mitigation, gender friendly in use, promote social inclusion and contribution in poverty reduction. LPG stove is found to be gender friendly whereas Biogas is found to be climate change friendly for cooking purpose. In case of lightning, gird electricity is gender as well as climate change friendly.

For cooking purpose, it is observed that LPG Stove is gaining popularity and spreading rapidly. In case of lightning, as the district is high potential to hydropower, it is assumed that all the households will be connected to national grid within this plan period.

In this study, three types of scenarios - Business as Usual Scenario, Medium Adaptation Scenario and Climate Resilient Scenario have been used for residential cooking purpose. For projection, household growth rate have been considered to be 0.57%. The share of different technologies for different scenario for cooking purpose is taken as follow.

Share of Technologies for different scenarios

	Scenarios	TCS	ICS	Biogas	Kerosene	LPG	Electricity	Others	
Rural	BAU	61.08	33.02	0.81	0.07	3.42	0.26	1.34	100
	Purposed MAS	0	70	5	0	15	10	0	100
	Purposed CRS	0	60	10	0	15	15	0	100
Urban	BAU	78	2.9	0	0	19.14	0	0	100
	Purposed MAS	0	45	5	0	30	20	0	100
	Purposed CRS	0	35	10	0	30	25	0	100

The Business as Usual Scenario (BAU) is based on current status, increment trends and population growth rates. This scenario does not give emphasis on social and gender inclusions. In this scenario, the total energy demand is found to be 2.51 million GJ in the base year, which has been increased to 2.59 million GJ (3.40%) at the end of 2019. The increment in residential and industrial sectors are noted whereas no increment is noted for transportation, commercial and agriculture sectors.

Medium Adaptation Scenario has taken into account the development of livelihoods by providing inclusive access to energy sources. It also takes into account cost of the technology along with adaptive measures to potential vulnerabilities of resources and technologies. In this scenario, emphasis is given to use of cheap and clean energy in the place of traditional inefficient energy sources and technologies. In this scenario, the total residential energy in the rural sector will be decreased from 1.92 million GJ in the base year 2014 to 1.40 million GJ at the end of the year 2019. The total energy demand for urban sector is forecasted to decrease from 0.24 million GJ to 0.104 million GJ. The consumption of electricity, LPG and biogas has been increased whereas it is decreased in case of fuel-wood.

Climate Resilient Scenario has emphasized the use of clean and environment-friendly energy. Meeting energy demand through promotion of the maximum possible clean energy technology, security of supply, achieving, energy saving leading to the reduced climate change vulnerabilities are the main rational of this scenario. The total energy demand in rural sector is predicted to decrease from 1.92 million GJ to 0.997 million GJ at the end of 2019. Under this scenario for urban sector at the end of 2019, the energy demand will be decreased from 0.242 million GJ to 0.096 million GJ. The demand of fuel wood has been decreased whereas electricity, LPG, and biogas have been increased.

It is estimated that by shifting from BAU Scenario to MA Scenario, emission of 20,254.19 metric tonnes of CO_2 Equivalent GHGs will be reduced whereas by shifting from BAU Scenario to CR Scenario, emission of 18,183.35 metric tonnes of CO_2 Equivalent GHGs will be reduced.

The implementation plan has focused on planning for rural as well as urban residential sector as the residential sector is the highest energy consuming sector of Dolakha. The level of intervention and budget requirements has also been analyzed for different scenarios. The district level offices have to take lead on technology assessment and institutional assessments for implementing DCEP. The DCEP should be the rolling document to be mainstreaming into usual annual and periodic development planning of the district, the DDC and line agencies in particular by adopting the current DDC planning process.

The detailed intervention of different technologies required for cooking in MAS is presented below:

Residential Energy demand for cooking in urban sector under MA scenario

	Households					
Fuels/Technology	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Electricity (Rice cooker, Micro-oven)	154	366	584	804	1027	1253
LPG stove	1019	1141	1264	1388	1514	1642
Fuelwood (ICS-Mud or metal type)	8479	7390	6288	5174	4046	2905
Biogas	0	53	108	162	218	274

Residential Energy demand for cooking in rural sector under MA scenario

	Households					
Fuels/Technology	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Electricity (Rice Cooker, Micro-oven)	2904	3748	4602	5466	6339	7222
Kerosene stove	38	31	24	16	8	1
LPG stove	1460	2447	3445	4454	5475	6507
Fuel wood (ICS- Mud or Metal type)	67,944	61,671	55,324	48,903	42,406	35,834
Biogas	356	711	1069	1432	1798	2169
Coal	544	438	330	221	111	0

The detailed intervention of different technologies required for cooking in CR scenario is presented below:

Residential Energy demand in urban sector under CR scenario

	Households					
Fuels/Technology	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Electricity (Rice Cooker, Micro-oven)	154	420	692	967	1245	1526
LPG stove	1019	1141	1264	1388	1514	1642
Fuel wood (ICS –Mud or Metal type)	8479	7264	6034	4791	3532	2260
Biogas	0	107	215	325	435	547

Residential Energy demand in rural sector under CR scenario

Fuels/ Technology	Households					
	2014	**2015**	**2016**	**2017**	**2018**	**2019**
Electricity (Rice Cooker, Micro-oven)	2904	4172	5455	6753	8065	9391
Kerosene stove	38	31	24	16	8	1
LPG Stove	1460	2435	3422	4420	5430	6450
Fuel wood (ICS-Mud or Metal Type)	67944	60670	53311	45866	38334	30715
Biogas	356	1146	1945	2752	3569	4395
Coal	544	438	330	221	111	0

In case of lightning, though DDC is assured that 100% of the households will be connected to National Grid within this planning period, this plan has allocated solar home system for around 10% of total households assuming these households being isolated will not be connected to National Grid.

Residential Energy demand for Lightning

Annual Energy Demand for	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Annual Grid Electricity requirement, kWh	3178238	3196354	3214573	3232896	3251324	3269856
Annual Solar PV requirement, KWh	175698.2	176699.7	177706.9	178719.8	179738.5	180763

Cost required without subsidy for different technologies under different scenario up to 2019 is given below

Cost Calculation

Cost estimation (without subsidy) for cooking purpose in urban sector under MA scenario

Technology	2015	2016	2017	2018	2019
ICS	3726517	3768958	3811761	3854930	3898468
Biogas	2599572	2629154	2658737	2689376	2719487

Cost estimation (without subsidy) for cooking purpose in rural sector under MA scenario

Technology	2015	2016	2017	2018	2019
ICS	26,673,306	26,973,663	27,276,578	27,582,070	27,890,158
Biogas	17226587	17422572	17619613	17819296	18019507

Cost estimation (without subsidy) for cooking purpose in urban sector under CR scenario

Technology	2015	2016	2017	2018	2019
ICS	2842904	2875271	2907916	2940839	2974042
Biogas	5199143	5258309	5318002	5378224	5438974

Cost estimation (without subsidy) for cooking purpose in rural sector under CR scenario

Technology	2015	2016	2017	2018	2019
ICS	19667517	19888008	20110374	20334629	20560787
Biogas	38379737	38816609	39257178	39701974	40149939

Cost calculation for Lightning Propose (SHS)

Year	2014	2015	2016	2017	2018	2019
Cost for SHS	94972000	95513340	96057766	96605296	97155946	97709735

Monitoring and Evaluation Plan has been formulated for checking and verifying the achievement of the proposed plan.

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Chapter One

Introduction

The Agreement between Alternative Energy Promotion Center (AEPC), Khumaltaar Heights, Lalitpur Sub Metropolitan City, Nepal (hereinafter referred to as the “Client”) and Joint Venture of Civil Informatics and Solutions P. Ltd. (CIAS) and Green Consult (P) Ltd. (Green) (hereinafter referred to as the term "Consultant") for **“Preparation of District Climate and Energy Plans (DCEPs) in Selected Districts of Cluster 2”** (hereinafter referred to as the "Project") was officially signed on 23 April 2014. Cluster 2 includes Dolakha, Ramechhap, Mohattorai, Chitwan and Nuwakot Districts. This report, as required in the letter of agreement, contains a detail District Climate and Energy Plan for Dolakha District.

1.1. Background

This District Climate and Energy Plan (DCEP) for Dolakha District is prepared by District Development Committee (DDC), Dolakha with technical support from the National Rural and Renewable Energy Programme (NRREP) under Alternative Energy Promotion Center (AEPC). NRREP is a single programme modality (where there are no other AEPC executed Development Partner supported renewable energy programmes or projects funded outside the NRREP) for removing remove inefficiencies, duplication, lack of co-ordination, supply led projects and fragmentation of aid to the rural and renewable energy sector in Nepal. For the effective coordination of different actors at the local and district levels, AEPC has been supporting the DDCs to establish District Environment Energy and Climate Change Section (DEECCS). The energy planning and implementation have been started in the DDC by preparing District Energy Situation Reports (DESR), establishing District Energy Funds and Community Energy Fund in different districts.

For long term visionary plan for renewable energy to mainstream gender and social inclusion, and response climate change issue at district level, DCEPs are being prepared. DCEPs for three districts (Mustang, Ilam and Makwanpur) have already been prepared during the first phase and are under implementation. In this phase, DCEPs are being prepared for 25 districts under 5 clusters. Gradually, DCEPs will be prepared for all the districts.

The main goal of the DCEP is to create a planning process to increase the dissemination of renewable energy technologies at district level, contributing to Nepal’s national and local development plans. DCEPs will act as a systematic roadmap, which serves as a periodic rolling plan of the district in the sector of renewable energy development and climate change preparation. Strategies for development and dissemination of the RETs in the district will be mapped out and climate adaptation and mitigation and gender and social inclusion linkages identified.”

1.2. Rationale

Planning is a process and not an event. It is the framework that helps us identify our starting point ("Where are we now"), our objective ("Where do we want to be in the future"), the way to reach our objective ("How are we going to get there") and finally how do we measure our progress. The performance of a plan in meeting its objectives must be evaluated and taken forward as a major input into further planning cycles. The objective should be to ensure sustainable improvements to service coverage and standards.

Effective, country oriented and district specific plans are necessary for addressing issues related with climate change and energy. Appropriate Planning offers the opportunity to deliver sustainable improvements in adopting and mitigation climate change, combat energy crisis and incorporating GESI issues.

Planning and strategies are necessary to ensure that AEPC and DDC services keep pace with demand, are appropriate to needs, contribute to a sound environment, are cost-effective and build continuously on existing and new opportunities offered.

DCEP provides a framework for decentralized energy planning that is customized to local contexts and needs. At the district level, DCEP can align with other sectorial plans and programs, as well as broader development planning to promote a more consistent and comprehensive strategy. DCEP can also be placed within a broader framework that encapsulates national plans, moving Nepal towards a low-carbon emission, socio-economic development pathway. DCEPs will play an important role in providing inputs to national renewable energy planning, following a bottom-up approach.

DCEP ensures in adoption of RETs at local level with controlled GHG emission for combating climate change. In fact, widespread application of RETs offers some of the best prospects for achieving deep reductions in greenhouse gas emissions at the global level, while satisfying some of the increased demand for commercial energy. Similarly DCEP will be aligned towards addressing gender and social inclusion (GSI) issues.

1.3 Objectives of DCEP

The main objective of this assignment is to develop District Climate and Energy Plan (DCEP) for Dolakha District. These plans need to be adaptive and de-centralized and should contain detailed implementation plan that can contribute in developing climate change adaptation and mitigation technologies and also addresses the mainstreaming of Gender Equality and Social Inclusion.

The specific objectives of the study are:

- To outline energy needs of Dolakha district
- To carry out the assessment of available resource, technology and institutions working in climate change and renewable energy/energy sector.

- To carry out situational assessments of climate change, gender equality and social inclusion in the Dolakha district.
- To assess the institutional arrangements of the Dolakha district, identify the gap and recommend for necessary improvements.
- To conduct capacity need assessment and identify the actions to implement the proposed District Climate and Energy Plan (DCEPs)
- To outline implementation of the plan with identification of roles and responsibilities of different stakeholders
- To recommend interventions of appropriate renewable energy technologies incorporating the influencing factors of climate change and GESI that contribute to climate change adaptation and mitigation and GESI mainstreaming

1.4 Scope of DCEP

The detailed DCEPs will provide the basis for adapting and mitigating climate change along with mainstreaming GESI through RETs and other energy related programs. The scopes of the assignment are as follows:

- Review and assess climate change policy and program
- Review and assess the available District Energy Situation reports, district plans, annual reports, district overview documents from respective districts
- Define the methodology; finalize scope (activities) and basis for subsequent work.
- Conduct desk study to review the relevant document, program, policies etc.
- Prepare and present all findings of the desk study at the inception workshop. Prepare Inception report incorporating all comments received from inception workshop.
- Assess and analyze energy supply and consumption patterns in the selected district based on technology with GESI perspective – identify weaknesses and limitations.
- Analyze vulnerable groups in the context of climate and GESI
- Identify the potential of all alternative energy resources e.g. micro hydro, solar, improved water mills, peltric sets, wind, biomass/biogas, etc. Targets and recommendations for identifying appropriate technology based on climatic condition, geographical variations and GESI perspectives.
- Prepare a broad climate change assessment of the district – (based on existing data)
- Identify all current and potential stakeholders in the RE (and interlinking) sectors, analyze strengths and weaknesses in terms of ability to implement RE strategy.

- Prepare integrated rural/renewable energy development and management plan including divisions of responsibility and specific activities of stakeholders.
- Integrate a district climate and energy strategy addressing potential for mitigation and adaptation activities.
- Provide tentative financial requirements for identified/proposed RETs and suggest funding mechanisms and possible sources of funding (subsidies through AEPC, DDCs/VDCs commitments, Contribution from users, other sources of funds like: micro finance, other distribute agencies in the districts)
- Ensure that gender equality and social inclusion is incorporated in planning and processes are mainstreamed into the DCEP.
- Recommend appropriate strategies to implement GESI responsive DCEP implementation.
- Provide a monitoring and evaluation plan, mechanism for disaggregated data base for the implementation of DCEPs.

1.5 Limitation of the study

Major limitations for the assessment are as follows:

- Energy demand at individual level has been calculated through generalization bases rather than actual assessment
- As this study was not a user focused assessment it has not been possible to explicitly assess the particular needs of women and social groups
- Hydro-meteorological data could not be obtained at local level and hence reference has been made from available station of DHM (i.e Jiri Station).
- The information available, from implementing partners of RET interventions in the district are based on the total number of installations carried out. There is no such information on whether a particular HH has installed the same technology twice and no such information on the number of functioning technologies. Therefore the study makes some assumption on the lifespan of the technology and subsequently the operation number of technologies.

1.6 District Overview

1.6.1 Geographic profile

Dolakha District is located in Northern part of Janakpur Zone, Central Development Region of Nepal between longitudes 85°51' to 86°38’E and latitudes 28°05' to 27°32'N. The district boundaries are marked by Sindhupalchowk in the west, Ramechhap in the south, Solukhumbu and Ramechhap in the east and China in the north. Dolkha district just touches

Kavreplanchowk district at southwest border. It occupies 2,191 sq.km areas, which is 1.49% of total area of Nepal.

All the part of Dolakha District lies in mountainous region. About 35% area lies in High-Himalaya, 40% in High-Mountain and 25% in Mid-Mountain range. Elevation of the district ranges from 762m to 7183m.

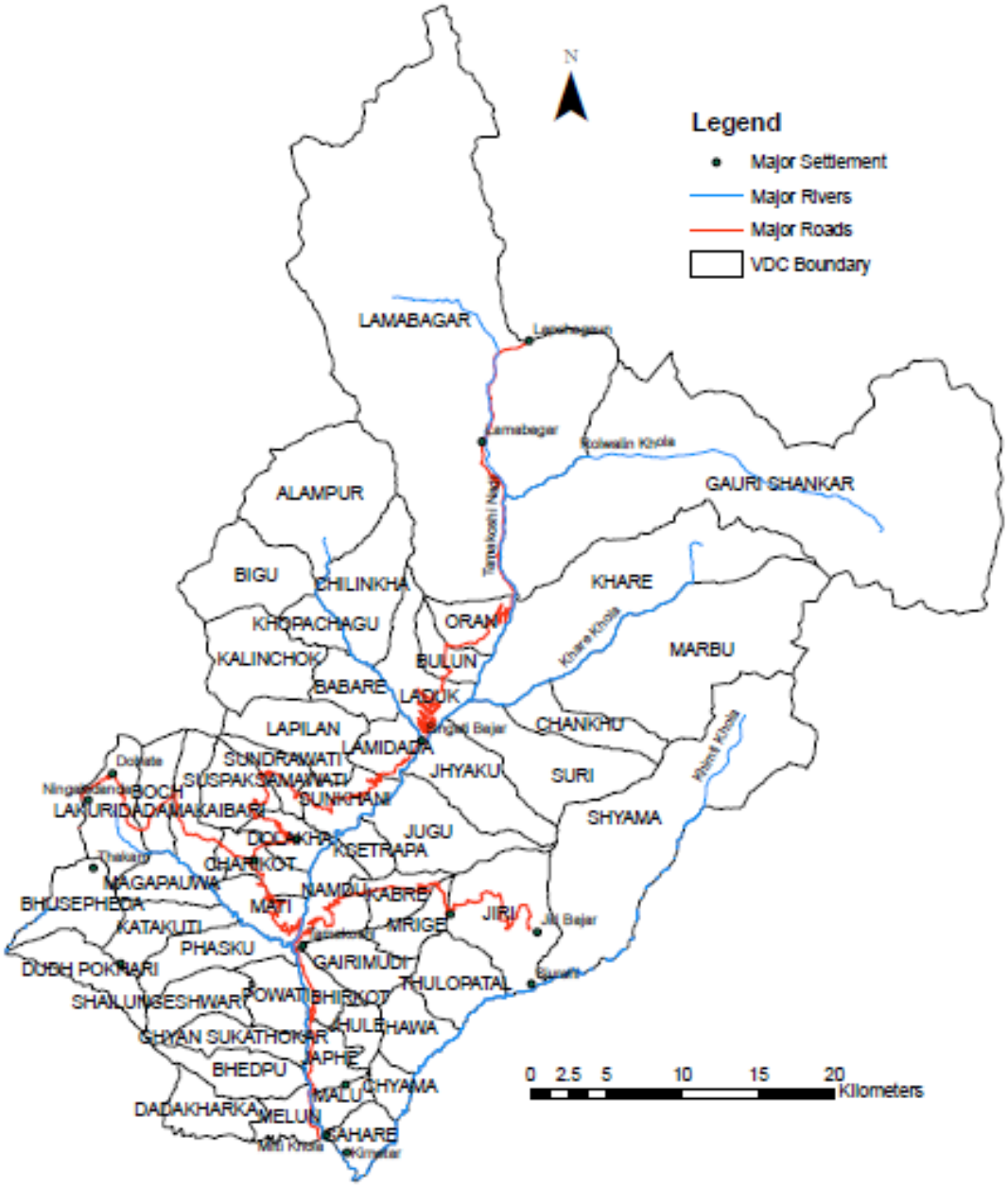

Figure 1: District Map of Dolakha

Administratively, the district comprises one (1) Municipality (Bhimeshwor) and 51 Village Development Committees (VDCs), and two electoral constituencies. Charikot is the district headquarters of Dolakha.

Khimti and Tamakoshi are the major rivers of the district. Other major streams of the district are Sagu Khola, Khare Khola, Chandrawati Khola etc. and all these streams including Khimti River drain to Tamakoshi. Khimti River also forms the east boundary for the district.

1.6.2 Demographic Structure

a. Population

According to the Census 2011 (CBS), total population of Dolakha was 186,557 with an annual population growth -0.91% (decreasing) and having 53.36% female population. The projected population of Dolakha is likely to reach around 180,032 in 2015. The average family size is decreasing, and it was 4.1 families per household in 2011. The literacy rate of people aged 5 years and above is increasing, and it was 62.8 in 2011. The population density per square kilometer is decreasing since 2001. It was 93 sq. km in 2001 and 85.2 sq. km in 2011. The following table shows the population status of Dolakha.

Table 1: Demographic status of Dolakha District

Population	1991 Census	2001 Census	2011 Census	2015 Projection*
Total Population	173236	204229	186557	180032
Male	84825	99963	87003	82302
Female	88411	104266	99554	97729
Total Households	35862	43165	45688	46738
Average Household size	4.8	4.7	4.1	3.9
Literacy Rate of 5 years and above	37.8	50.6	62.8	68.4
Population density per sq. Km	79.1	93	85.2	82.1

Source: ISRC 2014/15

b. Caste Ethnic Composition, Language and Religion

Though verities of Caste and Ethnic groups reside in Dolakh, the Chhetree (33.4%), Tamang (16.8%), Newar (9.4%), Brahmin Hill (9.2%) and Thami (8.9%) are the dominant groups. Similarly Sherpa, Kami, Jirel, Dhami/Dholi, Sarki, Magar, Gharti/Bhujel, and Sunuwar do also have remarkable presence within the district.

In terms of **religion**, the majority of people (67.8%) in Dolakha are Hindu followed by Buddhist (22.3%), Christian (1.6%) and smaller shares of Islam, Kirat, Bahai, Jain and other religions.

Language wise, 65.2% of total population speak Nepali and 15.8% of people speak Tamang. Thami is spoken by 7.97% followed by Sherpa language with 4.6%, Jirel 2.3%, and Newari 1.96%. Along with these languages there are also various languages having users less than 1% as shown in Table 2.

Table 2: Caste/Ethnic Composition of Dolakha District

Caste/ Ethnicity	Census 2011		Caste/ Ethnicity	Census 2011		Caste/ Ethnicity	Census 2011	
	Population	%		Population	%		Population	%
Chhetree	62335	33.4	Sarlo	4038	2.2	Badi	126	0.07
Tamang	31307	16.8	Magar	3076	1.7	Tharu	68	0.04
Newar	17498	9.4	Gharti/Bhujel	2698	1.5	Yadav	66	0.04
Brahmin Hill	17159	9.2	Sunuwar	1872	1.0	Hajam/Thakur	64	0.03
Thami	16642	8.9	Sanyasi/Dasnami	1348	0.7	Undefined Others	61	0.03
Sherpa	8933	4.8	Gurung	1024	0.6	Brahmin Terai	57	0.03
Kami	7982	4.3	Majhi	446	0.3	Terai Others	51	0.03
Jirel	4518	2.4	Thakuri	314	0.2	Other	569	0.31
Dami/Dholi	4130	2.2	Rai	175	0.1	Total	186557	100

c. Educational Status

As per Census report 2011, about 63% populations aged five and above are literate and can read and write. Only 73.3% of boys and men aged five and above and 53.7% of women and girls in Dolakha can read and write. 3.3% of men aged above five can read only whereas the similar percentage for women is 3.7. About 7.5% populations have passed School Leaving Certificate. Following figure shows completed level of education of Dolakha District as per 2011 Census.

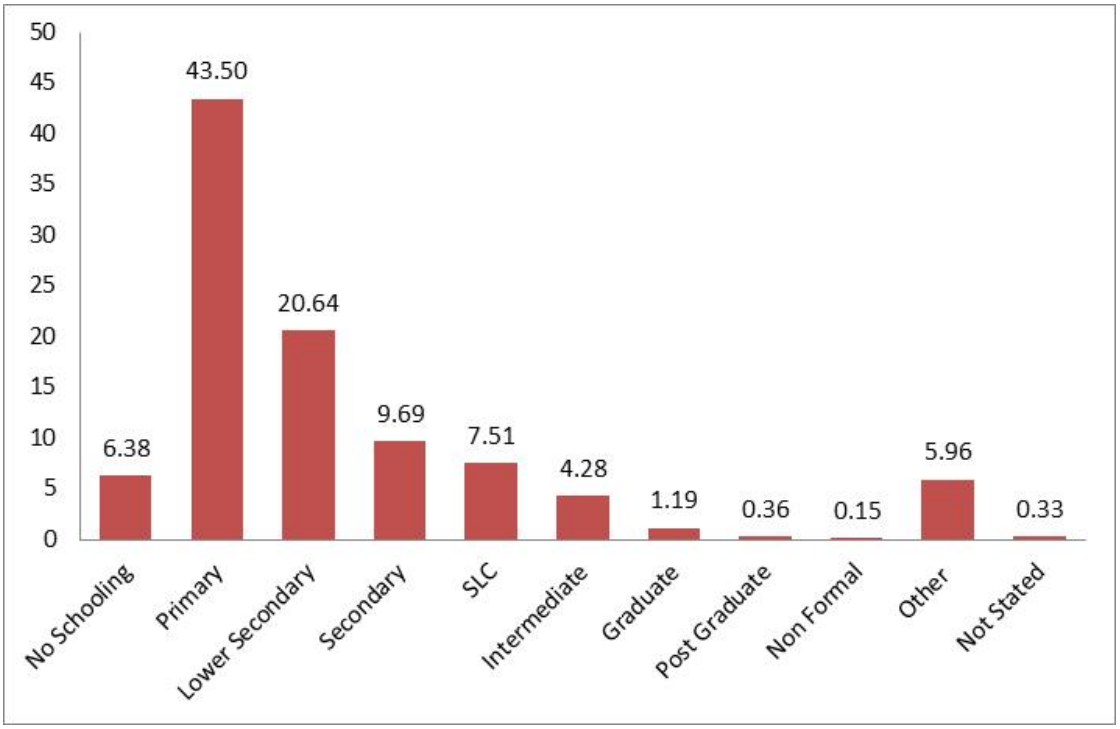

Figure 2: Completed level of education percentage

As per ISRC 2014/15, there were 315 Pre-primary centers, 429 Primary, 183 Lower Secondary, 93 Secondary and 44 Higher Secondary schools in Dolakha in 2012.

d. Health

According to ISRC 2014/15, there are one (1) governmental hospital, 6 institutions, 2 PHCC/HC, 9 HP, 43 SHP, 148 PHC Outreach Clinic, 169 EPI Clinic and 1249 FCHV in 2011/12. Only 4 NGO/INGOs were found to be involved in Health sector in Dolkha.

e. Economic Status

As per CBS 2011, altogether 148,488 people in Dolakha are aged 10 years and above, and they are considered potential for economic activities. It is noticed that in Dolakha district, 65% of people are economically active. About 58% of populations are usually active and employed; however, 0.35% populations are usually active but unemployed.

Agriculture is the main economic activities of Dolakha district; around 55.5% populations have their own agriculture business. About 15.3% populations are involved in wage/salary earning. About 9.3% populations are involved in own non-agricultural business, around 16.2% in extended economic and 33.3% in household chores. Similarly, 3.7% populations are seeking job, 31.3% are involved in study and 9.8% are involved in none of the activities.

Now a day, the trend of foreign migration for work is also rising. Remittance from foreign employment is also one of the main sources of income. Especially, the skill workers migrate to Gulf Countries for certain years. Similarly the non-skilled workers of southern part seasonally migrate to India in search of work.

f. Road Network

Average road density of the district is 6km/1000km^2. Still most of the part of Dolakha is yet to be connected with its District Headquarters via road network. There are 106.68 kms blacktop road, 10.00 kms gravel road and 20 km of earthen road. There is 1 airport in this district.

g. Land Use pattern and Forest Distribution

Among total land of Dolakha 36.1% land is occupied by forest, 25.31% by Agricultural land and 19.1% by shrub land. Similarly, 10.6% land is snow, 7.4% is barren land and 0.2% land is occupied by water bodies (Enviornmental Statistics 2008, 202013).

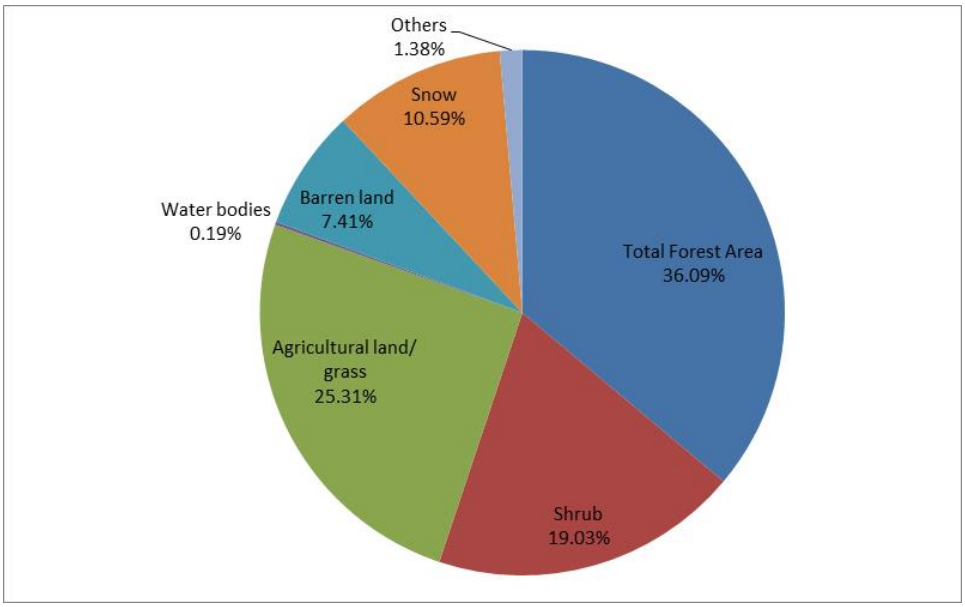

Figure 3: Land Use Pattern of Dolakha District

h. Drinking Water and Sanitation

According to National report of Census 2011, about 77.9% households are using tap /piped water supply, 3.7% households use well/kuwa, 16.7% households use spout water, 1.2% households use stream and river water. Similarly, about 0.3% households use other sources of water for drinking purpose.

Regarding the Sanitary facilities, about 30.4% households do not have toilet facilities, 38.7% have modern toilet and 30.6% have ordinary toilet facilities in the district.

i. Energy

According to National report of Census 2011, 94.36% of total household use firewood, 0.41% of total household use kerosene, 4.52% of total household use LPG, 0.13% of total household use biogas, 0.22% of total household use Electricity whereas 0.05% of total household use other source of energy for cooking purpose.

For the lighting purpose 81.80% of total household use Electricity, 12.65% of total household use Kerosene, 0.01% of total household use Bio-gas, 2.98% of total household use Solar, and 2.25% of total household use other source of energy.

From 1992 to 2011, according to BSP, 1210 biogas plants have been installed in Dolakha. Similarly regarding solar home system, 200 no. of system in 2008/09 with system capacity 5012 wp, 67 system with 1134 wp system capacity in 2009/10 and 165 system with 2852 wp capacity have been installed in the district.

Chapter Two

DCEP Preparation Process

2.1 DCEP Preparation Concept

The methodology for preparing DCEP is based on DCEP Preparation Guidelines prepared by AEPC. Methodology for assignment was developed by dividing the works into three phases and various stages as per ToR. Figure below shows the concept of the consultant for approach and methodology.

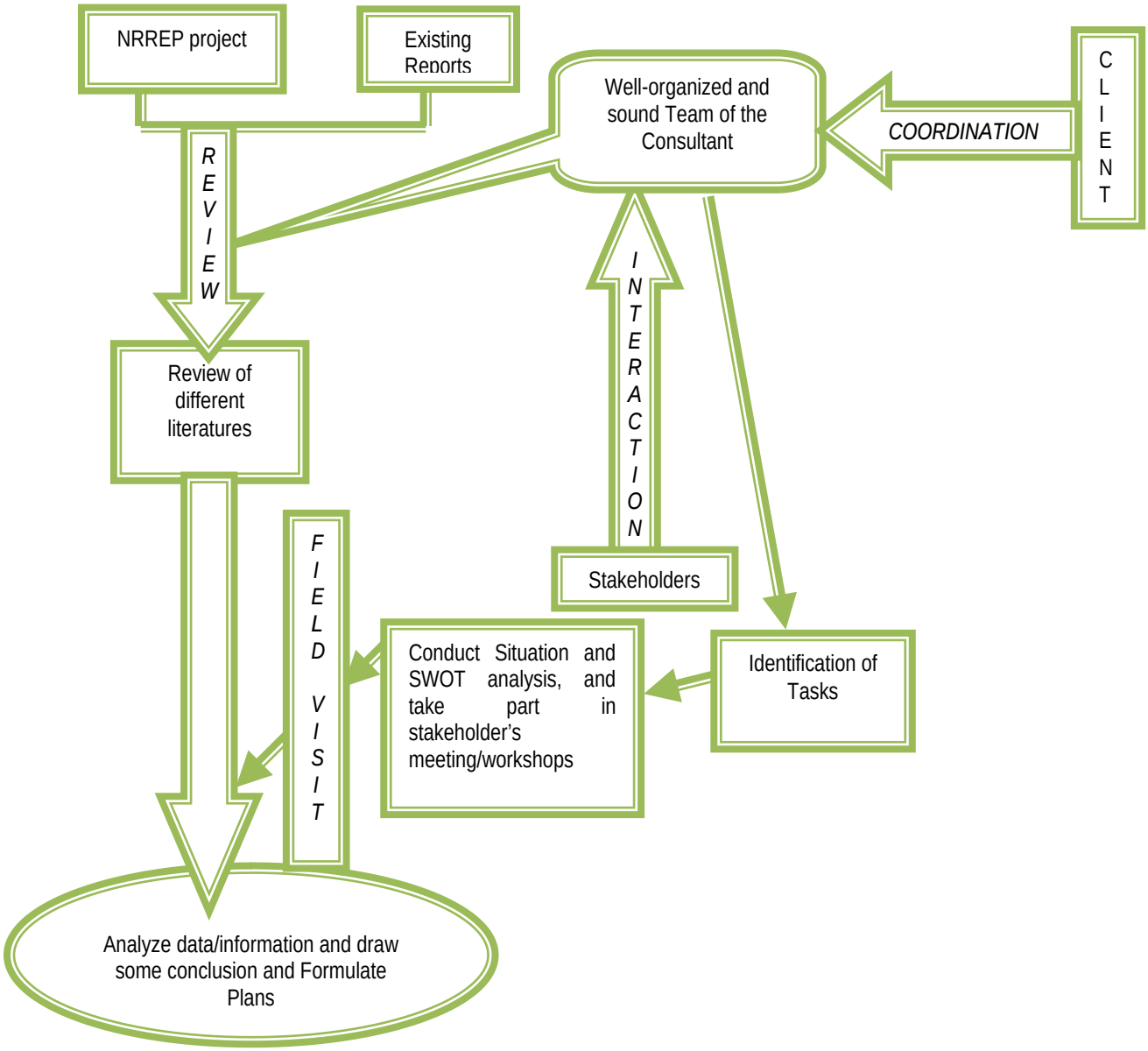

Figure 4: Approach to Conducting study for preparation of DCEPs

2.2 Steps involved in DCEP Preparation

The consultant has followed the nine stages of the DCEP preparation process as mentioned in the DCEP guidelines. Following figure outlines the DCEP preparation steps in brief

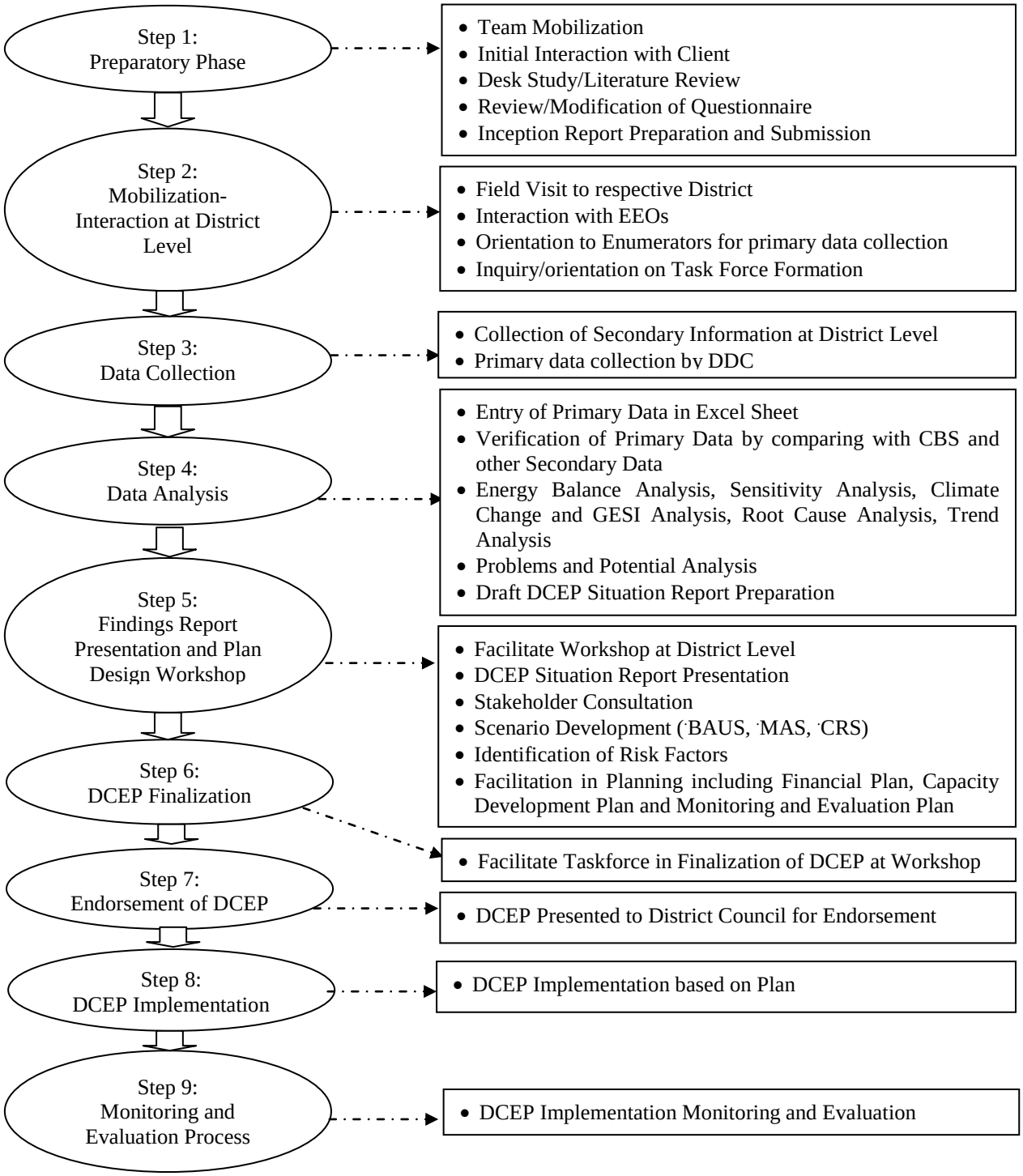

Figure 5: DCEP Preparation Steps

The final DCEP document has incorporated the relevant and appropriate feedback from related stakeholders and been approved by the DCEP task force (including DDC) and national level stakeholders.

2.3 Methodology for preparing DCEP

2.3.1 Data Collection

For preparation of DCEP, both primary and secondary data have been used. Primary data were collected by social mobilizers through checklist provided to them (Annex1). Orientation to social mobilizers for collecting data was given on 2nd week of Jesth. Relevant participatory rural appraisal (PRA) tools including focus group discussions (FGDs), key informant interview (KII) and stakeholder/experts consultation also formed the basis for collection of information on energy and climate vulnerabilities and impact and gender and social inclusion issues. The collated data was further used to compile climate, gender and social inclusion, technology and institutional assessments.

Secondary data were taken from various sources like CBS 2011, DESR report, District Profiles, data from Department of Hydrology and Meteorology (DHM) etc. Primary data and secondary data were compared for verification. After that, data collected were entered in excel sheet for further analysis.

2.3.2 Energy Assessment

The necessity of energy in the district was assessed by collecting information from different documents including district and VDC profiles as well as primary data. The data for residential, commercial, agricultural and industrial sectors have been collected. The residential energy demand was found high in the district.

For energy assessment, the total energy requirement for each end-use has been calculated by multiplying the minimum energy amount with the average efficiencies for each device as indicated by EPS (2010) used by DCEP for Ilam and Makwanpur.

Table 3: Device efficiencies of technologies

TCS	ICS	Charcoal	Biogas stove	LPG stove	Kerosene stove	Electric Kettle
10%	20%	20%	60%	65%	50%	80%

Source: EPS, 2010

Table 4: Minimum energy requirements in cooking activities for different devices (GJ/household/year)

Fuelwood		Charcoal	Biogas	LPG	Kerosene	Electricity
TCS	ICS	Charcoal stove	Biogas stove	LPG stove	Kerosene stove	Electric Kettle
55.0	27.5	27.5	9.2	8.5	11.0	6.1

Source: EPS, 2010

Table 5: Minimum energy requirements in lighting for different devices (kWh/household/year)

Electric Devices					**Kerosene Devices**		
CFL (7 W)	Fluorescent Lamps (40 W)	Incandescent Lamps (40W)	SHS (7 W)	SSHS (0.03 W)	Kerosene Tuki (5 lm)	Lantern (50 lm)	Gas Lamp (1000 lm)
35.8	44.2	143.1	35.8	38.2	2.6	8.6	26.1

Source: EPS, 2010

The level of the activities/ household shares and the intensity of energy for the device provide energy demand.

Energy Demand= Energy Intensity*Activity Level

Energy intensity is the amount of energy used per household and concerning activity level is the number of Households in case of residential sector. Energy demand changes with the change in energy intensity or activity level or both. Energy intensity changes with the technology use pattern of people which can be fairly estimated judging from the probable changes in the affinity of the people towards several available technologies.

The updated secondary data from various organizations including AEPC, BSP, WECS, CRT and EPS were used. In addition, specific energy consumption of different devices have been computed by multiplying the average annual household energy consumption (GJ/household) with their corresponding device shares.

2.3.3 Energy Resource Assessment

Forests, water and agriculture resources are treated as major energy sources in the district. The energy resource potential is taken from sources including Energy Poverty Study (EPS) 2010 and primary sources. The information on application for licenses and issues licenses on survey for generation was noted from the Department of Electricity in the district. In fact, it is a major source to get hydropower potential. Similarly, in order to find solar and wind potential, the reports-The Solar and Wind Energy Resources Assessment (SWERA)- have been referred. The potential of biogas was noted from the study of BSP on Technical and Market Potential of Biogas in Nepal. Furthermore, for the purpose of finding resource vulnerability, the report of the National Adaptation Programme of Action (NAPA), other supporting reports of climate change impacts and local perception of climate change impacts collected through focus group sessions were used in order to get resources vulnerable to the impacts of climate change in the district. The scenarios have been prepared using LEAP and considerations of communities, stakeholders and experts.

2.3.4 Technology Assessment

The technology assessment was done with the help of both the primary and secondary data. The analysis for the status and trend of specific technologies have been performed with the

data about obtained from the respective well-known monitoring/ implementing organizations. That is: Biomass, solar home systems, watermills and bio fuel from AEPC; Biogas from BSP-Nepal; Micro Hydro from the REDP; and Improved water mills from CRT/N. They have further been verified through focus group discussions. This section further analyzes issues related with energy costs which are based on market prices regarding costs of fuel as well the installation costs from REDP as well as triangulation with the implementing organizations in the districts and the principal organizations. Comparative analyses have been performed in order to prioritize the energy technologies based on financial estimates as well as from the environment perspectives.

For financial assessment, comparisons were done using following financial tools:

Payback Period

Net present value

Internal rate of return

Cost benefit analysis

Energy cost

From the environment perspective, comparisons were performed as:

Comparative emission rates of each of the technologies

Carbon emission abatement cost

Potential contribution to climate change adaptation

Vulnerability of the technology due to climatic variation and extreme events (through FGD)

These analyses have been carried out to prioritize different renewable energy technologies, considering prevailing values in the district to assess required costs to abate GHG emissions for different incremental investment for each technology.

The findings on technology prioritization are presented in Chapter 4.

2.3.5 Financial Assessment

For financial assessment, following terminologies were estimated.

Payback Period

Payback Period = Initial Cost / Uniform annual benefit = (Investment cost-Subsidy)/(Annual Income-Annual Expenditure)

The payback period should be used as a screening method only. It reflects liquidity, not the profitability of project.

Discounted payback period

It considers discounted cash flows (time value of money). The general formula for discounting is

PV = FV/[(1+m)n]

Net Present Value (NPV)

Present worth is an equivalence method of analysis in which a project's cash flows are discounted to a single present value.

NPV/NPW = A0/(1+i)0 + A1/(1+i)1+ …..+ AN/(1+i)N

NPV>0 : Accept

NPV<0: Reject

NPV=0: Remain indifferent

Net Future Worth

It is used to determine a project's value at commercialization (a future date), not its value when we begin investing (the present).

FW (i) = PW (i) (F/P, I, N)

Capitalized Equivalent

It is a constant annual net cash flow. In the project with lengthy service lives, it is recommended to apply.

CE (i) = A/i

Annual equivalent criterion

AE (i) = PW (i) (A/P, I, N)

Benefit/Cost Ratio

The total discounted income or revenue divided by total discounted cost will give benefit/cost ratio of the project. A cost-benefit analysis has been used, providing a systematic evaluation of the economic advantages (benefits) and disadvantages (costs) of a set of investment alternatives. Typically, a "Base Case" is compared to one or more Alternatives (which have some significant improvement compared to the Base Case). The analysis evaluates incremental differences between the Base Case and the Alternative(s). In other words, a benefit-cost analysis tries to answer the question: What additional benefits will result if this Alternative is undertaken, and what additional costs are needed to bring it about? It translates the effects of an investment into monetary terms and to account for the fact that benefits generally accrue over a long period of time while capital costs are incurred primarily in the initial years. The primary energy-related elements that can be monetized are investment costs, technology operating costs, ongoing maintenance costs, and remaining capital value (a combination of capital expenditure and salvage value). The computation is based on the discounted values of all costs and benefits.

2.3.6 Climate Change Assessment

For climate change assessment, precipitation and temperature data from Environmental Statistics of Nepal have been taken along with NAPA document and other secondary sources.

Similarly community and stakeholder's perception on changing climate and its consequences were documented and analyzed for further assessment. Trend in land use change and forest cover were also taken into consideration.

Impact of climate change in energy resources including possible impacts in upcoming years were estimated through trend analysis. Reductions on GHG emissions by switching from traditional energy towards eco-friendly alternative energy have been estimated as per IPCC guideline.

2.3.7 Institutional Assessment

Institutional assessment was done through interactions with the DCEP taskforce and during meetings with key agencies. Previous assessments carried out on capacity building such as short term and long term training needs for various institutions on micro-financing options, along with one-two-one interactions with participants of previous exchange visits were carried out. The findings for institutional assessment are presented in Chapter 3.

2.3.8 GESI Assessment

The disaggregate data available from field survey in terms of household heads and ownership of technologies as per ethnicity and gender has formed the basis for GSI assessment. The available data was analyzed considering the access and technologies with highest potential to address GSI issues to prioritize for scenario development. The FGDs also provided the basis for a brief overview of the utilization of various technologies, ownership, acceptance of various RE technologies and the livelihood benefit it has been providing to various groups.

2.3.9 Scenario Development and LEAP Projection

Both primary and secondary data were analyzed to draw conclusions and make appropriate recommendations. Required data on both energy supply and demand were collected and entered into the Long Range Energy Alternatives Planning System (LEAP) software to estimate the current energy demand of Dolakha and the energy demand and supply figures of the district were compared and further analyzed under different scenario in the software.

Three scenarios were developed taking important aspects such as climate change, gender and social inclusion into account. Three scenarios were developed as Business As Usual (BAU), Medium Adaptation (MA) and Climate Resilient (CR) Scenario with base year as 2010 and were subjected to projection by using LEAP for 5 years up to 2019. The penetration of technologies in different stratum of society were analyzed and quantified with the vulnerability analysis of different technologies. Other relevant software such as Microsoft excel has also been used for data analysis.

Energy Demand= Energy Intensity*Activity Level

Energy intensity which is the amount of energy used per household and concerning activity level which is the number of Households in case of residential sector. Energy demand changes with the change in energy intensity or activity level or both. Energy intensity changes with the technology use pattern of people which can be fairly estimated judging from the probable changes in the affinity of the people towards several available technologies.

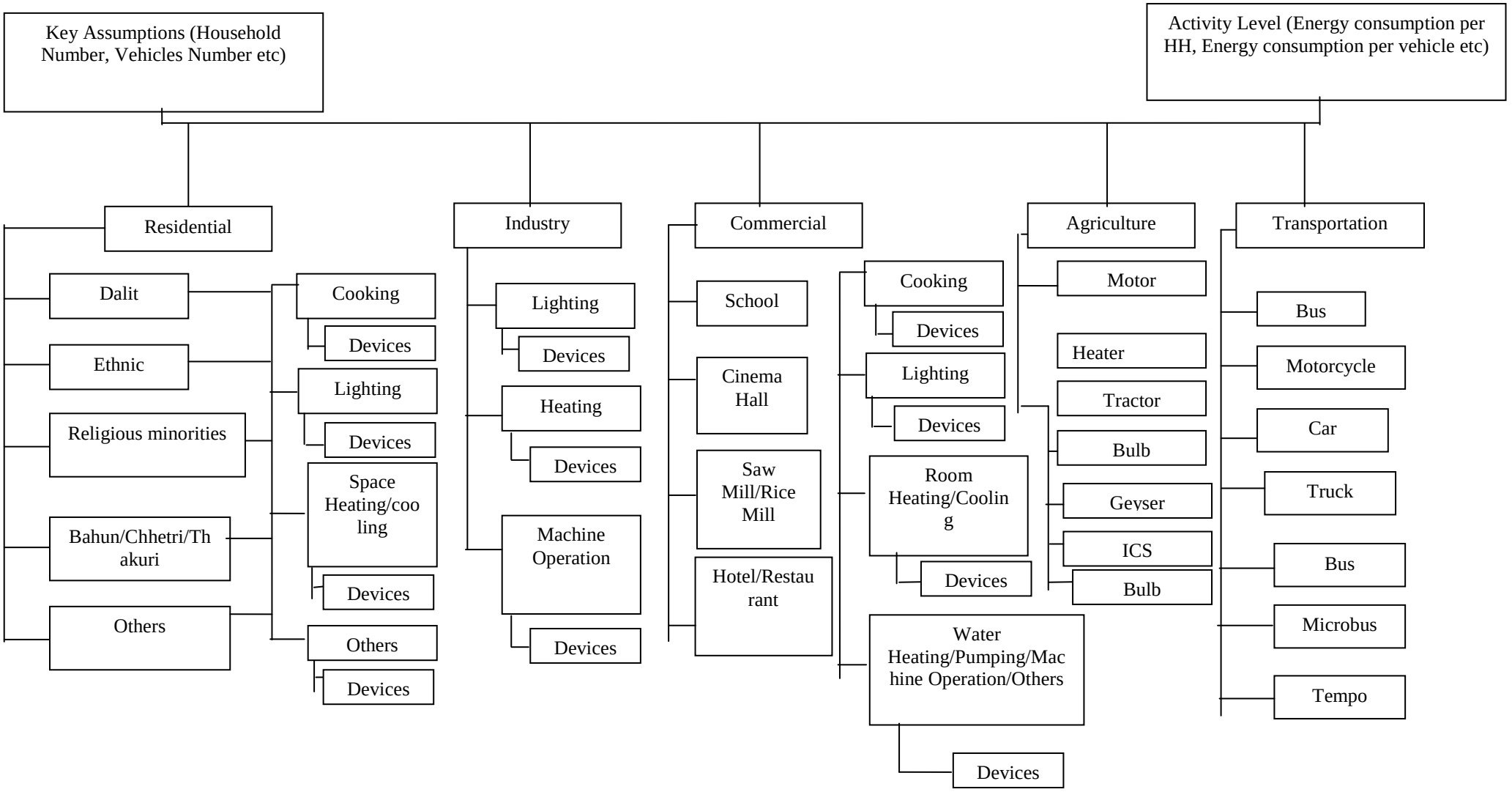

Figure 6: LEAP model framework

2.3.10 Workshop Facilitation and Preparation of DCEP

After preparation of draft report, it was sent to DDC for review. For detail interaction and collection of view from different stakeholders, district level workshop was organized by DEEU and consultant facilitated the workshop. Suggestions from the workshop have been incorporated and final DCEP report has been prepared.

2.3.11 Framework Development for Monitoring and Evaluation

Framework for monitoring the progress and achievement of the plan has been developed and presented in chapter 5. It includes parameters to be monitored, method and frequency of monitoring and responsible institution for monitoring. Software has also been developed so as to evaluate the achievement of the plan.

2.3.12 Software Development

Simple software has been developed by using Microsoft Excel to facilitate the concerned users to visualize the changes in the energy pattern with the implementation of appropriate energy and climate interventions. User can enter the basic parameters like population, household number, industry and commercial GDP etc. along with energy demand pattern of the region and they can observe the change in energy consumption pattern with the policy interventions to optimize the energy situation of the region.

Chapter Three

District Climate Change and Energy Situation of Dolakha

3.1 Climate Change Assessment

As per NAPA ranking for climate change vulnerability, Dolakha district lies in High vulnerability zone with vulnerability index from 0.061 to 0.786.

Table 6: Climate Change Vulnerability Indices

Sub-Indices		**Rank**	**Index Range**
Sensitivity	Human	Very Low	0-0.033
	Ecological	Low	0.06-0.16
	Combined	Very Low	0.00-0.146
Climate Risk/Exposure	Temperature and Rainfall	Moderate	0.270-0.441
	Ecological	Low	0.082-0.137
	Landslide	Low	0.073-0.212
	Flood	Very Low	0.000-0.023
	Drought	High	0.348-0.562
	GLOF	Very High	0.751-1.000
	Combined	High	0.500-0.681
Adaptive Capacity	Socio-economic	Moderate	0.396-0.556
	Technology	Very High	0.000-0.030
	Infrastructure	Very Low	0.521-1.000
	Combined	Very Low	0.521-1.000
Vulnerability	Temperature and Rainfall	High	0.452-0.640
	Ecological	Moderate	0.079-0.192
	Landslide	Moderate	0.477-0.629
	Flood	Very Low	0
	Drought	High	0.515-0.759
	GLOF	Very High	0.911-1.000
	Combined	Very High	0.787-1.000

Source: NAPA, Climate Change Vulnerability Mapping for Nepal, 2010.

As per the study by Shambhu Chamakar (2010) submitted to NAPA, MOE, overall temperature and precipitation of the Dolakha is increasing.

3.1.1 Precipitation

Precipitation data of Jiri Station is given in tables below

Table 7: Annual Precipitation of Dolakha District (Jiri Station)

Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Annual Precipitation (mm)	2526	2235	NA	NA	NA	2625

Year	2001	2002	2003	2004	2005	2006
Annual Precipitation (mm)	NA	NA	2839	2613	2015	1980
Year	2007	2008	2009	2010	2011	2012
Annual Precipitation (mm)	NA	2863	2010	2556	2682	2325

Source: Environmental Statistics of Nepal 2013

Table 8: Mean annual and seasonal Precipitation of Dolakha District (Jiri Station)

1971-2000				
Annual	**Monsoon**	**Winter**	**Pre-monsoon**	**Post-monsoon**
2266	1815.4	52.1	307.9	90.6

Source: Environmental Statistics of Nepal 2013

As per the study by Shambhu Chamakar (2010), the overall rainfall in the district has increased in last 21 years. But, the seasonal analysis showed that rainfall in Dolakha district had increased in monsoon and post monsoon season while it had decreased in other seasons.

According to the study, the average annual, winter, pre-monsoon and monsoon rainfall in last five year (2004-08) receives very low in comparison of last 16 years (1988-2003) in Dolakha. This fact shows that the prolonged drought, erratic rainfall and unseasonal rainfall is increasing in last five years even average annual rainfall has been increasing in pattern.

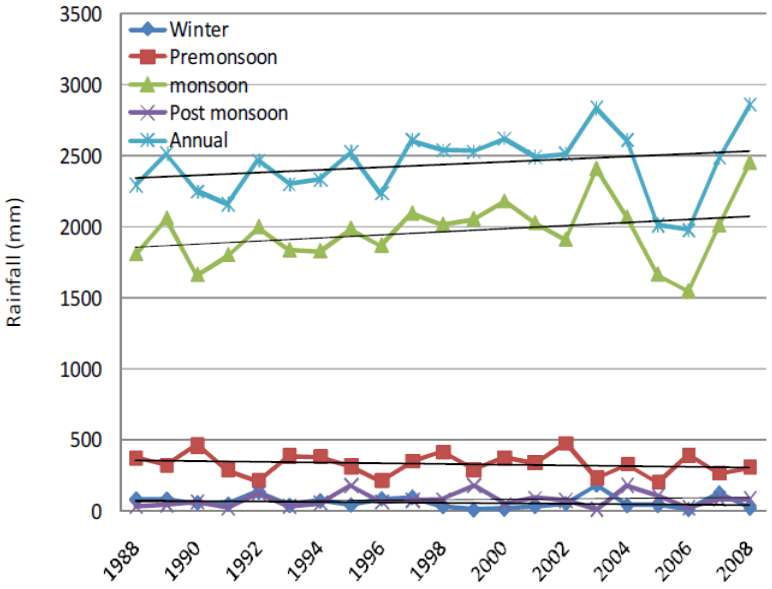

Figure 7: Annual and Seasonal Rainfall in Dolakha

3.1.2 Temperature

Temperature data of Jiri Station is given in tables below

Table 9: Mean Temperature of Dolakha District (Jiri Station)

Year	2001	2002	2003	2004	2005	2006
Temperature (^{o}C)	14.6	14.1	14.3	14.3	14.2	14.9

Year	2007	2008	2009	2010	2011	2012
Temperature (^{o}C)	5.3	14.3	14	NA	14.2	14.5

As per the study by Shambhu Chamakar (2010), the mean annual temperature for the last 21 years increased by 0.041 degree Celsius in Dolakha.

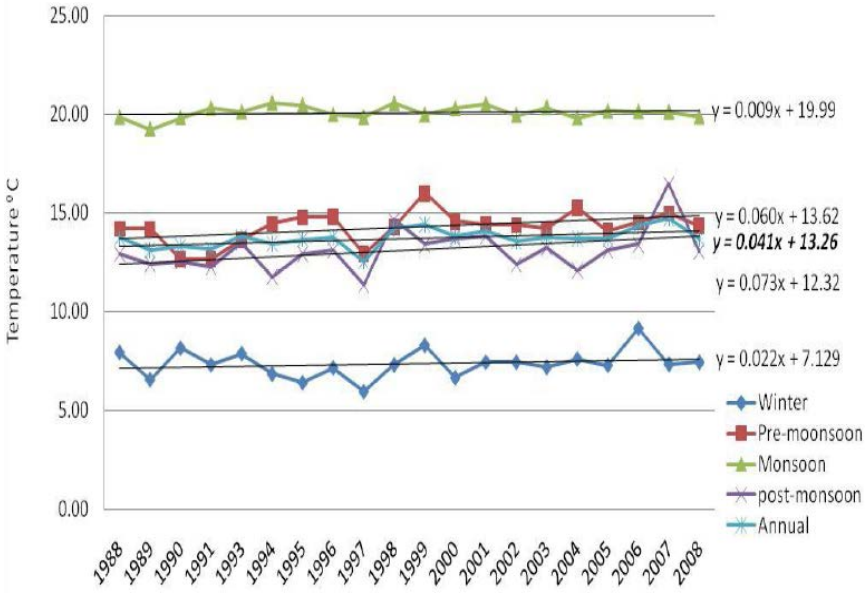

Figure 8: Average seasonal and annual temperature in Dolakha

3.1.3 Climate Change and Associated Disasters

During the workshop, major disasters due to climate change as reported by the participants are as follows.

- Increase in landslides and landslide induced flood disasters
- The district is facing uneven precipitation pattern and there is impact in vegetation too. This may be due to climate change.

3.2 GESI Assessment

Population: As per field survey 2014, the population of Dolka district is 239,575. Among them females are more than male. About 50.2% populations are female and 49.8% male. The average population per household in Dolkha is 5.1 members, which is higher for rural (5.1 persons per family) and urban (4.7 persons per family) as shown in Table 10.

Table 10: Population by sex and location

Location	Total Population			Family size
	Female	Male	Total	
Rural	107543	106803	214346	5.1
Rural %	50.17	49.83	100	
Urban	12625	12604	25229	4.7
Urban %	50.04	49.96	100	

Total	120168	119407	239575	5.1
Total %	50.2	49.8	100	

Source: Field Survey 2014

Larger population (89.5%) lives in rural area in comparison to urban (10.5%) area as shown in Table 10.1.

Table 11: Population distribution by location

Location	Rural		Urban		Total	
	Population	**%**	**Population**	**%**	Population	%
Female	107543	89.5	12625	10.5	120168	100.0
Male	106803	89.4	12604	10.6	119407	100.0
Total	214346	89.5	25229	10.5	239575	100.0

Source: Field Survey 2014

Ethnicity: Dalit, Janajati, Religious Minorities, Brahmin, Chetri and Thakuri are major ethnic / caste groups in Dolkha. Ten highly excluded groups live in Dolkha. They are Tamang, Thami, Kami, Damai/Dholi, Sarki, Sunuwar, Majhi, Badi, Chamar/Harijan/Ram and Mushar.

According to field survey, about 48.6% people are Janajati, 42.1% Brahmin/Chetri/Thakuri, 7% Dalits, 1.8 % religious minorities and 0.1% other groups in Dolkha.

Dalits are more in rural area (8%) than in urban area (5.2%). About 51.6% Janajatis live in rural area whereas 34.3% live in urban area. In contrary, 60.6% Brahmin/Chhetri/Thakuri groups live in urban areas and only 38.1% live in rural Dolkha. Only few (2.2%) religious minorities and 0.1% other cate/ethnicity groups live in rural Dolkha as shown in Table 11.

Table 12: Sampled population by ethnicity and location

Location	**Dalit**	**Janajati**	**Religious Minorities**	**Brahmin / Chhetri / Thakuri**	**Others**	**Total**
Rural	9791	63159	2641	46763	21	122375
Rural (%)	8.0	51.6	2.2	38.1	0.1	100
Urban	1322	8780	0	15530	0	25632
Urban (%)	5.2	34.3	0	60.6	0	100
Total	11113	71939	2641	62293	21	148007
Total (%)	7.5	48.6	1.8	42.0	0.1	100

Source: Field Survey 2014

Household Heads: Out of total of 47,486 households (HHs) in Dolkha, 81.4% HHs are headed by male and 18.6% are headed by female members of the family. The percentage of female headed households is slightly higher in rural area (19%) than in urban area (16%) as shown in Table 12.

Table 13: Number of Households by Head of family and Location

Location	House hold (Head of family)		
	Female	Male	Total
Rural	7965	34204	42169
Rural %	18.9	81.1	100
Urban	846	4471	5317
Urban %	15.9	84.1	100
Total	8811	38675	47486
Total %	18.6	81.4	100

Source: Field Survey 2014

Household by Ethnicity:

Of the total households in rural Dolkha, 7.5% are Dalit, 48.6% are Janajati, 1.8% religious minority and 42.1% Brahmin/Chhetri/Thakuri households. In rural Dolkha, 8% are Dalit, 51.6% are Janajati, 2.2% religious minority and 38.2% Brahmin/Chhetri/Thakuri households. Similarly, about 60.6% Brahmin/Chhetri/Thakuri households, 34.3% Janajati, 5.2% Dalit households are in urban Dolkha as shown in Table 13.

Table 14: Distribution of households by ethnicity and location

Location	Dalit	Janajati	Religious Minorities	Brahmin/ Chhetri/Thakuri	Others	Total
Rural	9791	63159	2641	46763	21	122375
Rural %	8.0	51.6	2.2	38.2	0.02	100
Urban	1322	8780	0	15530	0	25632
Urban %	5.2	34.3	0	60.6	0	100
Total	11113	71939	2641	62293	21	148007
Total %	7.5	48.6	1.8	42.1	0.01	100

Energy Source for Cooking in rural Dolkha:

In rural Dolkha, most of the households (61%) still use traditional stove for cooking. About 33% households use improved cooking stove (ICS), and about 3.42% households use LPG stove. Similarly, 1.31% households use coal stove for cooking and 0.81% of household use biogas for cooking. Only 0.26% household use Electricity, 0.07% households use kerosene and 0.04% households use organic briquette stove for cooking.

Only 0.5% Janajati household use electricity stove from national grid for cooking in rural Dolkha. Same way, only 0.1% Brahmin/ Chhetri /Thakuri households use organic briquette stove for cooking in rural Dolkha as shown in Table 14.

Table 15: Energy Sources for Cooking by Ethnicity in Rural Dolkha

Ethnicity	Traditional Stove	Improved cooking stove	Biogas Stove	LPG Stove	Organic briquette stove	Kerosene stove	Coal stove	Electric stove grid	Total
Brahmin Chhetri Thakuri	57.0	36.4	1.2	5.0	0.1	-	0.3	-	100.0
Religious Minorities	73.2	15.9	4.5	3.2	-	3.2	-	-	100.0
Janajati	62.3	32.5	0.4	2.4	-	-	1.9	0.5	100.0
Dalit	69.3	24.9	0.6	2.5	-	-	2.7	-	100.0
Weightage average	61	33	0.81	3.42	0.04	0.07	1.31	0.26	100

Source: Field Survey 2014

Energy Sources for Cooking in urban Dolkha:

For cooking, traditional stove users are still in majority (78%) in urban Dolkha. Other sources of energy for cooking include LPG stove (19.1%) and improved cooking stove (2.9%). About 55.6% Dalit communities are using traditional stove, and about 44.4% are using LPG stove for cooking. Janajati are using traditional stove (84.9%) and LPG stove (15.1%) for cooking. Similarly, Brahmin/Chhetri / Thakuri are using traditional stove (76%), LPG stove (19.3%) and improved cooking stove (4.8%) for cooking as shown in Table 15.

Table 16: Energy Sources for Cooking by Ethnicity in urban Dolkha

Ethnicity	Traditional Stove %	Improved cooking stove %	LPG Stove %	Total %
Brahmin Chhetri Thakuri	76.0	4.8	19.3	100.0
Janajati	84.9	-	15.1	100.0
Dalit	55.6	-	44.4	100.0
Weightage Average	78	2.9	19.1	100.0

Source: Field Survey 2014

Energy Source for Lighting in rural Dolkha:

In rural Dolkha, about 79% households are using electricity from national grid for lighting and 16.28 from micro-hydro. About 2.34% households are using solar energy and 2.62% kerosene for lighting. None of Religious minority households are using Solar light for lighting. Energy use percentage for lightning by ethnicity for rural Dolakha is given in Table 16 below.

Table 17: Percentage use of Energy Source for Lighting by Ethnicity in Rural Dolkha

	National Grid	Micro-hydro	Kerosene Light	Solar
Bahun Chettri Thakuri	78.5	15.8	2.1	3.6
Religious Minorities	83.8	14.3	1.9	-
Janajati	79.1	16.4	2.8	1.7
Dalit	76.3	18.4	4.2	1.1
Weightage Average	78.75	16.28	2.62	2.34

Source: Field Survey 2014

Energy Source for Lighting by Ethnicity in Urban Dolkha:

In urban Dolkha, 100% households use National grid electricity for lightning

Table 18: Percentage use of Energy Source for Lighting by Ethnicity in Urban Dolkha

Ethnicity	National Grid Electricity
Dalit	100
Janajati	100
Brahmin/ Chettri/ Thakuri	100
Average	100

Source: Field Survey 2014

3.3 Energy Demand Assessment

An assessment of the energy demand of different sectors including residential, industrial, commercial, agriculture and transportation in Dolakha is based on the minimum energy required for these activities. It is found using Energy Demand= Energy Intensity*Activity Level. Energy intensity which is the amount of energy used per household and concerning activity level which is the number of households in case of residential sector. Energy demand changes with the change in energy intensity or activity level or both. Energy intensity changes with the technology use pattern of people which can be fairly estimated judging from the probable changes in the affinity of the people towards several available technologies. Table shows energy demand for different sectors from 2014 to 2019. The energy demand is calculated 2.51, 2.55, 2.56, 2.58, 2.59 and 2.61 million GJ from 2014-2019, respectively.

Table 19: Energy demand for different sectors (‘000 GJ)

Branches	2014	2015	2016	2017	2018	2019
Residential	2,160.0	2,193.1	2,205.6	2,218.1	2,230.8	2,243.5
Transportation	97.1	97.1	97.1	97.1	97.1	97.1
Industrial	3.1	4.2	5.7	7.7	10.4	14.2
Commercial	121.0	121.0	121.0	121.0	121.0	121.0
Agriculture	133.4	133.4	133.4	133.4	133.4	133.4
Total	2,514.6	2,548.7	2,562.7	2,577.3	2,592.7	2,609.2

3.3.1 Residential

The residential sector is the largest consumer of energy in the district with a demand of 2.16, 2.19, 2.20, 2.22, 2.23 and 2.24 million GJ in 2014, 2015, 2016, 2017, 2018 and 2019, respectively. Cooking makes up the biggest share of energy consumption in the residential sector. In the district, there are 45,083 households. For the cooking purpose, 43,081 households are using fire wood whereas kerosene, LPG, cow dung, biogas, electricity are used by 306, 1061, 46, 83 and 24 households, respectively. In terms of fuel consumption, biomass has the largest share for cooking making up over 85% of fuel uses. For lighting, the main sources of energy is electricity (if the HH has access to the NEA or an off grid electricity connection) and kerosene (mainly in rural areas).

3.3.2 Commercial

The main consumers in the commercial sector of Dolakha are restaurants, hotels, hospitals, schools etc. The energy demand in the district in 2014 is estimated about 0.12 million GJ and no significant change in energy demand is noted up to 2019.

3.3.3 Industrial

The industrial sector is primarily based on the following industries: rice mills, saw mills, workshops, and other factories. The energy demand in industrial sector is found low compared to residential sector or total energy demand in the district.

3.3.4 Agricultural

The energy demand for agriculture sector from 2014-2019 are estimated to be 0.133 million GJ in the year 2014 and no significant change in energy demand is noted.

3.3.5 Implication of climate change on energy supply and consumption

General climatic phenomenon for the district is described in section 3.1. Impacts from weather phenomena associated with climate change pose risks of economic costs to energy suppliers and users. Increases in average temperatures and temperature extremes will lead to increase demand for energy for cooling and heating. Expected reductions in precipitation in the form of snowfall in the northern part of the District will reduce hydropower production. There are various hydropower projects including micro and pico hydropower and ongoing projects like Tamakoshi. These hydropower projects can be affected due to impact of climate change. Similarly expected seasonal water scarcity represent risks of electricity supply disruptions (load shedding). Climate change can impact on biodiversity resulting in less productivity of forest and hence impact in supply of fire woods. Impacts of climate change are risks to many oil and gas supply activities resulting in increased cost of petroleum products. However both climate change and rising concentrations of atmospheric carbon dioxide will affect bioenergy production potentials hence creating favorable condition for biogas production.

Longer winter seasons will lead to energy demand for heating. As the district lies in northern part of the country and has cold weather, energy requirement for space heating is noticed significant for the district.

3.4 Energy Resource Assessment

3.4.1 Biomass

Fuel wood: Fuel wood is the major energy resource in the district for all the activities in residential, commercial and agricultural uses. In total the district has 26862 ha of community forest land whereas 982.51 ha area for Hill Leasehold Forestry and Forage Development Project, and 1593.14 ha area for Leasehold Forestry and Livestock Programme.

Agricultural residue: Another traditional source of energy in the district is agricultural residue and animal dung. The main sources of agri-residue in Dolakha are rice, paddy, maize, and wheat; other sources provide much smaller quantities of energy.

Animal dung and biogas: With many rural households owning cattle and other domestic animals, animal dung is often used as a fuel source. The dung is being used for biogas production as well as traditional uses including organic fertilizer. In the district, there are 3825 households with land and cattle while technical potential of biogas plants from cattle dung is 2875. Out of them, 1211 biogas plants have constructed (Renewable Energy Data Book, 2012).

3.4.2 Commercial and Fossil fuels

As in other parts of Nepal, Dolakha also use fossil fuels which are imported from foreign countries. Some of the major areas where different types of fossil fuels are consumed is summarized in the Table below.

Table 20: Commercial fuel type and use practices

Fossil Fuels	Major Applications
Diesel	Transportation, Industries, Generators, Boilers, Water pumps
Kerosene	Cooking, Lighting
LPG	Cooking
Coal	Industry
Gasolene	Transportation, Small Generators

3.4.3 Renewable energy

Micro Hydro, Pico Hydro and IWM: There is good potential for micro hydro, pico hydro and IWM in the district. 36 micro hydro of 836 kW and 24 pico hydro of 77 kW are serving in the district in order to provide electricity whereas there are also 550 IWMs.

Solar and Wind: It is noteworthy that Dolakha has good solar resources in the country (in average more than 5.0 kWh/m2/day). 244 solar home systems of 4247 Wp have been installed whereas 37 solar dryers and cookers have been installed in the district. However,

regular wind flow has been observed in many places in the district, it is not noted any feasible site for installation of wind turbine.

3.4.4 Vulnerability and stresses to energy resources in the context of climate change

As indicated in section 3.1, Dolakha lies in very high vulnerability ranking in context to climate change. Though the district is low sensitive, the district is in high risk to Drought and GLOF and highly vulnerable regarding temperature and rainfall, Drought and GLOF. The district is moderately vulnerable considering ecological and landslide aspect. Similarly the district has very low adaptive capacity to climate change. This leads whole district vulnerable to energy resources too as most of the energy resources are directly or indirectly dependent on climate.

Energy resources that are dependent on water are impacted through climate induced disasters are the most vulnerable to stresses of climate change. Decreasing levels of water availability has a direct impact on hydropower production. It also results in a decrease in forest cover, decrease in agriculture production and livestock rearing which impact availability of energy resources like firewood, agriculture waste and animal dung. Increase spells of droughts result in forest fires which also adversely impact forest resources and availability of fuel wood; while climate induced disasters either eradicate the source or limit access to such resources. Weather induced hazards such as landslides can disrupt the supply of fuel and electricity to some extent when infrastructure like roads and transmission lines get damaged.

3.5 Technology Assessment

Different technologies available within the districts and potential for the districts have been assessed. Suitability of the technology in contest of resource availability, installation and operation cost, different aspects of climate change, different aspects of GESI etc. have been done and presented in tables below.

Table 21: Technology assessment for cooking purpose

Technologies	Existing Use Share		Cost Analysis		Resource Availability	Vulnerability to CC Impacts	Potential to Adaptation	Potential to Mitigation	Gender Friendly in use	Promote Social Inclusion	Contribute poverty Reduction
	Rural	Urban	Installation (NRs)	Monthly Operation							
Traditional Cooking Stove	61.08	78	150	600	Available within the district (forest resources)	Climate change can effect forest and trees so highly vulnerable	No any potential to adaptation	Adversely affect as it produces GHGs	Difficult in fire wood collection, smoke & health hazard	Does not promote because socially excluded groups do not have own forest land for fire wood collection.	No, rather it consumes productive time for firewood collection or need to spend money to buy firewood.
Improved Cooking Stove	33.02	2.9	Mud type 300 and metal type 7000	480	Available within the district (forest resources)	Climate change can effect forest and trees so highly vulnerable	As it requires less fuel wood is more adaptive that TCS	Adversely affect as it produces GHGs	Difficult in fire wood collection	It helps to promote social inclusion if equal access provided to community forest	Contribute poverty reduction in some extent as less firewood is needed and if subsidy provided for installation.
Kerosene Stove	0.07	0	1000	750	Imported	Not Vulnerable	No any potential to adaptation	Adversely affect as it produces GHGs	Difficult for pumping stove and bad kerosene smell & health hazard	Save time for work, but it is expensive and imported item, depend on others.	In some extent if subsidy provided for poor and save time for work
Biogas	0.81	0	48,600	0	Available in	Climate change	Favorable for	Potential to	Difficult in	Not in	Promote

					houses with livestocks	causes increase in temperature favorable for biogas production	climate change so highly adaptable	mitigation as it reduces methane release in atmosphere	feeding and mixing dung slurry for biogas, & need to keep livestock for dung	general, but yes, if installed in public level.	poverty reduction as it promotes livestock rearing
LPG Stove	3.42	19.14	3,000	750	Imported	Not Vulnerable	No any potential to adaptation	Adversely affect as it produces GHGs	Gender Friendly in use	No, it is expensive and hard to transport in rural areas. It is imported energy source.	No, it is expensive and increase poverty.
Electric Stove	0.26	0	3,500	850	National grid	Water resources are affected by climate change so vulnerable	No any potential to adaptation	Potential to mitigation as it does not emit GHGs	Gender friendly use but risk of electric socks	No	No

Table 22: Technology assessment for lightning purpose

Technologies	**Existing Use Share**		**Cost Analysis**		**Resource Availability**	**Vulnerability to CC Impacts**	**Potential to Adaptation**	**Potential to Mitigation**	**Gender Friendly in use**	**Promote Social Inclusion**	**Contribute poverty Reduction**
	Rural	**Urban**	**Installation**	**Monthly Operation**							
Kerosene lamp	2.62	0	400	300	Imported	Not Vulnerable	No any potential to adaptation	Adversely affect as it produces GHGs	Risk of contamination (health), smell and fire	Access and control to larger community and can be transported in remote areas also	Cheaper than electricity, so save money, but is is imported resource and available in the country.
Solar Home	2.34	0	20,000	250 (Battery	Freely	Not	Resource	Potential to	Gender	Yes, if	Yes, save time

System				replacement)	available	Vulnerable	freely available and not vulnerable to CC so potential to adaptation	mitigation as it does not emit GHGs	Friendly in use	subsidy provided	for work
Grid Electricity	78.75	100	10,000	350	National grid (not within the district)	Water resources are affected by climate change so vulnerable	No any potential to adaptation	Potential to mitigation as it does not emit GHGs	Gender Friendly in use but little risk of electric socks	Yes, helps in study at night also, but need to provide subsidy and distribute equally in rural area	Yes, if provided subsidy
Micro Hydro Electricity	16.28	0	Too expensive for single household	250	Within district	Water resources are affected by climate change so vulnerable	No any potential to adaptation	Potential to mitigation as it does not emit GHGs	Gender Friendly in use	Yes, locally available with subsidy	Yes, save time & energy for micro Enterprise development, ghatta/ mills/processing cottage industries.
Biogas Light	0	0	1000	90	Available in houses with livestocks	Climate change causes increase in temperature favorable for biogas production	Favorable for climate change so highly adaptable	Potential to mitigation as it reduces methane release in atmosphere	Difficult in feeding and mixing dung slurry for biogas, need to keep livestock	Yes, if installed publicly	Promote poverty reduction as promotes livestock rearing
LPG Light	0	0	3,000	400	Imported	Not Vulnerable	No any potential to adaptation	Adversely affect as it produces GHGs	Gender Friendly in use	No	No

Table 23: Technology assessment for lightning bulbs

Bulb Use Pattern	Cost		Health Hazard	Life time
	Installation	Monthly Operation		
Fillament	50	540	Risk to Eye Damage	600
Tubelight	1,000	360	Contains mercury, toxic metal	1500
CFL	350	81	Risk to Eye damage but less than filament	3000
LED	400	81	Health Friendly	3500

Adaptation potential: From the gender perspective, time saved and its use for social networking and involvement in community activities help in exchanging information and gaining knowledge regarding risks, disasters and the successes and failures of encountering them. In terms of different ethnic and marginalized groups, their settlement away from the rest of the community impairs their access to information and due to very little data it is not possible to say much about their adaptive potential.

3.6 Institutional Arrangements

The institutional assessment was carried out through stakeholder identification, consultations, capacity assessment and SWOT analysis tools to create a detailed implementation plan in order to implement the DCEP in Dolkha district.

Institutional analyses of some of the organizations are as follows:

District Environment and Energy Unit (DEEU) in DDC: The environment and energy unit (DEEU) plans and implement rural energy programmes in Dolkha under technical and financial supports from APEC and DDC of Dolkha. Most of the funds required to implement the rural energy programme comes from AEPC, while DDC also allocates significant funds to disseminate rural energy activities including biogas and ICS promotion and awareness activities. The DDC of Dolkha seemed to fully recognize the DEEU which a required condition for implementation of plans like DCEP. Similarly, the DEEU also seemed to have a good relationship with non-government organizations functional in the district. Hence, DEEU have good opportunity to mobilize qualified NGOs. Currently, the DEEU of Dolkha has full time staffs, but not sufficient in term of numbers and knowledge they acquire. Human resource in the DEEU is not currently sufficient to deliver the DCEP as implementation requires increase in activities including: monitoring and evaluation, subsidy disbursement and promotion and awareness activities. Therefore, the current human resources are unlikely to handle such an increase in activities.

District Forest Office (DFO): Conserving forest resources and its sustainable use within the district is the main objective of District Forest Office. Fuel wood production, plantation & seedling production, community forest management, leasehold forestry development program, nursery vegetation, forest management, timber production, training, awareness campaign are its regular programs related to climate change. Forests are closely related both with energy and climate change. Hence their sustainable use and conservation is crucial.

District Forest Office, Dolkha has been lunching different programs like Community Forest Development Programme, National Forest Development and Management Programme, Vegetation improvement, Plantation and Private Forest Programme, REDD-Reduced Emission from Deforestation and Forest Degradation Programme, etc. Annual budget allocation for such program is as per the government budget decision/red-book. Major strengths of this organization are: Forest conservation and management plays direct role in climatic balance and climate change impact reduction, this organization has trained human resources, has sector and subject related laws, and has grass root level users group in forest sectors (Community Forest Users Group). Major weakness of the organization are: Lower staffs of the organization like forest helpers are not up to date, there is lack of physical infrastructures like building, there is lack of enough budget to address all the district level issues, lack of energy and climate change focused program. Major opportunities of this organization are: livelihood related resources availability at local level, possibility of coordination with DDC and VDCs, possibility of funding from donor agencies for current issues like climate change, REDD, carbon trade, etc. Duplication of prevailing laws and rules, exploitation of natural resources, haphazard construction of infrastructures mainly roads destroying forests, forest encroachment and forest fires, illegal wildlife hunting poaching, etc. are major threats to the organization.

FECOFUN: Although FECOFUN do not deal directly with RETs, they operate in the field of climate change, with a core strategy to conserve Nepal's forests to reduce landslides and desertification. The organization does not have adequate skills to deal with issues in the district, although premises and access to information are present. There are no systems in place to measure the satisfaction of the operations of FECOFUN locally although they have significant contact with policy makers and external stakeholders. Gender and social issues are said dealt with adequately by the organisation, the capacity to pick up and deal with issues, and a specific gender policy of the organization in place. They deal less well with social inclusion issues, and it was not perceived that the staffing policy deals sufficiently with the issue. FECOFUN do target minority groups in their projects, and they have a specific social inclusion policy.

Rural Development Tuki Association (RDTA): The RDTA is a NGO with objectives related to climate change. The organization conducts action and applied research on climate change, natural resources, biodiversity, agriculture and social science, livestock, food security and public health. Promotion of environment friendly community development programs including organic farming is another objective of the organization and Livelihood Improvement Project in partnership with CWIN Nepal. The project is being implanted in eight northern VDCs of Dolkha district. The program activities directly related to climate change include training and material support ICS installation, orientation on climate change to school children, research on vulnerability assessment and climate change adaptation research, periodic plan on sustainable development (LAPA on Bahare VDC), This organization has been implementing Women and Children Empowerment This organization implements other activities that support to mitigate and adapt with changing climatic situation. The programs are: pollution pits and dust bins at school premises; herb garden, tree plantation in schools; organic farming, etc. Annual budget allocation for such programs is

around NRs. 88,88,000.00 Funding source: FORUT Norway and matching with local stakeholders.

SWOT analysis of RDTA to implement energy and climate change related program. *Strengths:* working with a widely acknowledged TUKI approach, a bottom up approach, for the community development having environment and climate friendly interventions since 1970s; almost four decades of long experience in integrated community development and LAPA; experienced human resources available, good network, resourceful organization with own office building, training hall, and soil test laboratory; etc. Weakness: large membership structure-lack of quick decision; lack of influence or lobbing / advocacy capacity in national and international level; Opportunity: experienced human resource on climate change/ecology; intensive membership network; good coordination / network; public trust and ownership, highly reputed organization in Dolkha. Threats: high expectation of local community and TUKI members; increasing competition among other peer NGOs; shrinkage in funding and partnership; limited income source, etc.

Besides, there are various donors, government line agencies, NGOs, INGOs, private sector, finance institutions and local organizations with aim of improving energy status and contributing in the field of climate change. However all these organizations are working disintegrated without coordination among each other. The taskforce formed for the preparation of this DCEP is expected to remove all these shortcomings and help to work in unified way.

Table 24: SWOT Analysis

Organization	Strength	Opportunities	Weakness	Threats
DEEU	Clear Mandate provided; Good Network at district level	INGOs/Donors & other stakeholders are convinced on the need of energy & climate issues	Lack of resource; No full authority (depends on AEPC); no connection in subsidy monitoring; lack of adequate staff; lack of guidelines & procedures	Internalization of DEEU by DDC (DEEU staff)
District Line Agencies	Act, policies, mandate available to work on energy and related field	Basket fund for different sectors (AID effectiveness; harmonization)	Lack of capacity building of staff (training, exposure); No Compulsion for budget Allocation Inter ministerial coordination gap	Political instability (transition period)
Local Government	Familiar with local conditions and needs	Increasing concern on energy and climate change issues; Network at grassroots level	Low priority to RETs; No long term plan; Lack of resources & human resources	No elected body Restructuring of state (uncertain)
Non	Commitment on	Bound by	Lack of resources;	Frequent

Government	MDGs and other CC mitigation & adaptation;	international commitment to get funding (like CO2 saving)	no long term vision & commitment; Lack of localized MDG goals	Leadership changes
INGOs & donors	Resourceful; International Experience; linkages/relationship with community; familiar with local context	Basket funding (can contribute to International commitment on climate change, MDGs, International Conventions	Lack of coordination; Can't internalize Paris declaration; not localized (not internalizing local context)	Priority country & sector may be changed Preset Conditions
Private Sector	Flexibility; competency	Regarded as a Development partner by the Govt.	Low risk baring capacity; low R&D investment; No presence at grass root level	Unfair competition; priority differs in govt. policies; conflict;
Banks	Capable to mobilize fund; Adequate in number	RETs in high demand (new investment opportunities); Foreign investment	Low priority for energy projects; no compulsion to invest on RETs (no policy)	
MFI & cooperatives	Flexible fund; presence at grass-root level; adequate in number	RETs in high Demand Resource Mobilization possibilities	Lack of adequate policies to invest on energy projects	Dependency on external fund. Insecure ROI Security of fund (investment)
FECOFUN & Networks	Wider network; Flexibility; Good Mobilization capacity	RETs in high Demand which is supported by policies	Lack of accountability / responsiveness; No compulsion to investment on RETs;	High politics (Political motivation); Conflict of interest with national policies (forest)
Users	Searching for Utility maximization (ready to invest)	Supported by policy; right based approach – civil engagement (benefit sharing)	Lack of access to adequate information; Lack of skills and resources	Conflict (transition phase); lack of elected body (lack of accountable agency)

Chapter Four

District Energy Scenario Development/Demand Projection

4.1 Introduction

A scenario explains how an energy system might evolve for a particular region under a particular policy over time. The energy scenario provides users, implementing agency and policy makers to consider particular type of energy for specific purpose. It also gives idea how such energy will be used over time. In this study, three types of scenarios have been used. They are Business as Usual Scenario, Medium Adaptation Scenario and Climate Resilient Scenario. For projection, household growth rate has been considered to be 0.57. Similarly share of different technologies for different scenario for cooking purpose is taken as follow.

Table 25: Share of Technologies for different scenarios

	Scenarios	TCS	ICS	Biogas	Kerosene	LPG	Electricity	Others	
Rural	BAU	61.08	33.02	0.81	0.07	3.42	0.26	1.34	100
	Purposed MAS	0	70	5	0	15	10	0	100
	Purposed CRS	0	60	10	0	15	15	0	100
Urban	BAU	78	2.9	0	0	19.14	0	0	100
	Purposed MAS	0	45	5	0	30	20	0	100
	Purposed CRS	0	35	10	0	30	25	0	100

The results of these scenarios have been compared. The GHG emissions have also been calculated under these scenarios.

4.2 Business as Usual Scenario

The Business as Usual Scenario (BAU) is based on current status, increment trends and population growth rates. The scenario forecasts consumption of different types of energy including fossil fuels, traditional energy, commercial energy and renewable energy as per actual present demand without changing level of energy intensity. This scenario does not give emphasis on social and gender inclusions. Table 25 presents energy demand of the district in different sectors under this scenario from 2014-2019. The total energy demand is found to be 2.51 million GJ in the base year, which has been increased to 2.59 million GJ (3.40%) at the end of 2019. The increment in residential and industrial sectors are noted whereas no increment is noted for transportation, commercial and agriculture sectors.

Table 26: Energy demand under BAU scenario ('000 GJ)

Sector	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Residential	2,160.0492	2,172.3615	2,184.7439	2,197.1970	2,209.7210	2,222.3164
Transportation	97.0575	97.0575	97.0575	97.0575	97.0575	97.0575
Industrial	3.0771	4.1756	5.6664	7.6892	10.4343	14.1593
Commercial	120.9762	120.9762	120.9762	120.9762	120.9762	120.9762
Agriculture	133.4497	133.4497	133.4497	133.4497	133.4497	133.4497

Total	2,514.6097	2,528.0205	2,541.8936	2,556.3696	2,571.6386	2,587.9591

The residential energy demand in the district is presented in Table 26. The energy demand in the rural sector has increased from 1.92 million GJ in the base year 2014 to 1.97 million GJ at the end of year 2019.

Table 27: Residential Energy demand in rural sector under BAU scenario ('000 GJ)

Fuels	2014	2015	2016	2017	2018	2019
Electricity	17.7136	17.8145	17.9161	18.0182	18.1209	18.2242
Kerosene	0.4220	0.4244	0.4268	0.4292	0.4317	0.4342
LPG	12.4066	12.4773	12.5485	12.6200	12.6919	12.7643
Wood	1,868.4531	1,879.1033	1,889.8142	1,900.5861	1,911.4195	1,922.3145
Biogas	3.2774	3.2961	3.3149	3.3338	3.3528	3.3719
Coal	14.9551	15.0403	15.1260	15.2123	15.2990	15.3862
Total	1,917.2779	1,928.2063	1,939.1971	1,950.2505	1,961.3670	1,972.5468

Table 27 presents residential energy demand in urban sector under this scenario. The total residential energy consumption for the base year 2014 in the urban sector under this scenario is 0.24 million GJ, which is predicted to increase 0.25 million GJ. The increment is noted by 8.10%.

Table 28: Residential Energy demand in urban sector under BAU scenario ('000 GJ)

Fuels	2014	2015	2016	2017	2018	2019
Electricity	0.9384	0.9437	0.9491	0.9545	0.9600	0.9654
LPG	8.6590	8.7083	8.7579	8.8079	8.8581	8.9086
Fuel wood	233.1740	234.5030	235.8397	237.1840	238.5360	239.8956
Total	242.7713	244.1551	245.5468	246.9464	248.3540	249.7696

4.3 Medium Adaptation Scenario

This scenario has taken into account the development of livelihoods by providing inclusive access to energy sources. It also takes into account cost of the technology along with adaptive measures to potential vulnerabilities of resources and technologies. In this scenario, emphasis is given to use of cheap and clean energy in the place of traditional inefficient energy sources and technologies.

The residential energy consumption in the rural sector under this scenario is presented in Table 28. The total residential energy in the rural sector has been decreased from 1.92 million GJ in the base year 2014 to 1.40 million GJ at the end of the year 2019.

Table 29: Residential Energy demand in rural sector under MA scenario ('000 GJ)

Fuels	2014	2015	2016	2017	2018	2019
Electricity	17.7136	22.8645	28.0736	33.3413	38.6682	44.0547
Kerosene	0.4220	0.3409	0.2590	0.1760	0.0922	0.0073
LPG	12.4066	20.7959	29.2804	37.8609	46.5384	55.3135
Fuelwood	1,868.4531	1,695.9418	1,521.4032	1,344.8198	1,166.1738	985.4476
Biogas	3.2774	6.5384	9.8365	13.1719	16.5451	19.9562
Coal	14.9551	12.0322	9.0756	6.0849	3.0598	-

Total	1,917.2779	1,758.5642	1,597.9789	1,435.5058	1,271.1286	1,104.8309

Table 29 shows residential Energy demand in urban sector under MA scenario (‘000 GJ). The total energy demand is forecasted to decrease from 0.24 million GJ to 0.104 million GJ. The consumption of electricity, LPG and biogas have been increased whereas it is decreased in case of fuel-wood.

Table 30: Residential Energy demand in urban sector under MA scenario (‘000 GJ)

Fuels	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Electricity	0.9384	2.2330	3.5623	4.9066	6.2661	7.6410
LPG	8.6590	9.6945	10.7416	11.8003	12.8707	13.9530
Fuelwood	233.1740	203.2235	172.9239	142.2724	111.2658	79.9012
Biogas	-	0.4921	0.9898	1.4931	2.0022	2.5170
Total	242.7713	215.6431	188.2176	160.4724	132.4048	104.0121

4.4 Climate Resilient Scenarios

This scenario has emphasized the use of clean and environment-friendly energy. Meeting energy demand through promotion of the maximum possible clean energy technology, security of supply, achieving, energy saving leading to the reduced climate change vulnerabilities are the main rational of this scenario. The residential energy demand under CR scenario from 2014-2019 is presented in Table 30 (rural) and 31 (urban).

Table 31: Residential Energy demand in rural sector under CR scenario (‘000 GJ)

Fuels	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Electricity	17.7136	25.4514	33.2768	41.1907	49.1937	57.2865
Kerosene	0.4220	0.3409	0.2590	0.1760	0.0922	0.0073
LPG	12.4066	20.7009	29.0894	37.5728	46.1520	54.8278
Wood	1,868.4531	1,668.4191	1,466.0440	1,261.3076	1,054.1895	844.6694
Biogas	3.2774	10.5427	17.8907	25.3221	32.8377	40.4381
Coal	14.9551	12.0322	9.0756	6.0849	3.0598	-
Total	1,917.2779	1,737.5377	1,555.6862	1,371.7052	1,185.5762	997.2808

The total energy demand in rural sector is predicted to decrease from 1.92 million GJ to 0.997 million GJ at the end of 2019. Under this scenario for urban sector at the end of 2019, the energy demand will be decreased from 0.242 million GJ to 0.096 million GJ. The demand of fuel wood has been decreased whereas electricity, LPG, and biogas have been increased.

Table 32: Residential Energy demand in urban sector under CR scenario (‘000 GJ)

Fuels	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Electricity	0.9384	2.5593	4.2185	5.8966	7.5936	9.3099
LPG	8.6590	9.6945	10.7416	11.8003	12.8707	13.9530
Fuelwood	233.1740	199.7521	165.9417	131.7393	97.1417	62.1453
Biogas	-	0.9842	1.9796	2.9863	4.0044	5.0340
Total	242.7713	212.9901	182.8814	152.4225	121.6104	90.4422

4.5 Comparison of the scenarios

Table 32 presents energy demand scenarios under BAU, MA and CR scenarios in the district from 2014 to 2019. The total energy demand is determined to be 2.16 million GJ in the base year 2014. The energy demand has been forecasted 2.22 million GJ at the end of year 2019 under BAU scenario. It means there may be increment in the demand by 3.41%. Due to adaptation of Medium Adaptation Scenario and Climate Resilient Scenario, the consumption of fuels will be lessened to 1.21 and 1.09 million GJ, respectively at the end of 2019. The reduction in energy consumption means cutback of conventional fuels, mainly fuel wood and consequently saving of forests. It will help to keep our climate.

Table 33: Residential Energy demand under various scenarios ('000 GJ)

Scenarios	2014	2015	2016	2017	2018	2019
BAU Scenario	2,160.0492	2,172.3615	2,184.7439	2,197.1970	2,209.7210	2,222.3164
Climate Resilient (CR) Scenario	2,160.0492	1,950.5278	1,738.5676	1,524.1276	1,307.1866	1,087.7229
Medium Adaptation (MA) Scenario	2,160.0492	1,974.2073	1,786.1965	1,595.9783	1,403.5335	1,208.8430

4.6 GHG emission in different scenarios

GHGs emission from energy use of different sectors along with possible emission up to 2019 is given in table below. It is estimated that by shifting from BAU Scenario to MA Scenario, emission of 20,254.19 metric tonnes of CO_2 Equivalent GHGs will be reduced upto 2019 whereas by shifting from BAU Scenario to CR Scenario, emission of 18,183.35 metric tonnes of CO_2 Equivalent GHGs will be reduced.

Table 34: Global warming potential in Residential sector under different energy scenarios from 2014-2019 (1000 Metric Tonnes CO_2 Equivalent)

Scenarios	2014	2015	2016	2017	2018	2019	Total
BAU Scenario	15.5	15.6	15.7	15.7	15.8	15.9	94.2
Climate Resilient (CR) Scenario	15.5	14.4	13.3	12.1	11.0	9.8	76.0
Medium Adaptation (MA) Scenario	15.5	14.2	13.0	11.7	10.4	9.1	73.9

Chapter Five

DCEP Plan

5.1 Introduction

This chapter presents a detailed implementation plan for coming 5 years on the MAS and CRS scenarios. The implementation plan has focused on planning for rural as well as urban residential sector as the residential sector is the highest energy consuming sector of Dolakha. The level of intervention and budget requirements has also been analyzed for different scenarios. The district level offices have to take lead on technology assessment and institutional assessments for implementing DCEP. The DCEP should be the rolling document to be mainstreaming into usual annual and periodic development planning of the district, the DDC and line agencies in particular by following the current DDC planning process.

5.2 Analysis of existing policies to implement proposed plan

The key strategies under which DDC is functioning reflect strong supports for:

- Development of RE resources based on community ownership and joint financing by community and local and central government.
- Conduct feasibility studies
- Increase awareness to increase growth of RE sector
- Prioritising RE projects for densely populated areas and development of a clean energy village
- Utilisation of CDM mechanism where feasible

In addition to local government commitments, the central government has a national level programme under which the district can benefit as well. Renewable Energy Subsidy arrangements provide for about 50% capital cost subsidy for installing micro and pico hydro. Dissemination of solar home systems, biogas and other renewable energy technologies are also provided with subsidies ranging from 25-40% of the installation costs on average. These policies will have positive implications in implementing DCEP in micro hydro by assisting financing options. Policies at both central and local level also provide technical assistance for capacity building and awareness activities in the field.

5.3 Analysis of intervention required in different scenarios

In line with the scenarios presented in chapter 4, various installation and operation targets have been set for a number of RET technologies. The interventions that are put forward are simply based on required resource mix that is prescribed for a scenario in 2020. The detailed intervention of different technologies required in MAS is presented below:

Table 35: Residential Energy demand for cooking in urban sector under MA scenario

Fuels/Technology	Households					
	2014	**2015**	**2016**	**2017**	**2018**	**2019**
Electricity (Rice cooker, Micro-oven)	154	366	584	804	1027	1253
LPG stove	1019	1141	1264	1388	1514	1642
Fuelwood (ICS-Metal type)	183	715	1253	1798	2349	2905
Biogas	0	53	108	162	218	274

Table 36: Residential Energy demand for cooking in rural sector under MA scenario

Fuels/Technology	Households					
	2014	**2015**	**2016**	**2017**	**2018**	**2019**
Electricity (Rice Cooker, Micro-oven)	2904	3748	4602	5466	6339	7222
Kerosene stove	38	31	24	16	8	1
LPG stove	1460	2447	3445	4454	5475	6507
Fuel wood (ICS- Metal type)	16,349	20,160	24,013	27,910	31,850	35,834
Biogas	356	711	1069	1432	1798	2169
Coal	544	438	330	221	111	0

The detailed intervention of different technologies required in CR scenario is presented below:

Table 37: Residential Energy demand in urban sector under CR scenario

Fuels/Technology	Households					
	2014	2015	2016	2017	2018	2019
Electricity (Rice Cooker, Micro-oven)	154	420	692	967	1245	1526
LPG stove	1019	1141	1264	1388	1514	1642
Fuel wood (ICS -Metal type)	183	589	999	1415	1835	2260
Biogas	0	107	215	325	435	547

Table 38: Residential Energy demand in rural sector under CR scenario

Fuels/ Technology	Households					
	2014	**2015**	**2016**	**2017**	**2018**	**2019**
Electricity (Rice Cooker, Micro-oven)	2904	4172	5455	6753	8065	9391
Kerosene stove	38	31	24	16	8	1
LPG Stove	1460	2435	3422	4420	5430	6450
Fuel wood (ICS-Metal Type)	16349	19159	22000	24873	27778	30715
Biogas	356	1146	1945	2752	3569	4395
Coal	544	438	330	221	111	0

Dolakha is one of the Hydropower Hub district in Nepal. During workshop consultation, participants including DDC and NEA officials assured that Dolakha district will achieve 100% electrification by grid-connection within the planned periods. It is assumed that though the district is heading towards 100% electrification by grid-connection, around 10% isolated

households in remote area will still be deprived with national grid and need Solar Home Systems.

Table 39: Residential Energy demand for Lightning

Annual Energy Demand for	2014	2015	2016	2017	2018	2019
Annual Grid Electricity requirement, kWh	3178238	3196354	3214573	3232896	3251324	3269856
Annual Solar PV requirement, KWh	175698.2	176699.7	177706.9	178719.8	179738.5	180763

5.4 Financing Plan

This section deals with investment requirement for the next five years to achieve the scale of intervention for the two scenarios MAS and CRS. To carry out the analysis of investment required to implement the intervention in the two scenarios, the inflation factor is not considered. This allows for a more thorough analysis of the cost requirements in the present context. The cost per unit of the technologies is listed in the Table below.

Table 40: Unit cost of technologies

Technology	Cost (NRs)	Remarks
Improved Cook Stove (Mud Type)	300	
Improved Cook Stove (Metal Type)	7000	
Biogas	48,600	
Micro/Pico Hydro	265,000	Per kW
Small Hydro	150,000	Per kW
Solar Home System	20,000	20 Wp
IWM	15,000	

The subsidy amounts are also considered which is to remain constant throughout the planning years. The current subsidy policy for some of the technologies is presented in the table below.

Table 41: Subsidy policy

Resource	Technology	Cost (NPR)	Subsidy
Fuel wood	Improved cook stove (Mud)	350	0
	Metallic stove	7000	2700 for 2 pot 4000 for 3 pot
Biogas	Biogas stoves (2, 4, 6 m^3)	48600	12000 + 700 (2500 for marginalised) (4000 for toilet attached)
Solar	10-18 Wp	1000/Wp	5000
	20 Wp	20000	6000
	Institutional		75% not exceeding 15,000
Micro-Hydro	IWM	15000	12,000 for Grinding (27,000 for other end uses) (6000/HH up to 5kW but no more than 60,000 per KW)

	5 kW	265,000/kW	12000/HH no more than 97,500 per KW
	500 kW to 10 MW	150,000/kW	No subsidy
	5 kW to 500 KW (rehabilitation)		50% of the installation cost subsidy will not be more than NPR 62,500 per kW generated.
	Institutional and community use		97,500 extra
	Transportation		500 per KM per kW, not exceeding 10KM and 30,000 per KW generated
	Productive use		10,000 per KW not exceeding 25,000 per project

Cost calculation

The cost for implementation of different renewable energy technologies are calculated below:

Table 42: Cost estimation (without subsidy) for cooking purpose in urban sector under MA scenario

Technology	2015	2016	2017	2018	2019
ICS	3726517	3768958	3811761	3854930	3898468
Biogas	2599572	2629154	2658737	2689376	2719487

Table 43: Cost estimation (without subsidy) for cooking purpose in rural sector under MA scenario

Technology	2015	2016	2017	2018	2019
ICS	26,673,306	26,973,663	27,276,578	27,582,070	27,890,158
Biogas	17226587	17422572	17619613	17819296	18019507

Table 44: Cost estimation (without subsidy) for cooking purpose in urban sector under CR scenario

Technology	2015	2016	2017	2018	2019
ICS	2842904	2875271	2907916	2940839	2974042
Biogas	5199143	5258309	5318002	5378224	5438974

Table 45: Cost estimation (without subsidy) for cooking purpose in rural sector under CR scenario

Technology	2015	2016	2017	2018	2019
ICS	19667517	19888008	20110374	20334629	20560787
Biogas	38379737	38816609	39257178	39701974	40149939

Table 46: Cost calculation for Lightning Propose (SHS)

Year	2014	2015	2016	2017	2018	2019
Cost for SHS	94972000	95513340	96057766	96605296	97155946	97709735

5.5 Monitoring and Evaluation Plan

The monitoring and evaluation plan for different RETs promotion and related programs are presented in Tables below. DEEU should bear major role for coordinating and facilitating different agencies assigned for monitoring and evaluation. DCEP task force will directly monitor and evaluate the progress and take major decisions whenever needed to ascertain the implementation of plan. Most of the activities and their outputs shall be monitored on an annual basis. DEEU/ DCEP task force can carry out the monitoring itself or sub contract consultants. DDC, AEPC, VDCs implementing partners, RET companies, NGOs, CBOs and civil society should provide support and assistance to carry out monitoring and evaluation. Following tables below provides the general monitoring and evaluation plan for DCEP implementation with in district.

Table 47: Monitoring and evaluation plan for Improved Cook Stove

Target					Activity	Indicators	Tool for verification	Frequency of Monitoring	Institution Responsible for Monitoring	Supporting Organizations
2015	2016	2017	2018	2019						
20875	25266	29708	34199	38739	ICS Installation	Target number of ICS for each year are installed and are in operation	HH Survey and sample observation/ICS programme annual report	Annually	DCEP task force, DEEU, Consultant	DDC, Implementing partner, NGOs, ICS promoters
					Financial support towards installation of ICS	Finance required is reflected on DDC's annual budget for alternative energy and is spent as per implementation plan.	DDC annual Budget and expenditure	Annually	DCEP task force/ DEEU	DDC, AEPC
					Promotion and awareness of ICS and its benefits	IEC materials should be developed on impact of indoor air pollution on health and and dispersed in all VDCs	Presence of IEC materials in VDCs and HHs	Biannual	DCEP task force, DEEU, Consultant	NGO
1	1	1	1	1	Monitoring	A yearly monitoring report is produced on ICS with user survey, scale of intervention, degree of usage and quality of intervention	Monitoring and Evaluation report	Annually	DCEP task force, Consultant, DEEU	AEPC
1	1	1	1	1	Training for ICS promoters	50 persons are trained on the process of ICS installation each year	Training completion report	Annually	DCEP task force, DEEU, AEPC,	NGO

Table 48: Monitoring and evaluation plan for Biogas

Yearly Target					Activity	Indicators	Tool for verification	Frequency of Monitoring	Institution Responsible for Monitoring	Supporting Organizations
2015	2016	2017	2018	2019						
764	1177	1594	2016	2443	Biogas plant installation	Target numbers of biogas for each year are installed and are in operation.	HH Survey and sample observation/ BSP programme Annual report	Annually	DCEP task force , DEEU, BSP, Consultant	Biogas companies
					Subsidy provision as per subsidy policy	All biogas plants installed through pre-qualified companies have been provided subsidy as per AEPC's subsidy policy	Subsidy approval document	Annually	DCEP task force , DEEU	AEPC, BSP
					Provide after sales service	At least 95% of biogas installed HHs have access to after sales service and at least 80% are satisfied with the service	Biogas user survey; Monitoring report	Annually	DCEP task force , DEEU, Consultant	BSP
1	1	1	1	1	Monitoring	A yearly monitoring report is produced on Biogas with user survey, scale of intervention, degree of usage and quality of intervention	Monitoring and evaluation report	Annually	DCEP task force , BSP, Consultant, DEEU	AEPC
1	1	1	1	1	Provide operation and maintenance training for biogas users	At least one member of the biogas installed HH has been trained on operation and maintenance of biogas plants	Biogas user survey; End of year monitoring report	Annually	DCEP task force, DEEU, Consultant	BSP

Table 49: Monitoring and evaluation plan for Solar Home System

Yearly Target					Activity	Indicators	Tool for verification	Frequency of Monitoring	Institution Responsible for Monitoring	Supporting Organizations
2015	2016	2017	2018	2019						
437	875	1312	875	875	Installation of SHS	Target numbers of SHS for each year are installed and are in operation.	HH Survey and sample observation	Annually	DCEP task force , DEEU, Consultant	Solar companies
					Subsidy provision as per subsidy policy	All SHS installed through pre-qualified companies and provided subsidy as per AEPC's policy	Subsidy approval document	Annually	DCEP task force, DEEU	AEPC, Solar companies
1	1	1	1	1	Promotion and awareness of SHS	Finance required is reflected on DDC's annual budget for alternative energy and is spent as per implementation plan	End of year monitoring report	Annually	DCEP task force , DEEU, Consultant	Solar companies
1	1	1	1	1	Promotion and awareness of safe battery disposal	One brochure will developed for disposal and battery usage techniques and benefits of SHS	End of year monitoring report	Annually	DCEP task force, DEEU	AEPC , NGO
					Provide after sales service	At least 95% of SHSs installed HHs have access to after sales service and at least 85% are satisfied with the service	SHS user survey; End of year monitoring report	Annually	DCEP task force, DEEU, Consultant	AEPC, Solar companies
1	1	1	1	1	Operation and maintenance training to SHS users	At least one member of the SHS installed HH has been trained on operation and maintenance of SHS	SHS user survey	Annually	DCEP task force , DEEU, Consultant	AEPC, Solar companies
1	1	1	1	1	Monitoring	A yearly monitoring report is produced on SHS with user survey, scale and quality of intervention	Monitoring and evaluation report	Annually	DCEP task force, DEEU,AEPC, Consultant	Solar companies

Table 50: Monitoring and evaluation plan for Improved Water Mill

Target					Activity	Indicators	Tool for verification	Frequency of Monitoring	Institution Responsible for Monitoring	Supporting Organizations
2015	2016	2017	2018	2019						
5	10	15	10	10	Installation of IWM	Number of traditional water mills improved	Annual report	Annually	DCEP task force, DEEU	IWM companies
					Subsidy Provision (for grinding)	All systems installed through pre-qualified companies have been provided subsidy as per AEPC's policy	Subsidy approval document	Annually	DCEP task force, DEEU AEPC,	IWM companies
					Provide after sales service	At least 95% of IWM owners have access to after sales service and at least 80% are satisfied with the service	IWM user survey; End of year monitoring report	Annually	DCEP task force, DEEU, Consultant	AEPC
1	1	1	1	1	Monitoring	A yearly monitoring report is produced on IWM with user survey, scale and quality of intervention	Monitoring and evaluation report	Annually	DCEP task force, DEEU, AEPC, Consultant	IWM companies
					Provide resources for IWM rehabilitation and relocation	DDC and or AEPC allocates additional resource as per financing plan for the same purpose for pico hydro as well	DDC annual budget; Subsidy approval sheet	Annually	DCEP task force, DEEU	AEPC
					Promote end use diversification of IWM	Promoted IWM will adopt other end uses beside grinding	IWM user survey; End of year monitoring report; IWM annual report	Annually	DEEU, AEPC, RSC	IWM companies

Table 51: Monitoring and Evaluation Plan for Support Programs

Target					Activity	Indicators	Tool for verification	Frequency of Monitoring	Institution Responsible for Monitoring	Supporting Organizations
2015	2016	2017	2018	2019						
1					Vulnerability assessment of VDCs	A community based vulnerability assessment report is produced	Assessment report for District	Once	DCEP task force, DEEU, AEPC, District line agencies	Consultant
1	1	1	1	1	Monitoring of climate adaptation need for prioritized intervention areas	A report on adaptation needs of technology, resource, community intervention needs etc.	Assessment report for District	Once	DCEP task force, DEEU, AEPC	Consultant
					Awareness of climate change issues through knowledge products including Indigenous knowledge systems	Knowledge products developed on impacts and vulnerability, adaptation and indigenous adaptation methods	Monitoring and evaluation report	Annually	DCEP task force, DEEU, District line agencies	AEPC
1	1	1	1	1	Liaison between government line agencies for hazard preparedness	Increase synergy between DEEU and district line agencies.	Meeting minutes	Annually	DCEP task force, DDC, AEPC	DEEU
1	1	1	1	1	Data collection to collate disaggregated data on RE based on gender and ethnicity	End of project report	End of project report	Annually	DCEP task force, DEEU, Consultant	AEPC

Table 52: Monitoring and evaluation plan for Capacity Building/ Training

Target					Activity	Indicators	Tool for verification	Frequency of Monitoring	Institution Responsible for Monitoring	Supporting Organizations
2015	2016	2017	2018	2019						
					Promote and create access to finance for RETS	Finance institution provide financing for RETs including biogas, micro/pico hydro and SHS	End of year monitoring	Annually	DCEP task force, DEEU	All private companies
1	1	1	1	1	Training of RET stakeholders on climate change related issues	A district wide training is held through which at least 1 person from every VDCs and municipality and every organizations active in these issues	Training completion report	Annually	DCEP task force, DEEU, district line agencies	AEPC, NGO
1	1	1	1	1	Training on business development to RET companies including NGO and CBO	A district wide training is held through which at least 1 person from every VDCs and municipality and every organizations benefitted	Training completion report	Annually	DEEU, district line agencies.	AEPC, NGO
1	1	1	1	1	Provide training on integrated water resource management and forest management to community based organizations	A district wide training is held through which at least 1 person from every VDCs and municipality and every organizations active in rural development activities are imparted knowledge on climate change issues.	Training completion report	Annually	DEEU, district line agencies.	AEPC, NGO

Chapter Six

Recommendations

6.1 Gender and Social Inclusion

- There should be a provision of gender and socially disaggregated data to monitor the progress on GSI issues. Currently not all the data are disaggregated by gender, class, caste and ethnic group wise creating disaggregated data for the whole district in terms of who owns different RETs, who is trained on what RETs etc. Collection and analysis of these data is to be the responsibility of DEEU and DCEP implementing partners with the support from national level organizations like AEPC, SNV and others. There should be a compulsory mechanism to include and institutionalize GSI in all the reporting communication frameworks.
- Data collection surveys need to be designed for disaggregated data. The data collection systems used by organisations including AEPC need to be revised so that they are more users friendly and systematic in order to access GSI specific data. Local experienced NGOs and enumerators or local social mobilizers could be used to collect necessary, reliable and consistent data/information.
- Women, Dalits, Ethnic Group, Religious Minorities, poor and all excluded groups need to be especially targeted for awareness raising and capacity building on Renewable Energy (RE) development.
- Make sure that women and poor have equitable say in decisions making processes in their respective institutions and networks. It is necessary to have at least 33-51% women's representation in all institutional mechanisms created for RETs promotion and development. Likewise, the percentage representation of poor, ethnic groups, Dalit and other caste groups are to be in line with the proportionate share of the population of their respective category.
- Renewable energy (RE) opportunities should be focused to foster equitable development from GSI perspective. Develop strategies for empowering women and excluded groups in planning for DCEP. The GSI friendly Energy Technologies such as Improved Cooking Stove (ICS), Biogas Stove, Electric Stove, LPG Stoves, etc should be promoted for cooking.
- Biogas technology could be promoted also among the households where livestock are not kept through providing subsidy for buying cattle dung from the cattle farm nearby. For subsidy, equal amount may not be appropriate for whole district as the cost of materials and labour vary from location to locations even within the district.
- Awareness raising activities such as door to visits, meetings, Radio, FM, street drama, etc. in rural areas to promote use of smokeless technology and reduce heavy use of fuel woods for cooking that have negative implication on personal health and environment.

- Local social mobilizers who are already involved in various project / programs like PAF and LGCDP could be utilized for awareness programs. And the DCEP should be implemented through women groups and Nagarik Wada Munch Committees of VDC/Municipalities formed in absence of elected local body.
- A targeted approach for women, poor, ethnic groups and Dalits is required. At present, DDC provides services as per the demand from the households who have access to information and financial resources. Currently poor, marginalized and women headed households have not been able to exploit these benefits. This could be due to lack of both information on the available technologies and financial ability to invest in them.
- There needs to be a mandatory provision to allocate at least 50% of the resources to women's ownership at least for household level energy technologies as women are the primary users and managers of household level energy.
- A more appropriate weighting system needs to be designed that more effectively qualifies the influence of climate change and GSI on energy planning in terms of access, reduced drudgery, increased livelihoods and improved decision making.
- It should be ensured that chosen technologies are accessible and affordable to women, women headed households, poor and other marginalized groups. Since accessibility and affordability of the technologies are the key variables to measure its adoptability, appropriate measures like additional subsidies to these groups of people should be made.
- All technologies introduced should support reducing drudgery and workload of people particularly of women, poor and the marginalised. In context of Smokeless Kitchen by 2017, ICS is going to be one of the popular RETs for women, poor and marginalized, promotion of fast growing fuel wood species in the local community forest and private land could support women, poor, ethnic groups and Dalit to get regular flow of firewood to run their ICSs in collaboration with community forest user groups and district forest office.
- Likewise, promotion of fodder/forage in community forest and also in private land reduces drudgery and workload of people particularly of women.
- Fodder promotion in community forestry will support poor, women and other marginalized groups since these groups of people have limited private land holding to grow fodder in their farm land. Such interventions not only support the running of biogas by providing animal feed but also increase the income of the households by selling livestock and their product which in the long run increases the RET investment capacity of the participating households.
- New energy technologies like "solar heater" should be introduced for cooking.
- Bio-char is also being promoted in some 11 districts by Bio-Energy Project funded by the European Union. This helps to meet the increasing energy demand replacing environmentally hazardous fossil fuels; and it helps to reduce carbon emissions and create

additional local employment. Moreover, it will help increase the value of forests, trees, shrubs and other woody perennials as well as it is GSI friendly.

- It needs to be ensured that women, poor and marginalized groups have equitable access to information and skill development in operating and maintaining the chosen technologies. In all cooking related RETs, more than 75% of the training participants should be women. This number might exceed in the case of improved cook stoves as women seem confident to sell their skills after they have received Training of Trainers (ToT). As ICS fixation doesn't require any prior investment (except training) this might be one of the suitable income generation activities for these category of people.
- Central funding sources should be sought to provide financial resources, and subsidies for women, women headed household, poor, ethnic groups, Dalit and other marginalized groups.
- Local level resource should additionally be made available where adequate central funding is not available. Such funding sources can include VDCs, local forest user groups, local saving credit groups and the like.
- For tracking the continued progress and for regular policy feedback there should be a strong GSI inclusive monitoring mechanism which will provide strong evidences and data for the formulation of GSI friendly energy policies at the national level.
- To materialize all the above recommendations, there needs to be a strong service delivery mechanism with strong GSI support at all levels (community, district and national level). There is a need to establish strong GSI focal unit with adequate resources and power delegation at all levels.

6.2 Technology

- There needs to be research, development and implementation of appropriate technology in the district. Utilization of available energy resources at the local level makes the technology sustainable.
- While designing energy system in the district, it is needed to make sure that the supply meets the demand which will naturally increase over time. There is a need to assess and monitor energy systems to ensure systems can adapt to anticipated climate change impacts. Similarly, there is need to implement demand side management as adaptation measure.
- The concern district authority should make conductive environment and encourage private companies, local NGOs, users' group and individuals for development of RETs in Dolakha. Special focus should be made to harness solar, bio-fuel, biogas and pico-hydro resource of the district.
- Research, development and implementation of improved biomass stoves needs to be carried out that so that stoves that use fuel other than wood can also be utilised for water boiling, preparing feed for livestock etc at greater efficiencies.

- Biogas plants construction should be needed to accelerate. The promotion of this technology in commercial and industrial will be beneficial as well.
- Installation of solar home system, small solar home system, solar pumping, solar cooker and dryer is needed to furthermore accelerate as decentralized system in the district. Use of solar pump for deep irrigation in the agricultural sector provides promotion of agricultural products in the district. In addition, solar thermal heater seems very useful for hotels, restaurants, commercial complexes and individual houses for hot water supply.
- LPG selling points need to be expanded in more places (especially in rural areas) in the future to meet its increasing demand.
- National RET programmes such as MGSP or the IWM programme could look at the vulnerability of RE systems and revise feasibility studies to include analysis of climate vulnerabilities and R&D could be carried out to look at climate proofing technologies.
- With ICS lasting longer and more efficient it would mean less stress on the dwindling forest resource as well as on the scale of interventions required to replace the defunct ICS. Overall it would add efficiency to the natural and financial resources.

6.3 Climate Change

- Climate change is real and underway, so there is a need of impact identification and adoption to cope with vulnerabilities to minimize the impact of climate change in livelihood like change in energy use pattern, agriculture practices etc.
- Representative and scientific climatic stations should be installed and data related to climatic phenomena should be recorded regularly for identifying actual scenario of climate change.
- Detail research on impact of climate change in hydropower and other energy resources is necessary. Catchment area of major river systems should be managed through integrated watershed management approaches.
- Degraded lands can be handed over to community for developing community forests. Appropriate tree species suiting the local ecology and having beneficial impacts in livelihoods should be selected for plantation.
- Proper planning for urbanization of major urban areas is necessary. Waste to energy concept can be developed for management of solid wastes generated in urban area.
- Extraction of sands and gravels from river banks should be monitored strictly and should be extracted only in sustainable manner.
- Biogas installation and use can be associated with CDM mechanism is appropriately flowed UNFCCC Guidelines.

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Annex 1:
Energy Assessment Checklist

जी बि स को नाम:
गा बि स को नाम:

फोरम नों २ (घरेलु क्षेत्र)

उर्जा को स्रोत	उर्जा को प्रकार		दलित		जनजाती		मदेसी		धार्मिक अल्पसंख्यक		बाहुन/छेत्री/ठकुरी		जम्मा	
			प्रयोग गर्ने घरधुरी	जम्मा खपत	प्रयोग गर्ने घरधुरी	जम्मा खपत	प्रयोग गर्ने घरधुरी	जम्मा खपत	प्रयोग गर्ने घरधुरी	जम्मा खपत	प्रयोग गर्ने घरधुरी	जम्मा खपत	प्रयोग गर्ने घरधुरी	जम्मा खपत
पकाउन	परम्परागत चुलो	दाउरा												
		क्रिसिजन्य भुस पराल												
		जनावर को गुइठा												
	सुधारिएको चुलो	दाउरा												
		क्रिसिजन्य भुस पराल												
		जनावर को गुइठा												
	जैविक ब्रिकेट चुलो													
	बायोग्यास चुलो													
	मट्टीतेल चुलो													
	एल पी ग्यास चुलो													
	कोइला चुलो													
	विधुतीय चुलो (ग्रिड)													
	विधुतीय चुलो (ग्रिड बाहेक, माइक्रो हाइड्रो)													
	सौर्य उर्जो													
	अन्य													
बिजुली बाल्न	मट्टीतेल बत्ति													
	एल पी ग्यास बत्ति													
	ब्यायोग्यास बत्ति													
	सोलार बत्ति													
	राष्ट्रिय बिदुत	सामान्य बलब												
		टिउब लाइट												
		सि एफ एल बलब												
		एल इ डी बलब												
	माइक्रो हाइड्रो	सामान्य बलब												
		टिउब लाइट												
		सि एफ एल बलब												
		एल इ डी बलब												
कोठा तताउन /चिसाउन	जैविक हिटर (बायोमास)	दाउरा												
		क्रिसिजन्य भुस पराल												
		जनावर को गुइठा												
		जैविक ब्रिकेट चुलो												
	केरोसिन हिटर													
	एल पी ग्यास हिटर													
	कोइला हिटर													
	ऐर कन्डिसन (राष्ट्रिय बिदुत)													
	ऐर कन्डिसन (माइक्रो हाइड्रो)													
	पंखा (राष्ट्रिय बिदुत)													
	पंखा (माइक्रो हाइड्रो)													
	अन्य													
आन्य प्रयोजनको लागि	राष्ट्रिय बिदुत	टि वि												
		आइरन												
		रेडियो												
		पानि तान्नकोलागी												
		अन्य												
	माइक्रो हाइड्रो	टि वि												
		आइरन												
		रेडियो												
		पानि तान्नकोलागी												
		अन्य												
	परम्परागत पानि घट्ट													
	सुधारिएको पानि घट्ट													
	आन्य उर्जाका प्रकारहरु													
गाइ-बस्तुहरुको पालन														

फर्म भर्ने को नाम:
फोन नों:

जी बि स को नाम:

फोरम नों ६ (यातायात क्षेत्र)

गा बि स:

यातायात को किसिम	उजो को स्रोत							
	पेट्रोल		डिजेल		एल पी ग्यास		बिदुतीय	
	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (नों)	संख्या	युनिट
मोटर साइकल								
कार								
बस								
ट्रक								
ट्राक्टर								
माइक्रो बस								
टेम्पो								
अन्य								

गा बि स:

यातायात को किसिम	उजो को स्रोत							
	पेट्रोल		डिजेल		एल पी ग्यास		बिदुतीय	
	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (नों)	संख्या	युनिट
मोटर साइकल								
कार								
बस								
ट्रक								
ट्राक्टर								
माइक्रो बस								
टेम्पो								
अन्य								

गा बि स:

यातायात को किसिम	उजो को स्रोत							
	पेट्रोल		डिजेल		एल पी ग्यास		बिदुतीय	
	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (नों)	संख्या	युनिट
मोटर साइकल								
कार								
बस								
ट्रक								
ट्राक्टर								
माइक्रो बस								
टेम्पो								
अन्य								

गा बि स:

यातायात को किसिम	उजो को स्रोत							
	पेट्रोल		डिजेल		एल पी ग्यास		बिदुतीय	
	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (नों)	संख्या	युनिट
मोटर साइकल								
कार								
बस								
ट्रक								
ट्राक्टर								
माइक्रो बस								
टेम्पो								
अन्य								

गा बि स:

यातायात को किसिम	उजो को स्रोत							
	पेट्रोल		डिजेल		एल पी ग्यास		बिदुतीय	
	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (नों)	संख्या	युनिट
मोटर साइकल								
कार								
बस								
ट्रक								
ट्राक्टर								
माइक्रो बस								
टेम्पो								
अन्य								

गा बि स:

यातायात को किसिम	उजो को स्रोत							
	पेट्रोल		डिजेल		एल पी ग्यास		बिदुतीय	
	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (लिटर)	संख्या	जम्मा खपत (नों)	संख्या	युनिट
मोटर साइकल								
कार								
बस								
ट्रक								
ट्राक्टर								
माइक्रो बस								
टेम्पो								
अन्य								

जी बि स को नाम:
गा बि स को नाम:

फोरम नो ३ (ब्यापारिक क्षेत्र)

ब्यापारिक संघ संस्थाको नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पकाउनको लागि			
पानि तताउनको लागि			
बिजुली बाल्नको लागि			
उपकरणहरु चलाउनको लागि			
कोठा तताउनको लागि			
कोठा चिसो बनाउनको लागि			
पानि तान्नकोलागी			
अन्य			

ब्यापारिक संघ संस्थाको नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पकाउनको लागि			
पानि तताउनको लागि			
बिजुली बाल्नको लागि			
उपकरणहरु चलाउनको लागि			
कोठा तताउनको लागि			
कोठा चिसो बनाउनको लागि			
पानि तान्नकोलागी			
अन्य			

ब्यापारिक संघ संस्थाको नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पकाउनको लागि			
पानि तताउनको लागि			
बिजुली बाल्नको लागि			
उपकरणहरु चलाउनको लागि			
कोठा तताउनको लागि			
कोठा चिसो बनाउनको लागि			
पानि तान्नकोलागी			
अन्य			

ब्यापारिक संघ संस्थाको नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पकाउनको लागि			
पानि तताउनको लागि			
बिजुली बाल्नको लागि			
उपकरणहरु चलाउनको लागि			
कोठा तताउनको लागि			
कोठा चिसो बनाउनको लागि			
पानि तान्नकोलागी			
अन्य			

ब्यापारिक संघ संस्थाको नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पकाउनको लागि			
पानि तताउनको लागि			
बिजुली बाल्नको लागि			
उपकरणहरु चलाउनको लागि			
कोठा तताउनको लागि			
कोठा चिसो बनाउनको लागि			
पानि तान्नकोलागी			
अन्य			

ब्यापारिक संघ संस्थाको नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पकाउनको लागि			
पानि तताउनको लागि			
बिजुली बाल्नको लागि			
उपकरणहरु चलाउनको लागि			
कोठा तताउनको लागि			
कोठा चिसो बनाउनको लागि			
पानि तान्नकोलागी			
अन्य			

जी बि स को नाम:

गा बि स को नाम:

फोरम नों ४ (उद्योगीक क्षेत्र)

उद्योगीक संघ संस्थाको नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
बिजुली बाल्नको लागि	सामान्य बलब		
	टिउब लाइट		
	सि एफ एल बलब		
	एल इ डी बलब		
	सोडियम अर्क बलब		
	अन्य		
तताउनको लागि	बोइलर		
	कोम्बुस्शन		
	अन्य		
मेसिन चलाउनको लागि	बिदुतिय मेसिन		
	कोम्बुस्शन मेसिन		
	अन्य		
पानि तान्नकोलागी			
अन्य			

उद्योगीक संघ संस्थाको नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
बिजुली बाल्नको लागि	सामान्य बलब		
	टिउब लाइट		
	सि एफ एल बलब		
	एल इ डी बलब		
	सोडियम अर्क बलब		
	अन्य		
तताउनको लागि	बोइलर		
	कोम्बुस्शन		
	अन्य		
मेसिन चलाउनको लागि	बिदुतिय मेसिन		
	कोम्बुस्शन मेसिन		
	अन्य		
पानि तान्नकोलागी			
अन्य			

उद्योगीक संघ संस्थाको नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
बिजुली बाल्नको लागि	सामान्य बलब		
	टिउब लाइट		
	सि एफ एल बलब		
	एल इ डी बलब		
	सोडियम अर्क बलब		
	अन्य		
तताउनको लागि	बोइलर		
	कोम्बुस्शन		
	अन्य		
मेसिन चलाउनको लागि	बिदुतिय मेसिन		
	कोम्बुस्शन मेसिन		
	अन्य		
पानि तान्नकोलागी			
अन्य			

उद्योगीक संघ संस्थाको नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
बिजुली बाल्नको लागि	सामान्य बलब		
	टिउब लाइट		
	सि एफ एल बलब		
	एल इ डी बलब		
	सोडियम अर्क बलब		
	अन्य		
तताउनको लागि	बोइलर		
	कोम्बुस्शन		
	अन्य		
मेसिन चलाउनको लागि	बिदुतिय मेसिन		
	कोम्बुस्शन मेसिन		
	अन्य		
पानि तान्नकोलागी			
अन्य			

जी बि स को नाम:

फोरम नों ५ (क्रीसि क्षेत्र)

गा बि स को नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	उपकरण को संख्या	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पानि तान्नको लागि				
तताउनको लागि				
अन्य				

गा बि स को नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	उपकरण को संख्या	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पानि तान्नको लागि				
तताउनको लागि				
अन्य				

गा बि स को नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	उपकरण को संख्या	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पानि तान्नको लागि				
तताउनको लागि				
अन्य				

गा बि स को नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	उपकरण को संख्या	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पानि तान्नको लागि				
तताउनको लागि				
अन्य				

गा बि स को नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	उपकरण को संख्या	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पानि तान्नको लागि				
तताउनको लागि				
अन्य				

गा बि स को नाम:

उर्जा प्रयोग को प्रयोजन	उपकरण को प्रकार	उपकरण को संख्या	प्रयोग हुने उर्जाको किसिम	जम्मा खपत
पानि तान्नको लागि				
तताउनको लागि				
अन्य				

जिल्ला: फारम नो ७

गा.बि.स.मा भएका खोलानालाको बिवरण

क्र.सं.	गा.बि.स.को नाम	खोलानालाको नाम	अनुमानित बहाव (लिटर प्रति सेकेन्ड)	अनुमानित उचाई मिटर	समेट्ने वडाहरु
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फारम भर्ने को नाम:
फोन नो:

s.n	Name of VDC	Name of Persons Contacted	Name of Office	Designation	Contact No	Problems related to Energy/Climate Change and GESI	Possible Solutions
1							
2							
3							
4							
5							
6							

Annex 2:
Workhsop Meeting Minute