Presentation
on
Introduction to RE Mini Grid Projects in Nepal

By:
Santosh Rai,
Engineer/Project Manager
Alternative Energy Promotion Center
Private Sector-Led Mini-Grid Energy Access Project
Email: santosh.rai@aepc.gov.np
10 September 2019

Contents

- Overview of Mini Grid Projects
- Case Studies
- Lesson Learned
- Disaster Risks

Overview of Mini Grid Projects

- Energy Scenario
- History of Development of Mini Grid
- Existing Mini Grid Programs/Projects
- Current Status of Mini Grid Projects
- Type of Mini Grid Projects

Energy Scenario

Energy Consumption Facts

- The share of traditional, commercial and renewable energy sources are 68.6 %, 28.2 % and 3.2 %

- The total electricity consumption is 4,102 GWh (Household = 44 %, Commerce/trade =38 %, Industry = 7 % and Others = 13 %) of which about 45 % is imported from India.

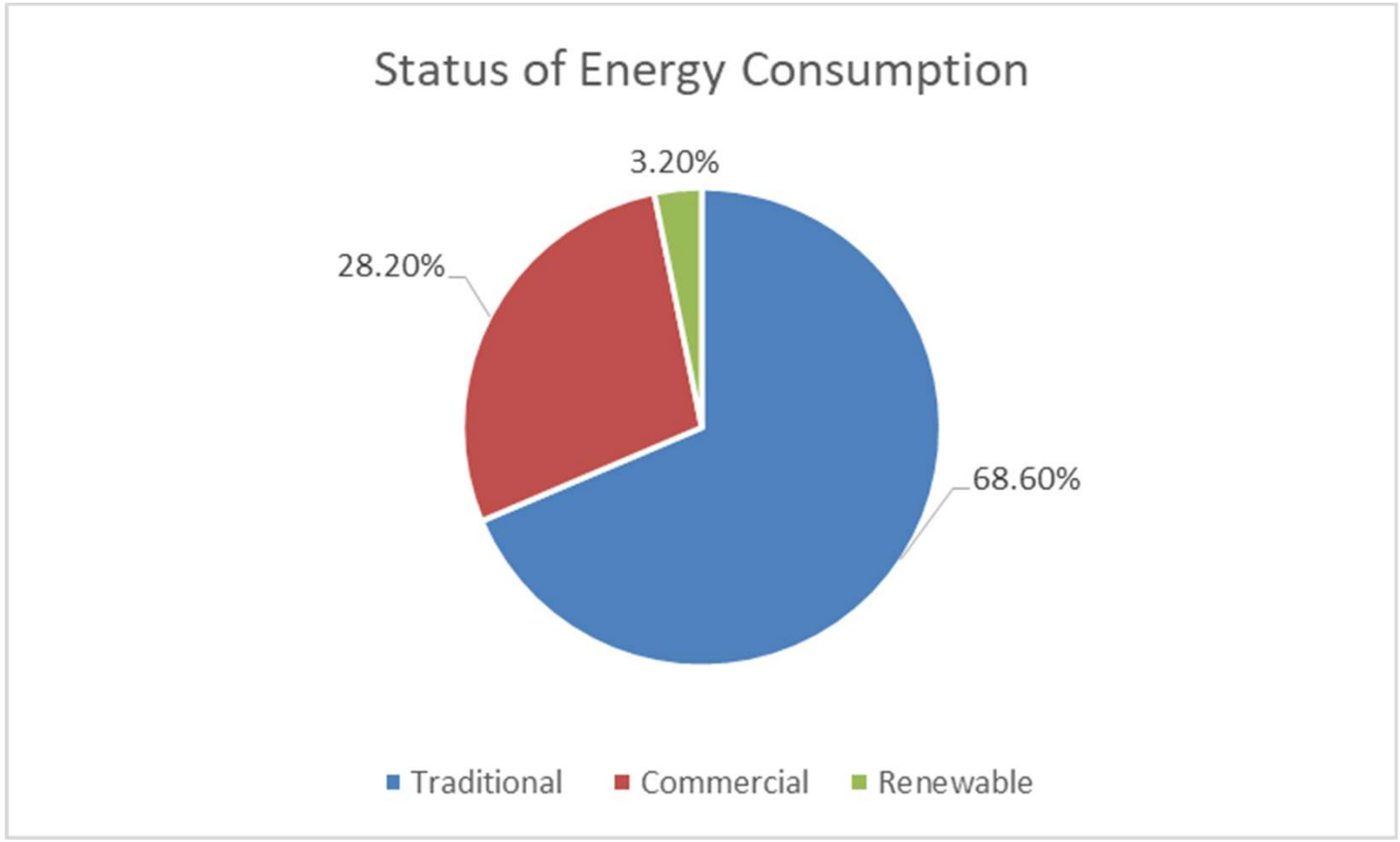
- Out of total installed capacity of 1142 MW to national grid (1029.42 MW = Hydropower, 53.40 MW = Thermal plant, 27 MW = Solar & 32 MW = MHP)

- The national electricity access has been reached to 77.2 % of total population

Source: Economic survey report 2018/19, Ministry of Finance

Energy Scenario

Status of Energy Consumption



Source: Economic survey report 2018/19, Ministry of Finance

Energy Scenario

Energy Consumption Pattern

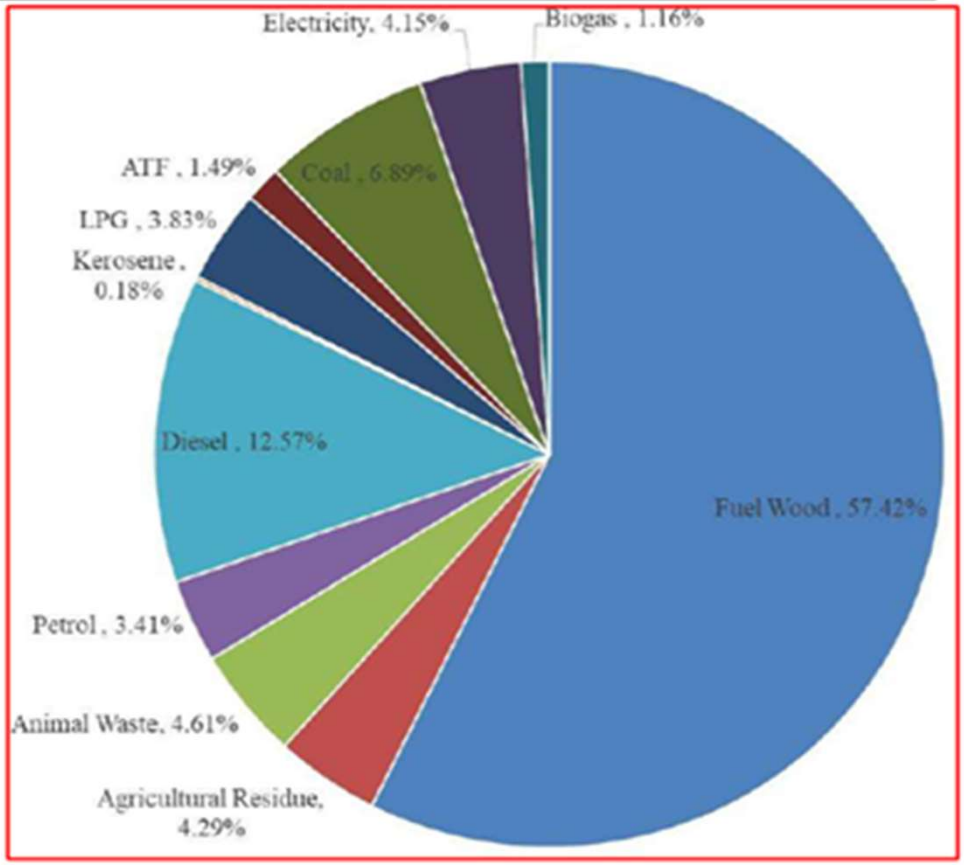
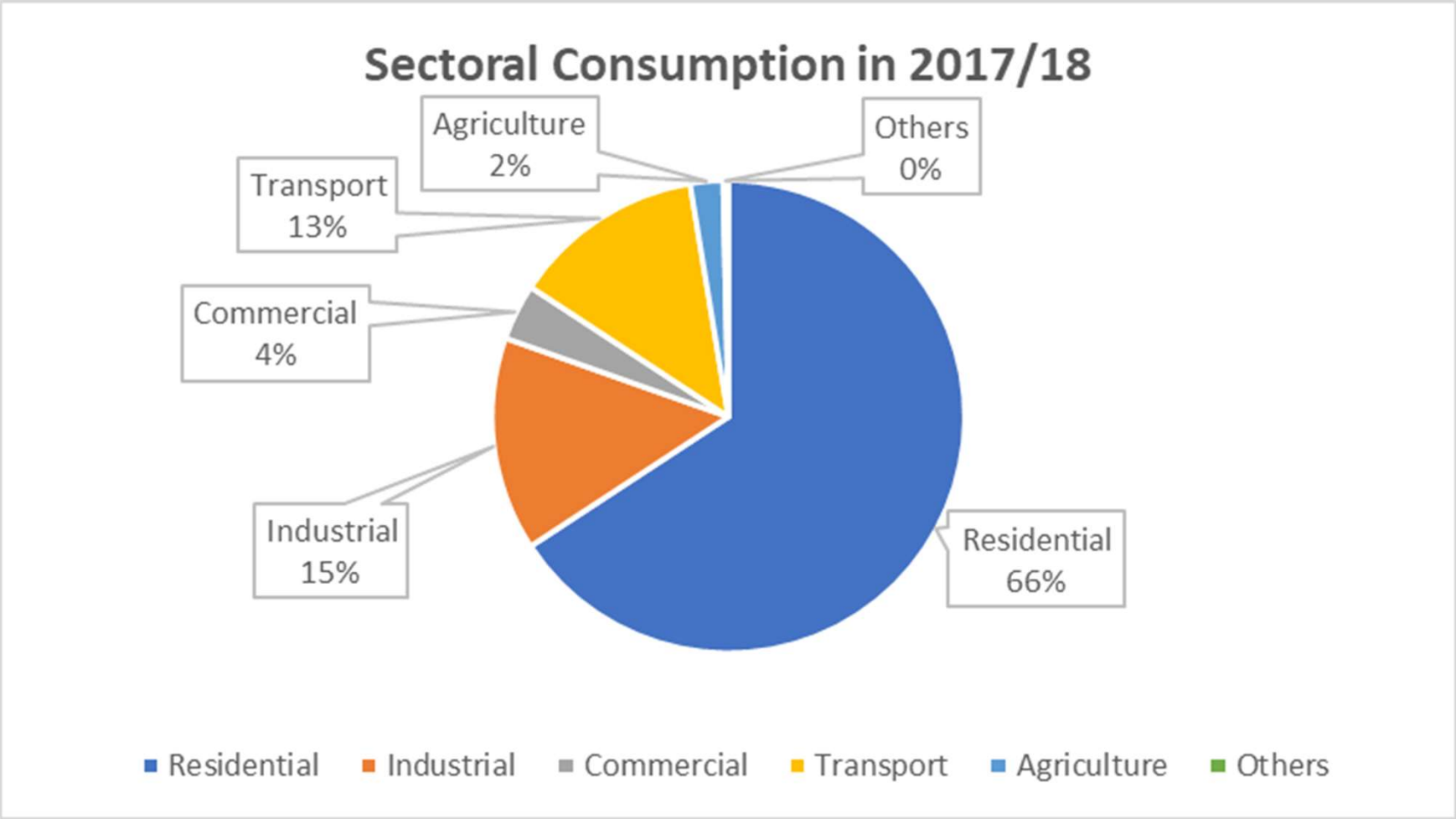


Figure 9-3: Energy Consumption Pattern of the Country in 2017/18

Source: WECS Synopsis Report, 2019

Energy Scenario

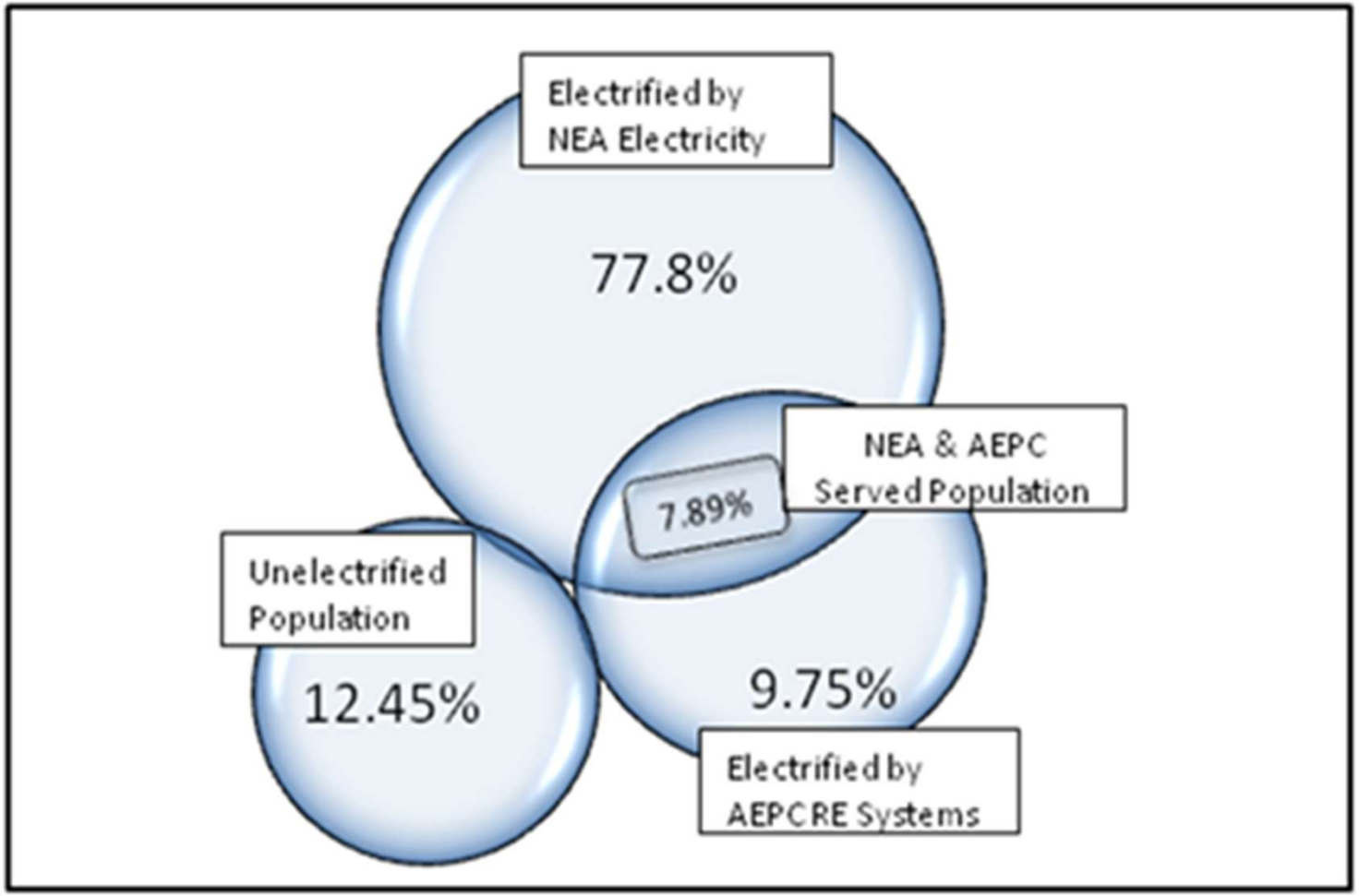
Energy Consumption Pattern



Source: WECS Synopsis Report, 2019

Energy Scenario

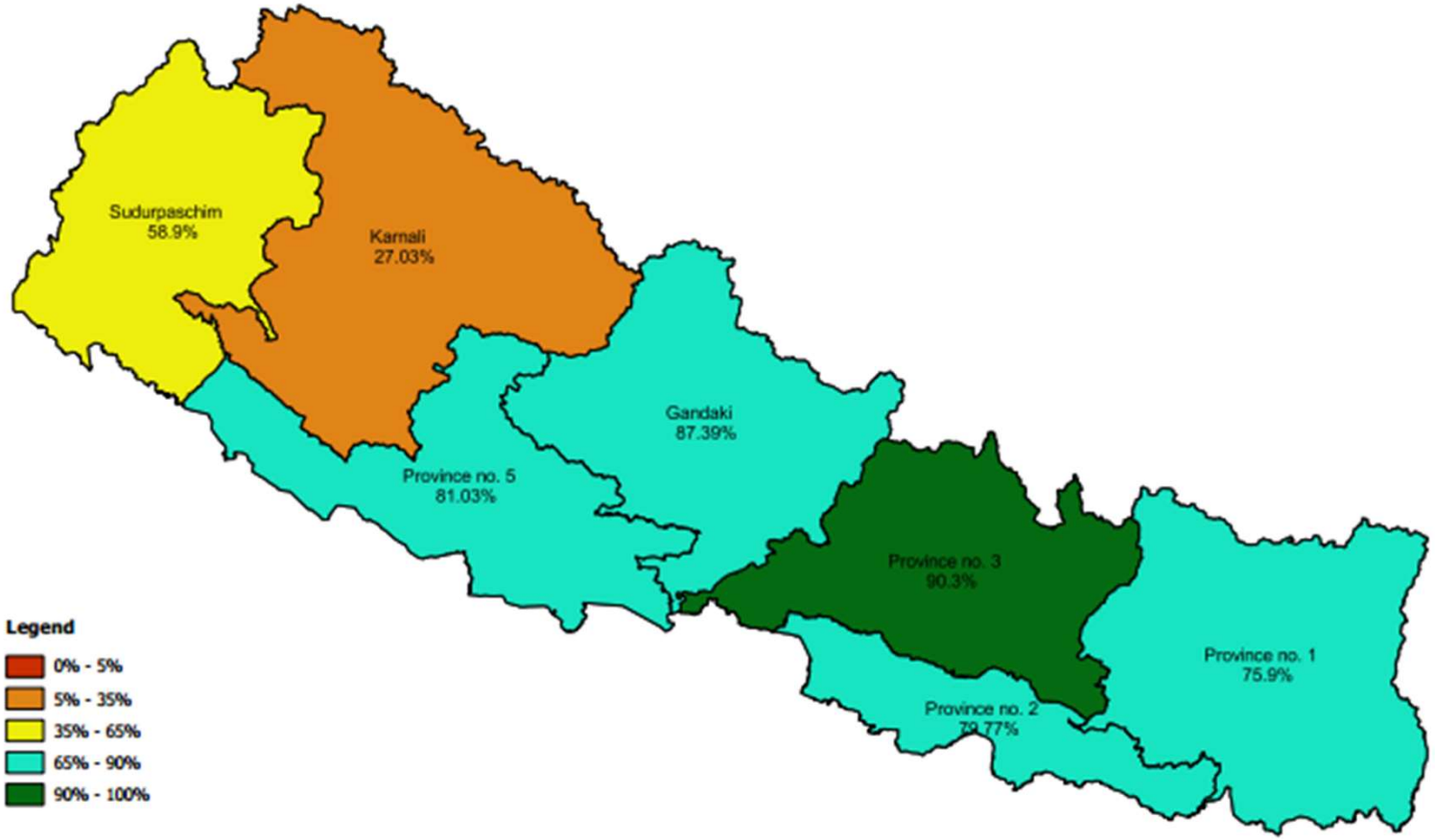
Electrification Status (AEPC and NEA July 2019)



Total HH without Electricity = 740,511 HHs

Energy Scenario

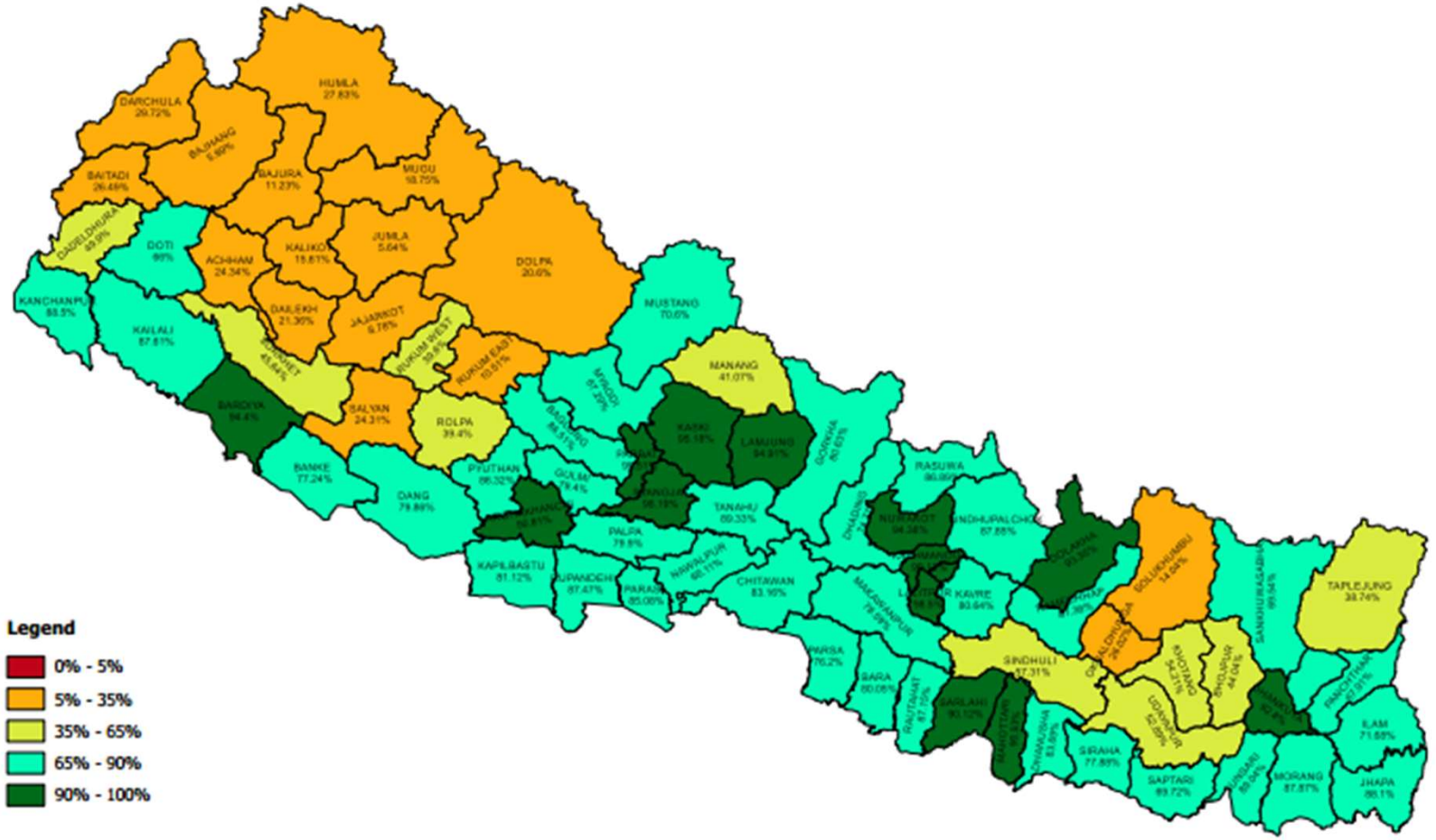
Province-wise Household Electrification Status (%)



Source: Nepal Electrification Statistics, NEA, 2019

Energy Scenario

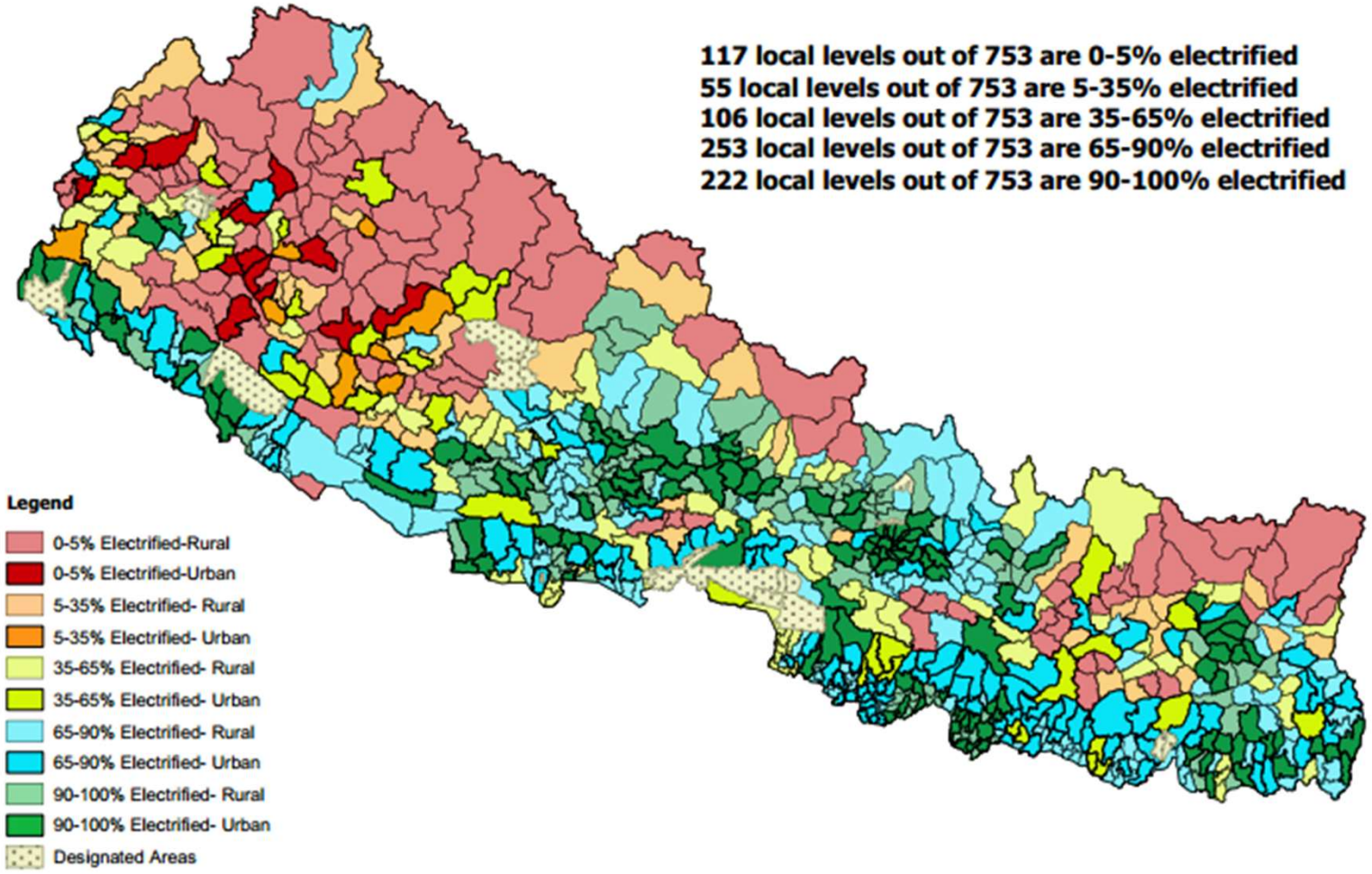
District-wise Household Electrification Status (%)



Source: Nepal Electrification Statistics, NEA, 2019

Energy Scenario

Local Level Electrification Status (%)



Source: Nepal Electrification Statistics, NEA, 2019

Energy Scenario

Rationale Behind Scaling Up of Off Grid RETs

- Grid expansion is not viable due to few consumers in remote village
- Mini Grids can be viable option due to rugged geography
- Mini Grids can provide grid quality 3-Ø and 1-Ø Electricity
- Mini Grids can support local enterprise development
- Mini Grids can serve larger community (few HHs to many hundred HHs)
- Mini Grids can sustain through monthly tariff collection from End Users
- Present off grid system can be future Grid-Connected system that will support to enhance long distance weak national grid quality

Overview of Mini Grid Projects

History of Development of Mini Grid

- History of Development of Micro/Mini Hydro
- History of Development of Solar and Solar Wind Mini Grid

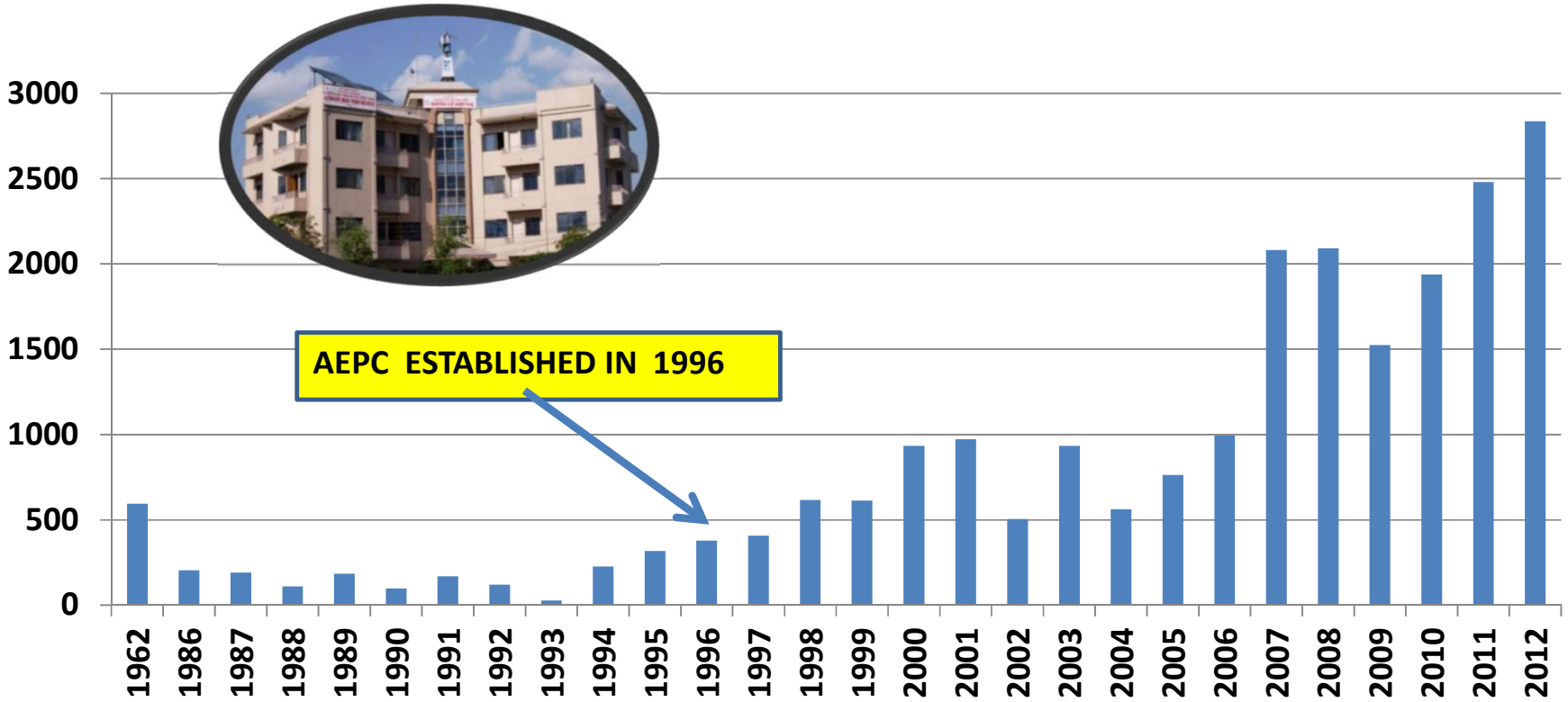
History of Development of Mini Grid

History of Development of Micro/Mini Hydro

- Pharping Hydropower Plant (500 kW) - one of the oldest hydropower plants of Asia, the first hydropower plant of Nepal, constructed on 22 May 1911
- Diesel mills in hills for agro processing – before 1960s
- In the 1960s, “Turbine Mills” introduced using locally developed turbine as an alternative to diesel operated mills
- In 1980s small generators added to the turbine mills for lighting at night and supplying surplus power to few households.
- Turbines modified to supply electric power - Micro Hydro Plant
- GoN provided subsidy through Agriculture Development Bank for promotion of Micro Hydro Plant.
- AEPC established on 3 November 1996 with the objective of developing and promoting renewable/alternative energy technologies in Nepal.

History of Development of Mini Grid

History of Development of Micro/Mini Hydro (MHP Development Trend)



Source: RE Data Book 2012, ESAP, RERL

History of Development of Mini Grid

History of Development of Solar and Solar Wind Mini Grid

- 3 solar mini-grid of total capacity 130 kWp were installed in Gamgadhi, Simikot and Tatopani with the support from French Government – 1989
- Solar Wind mini grid of 12 kW at Dhaubadi, Nawalparasi with support from ADB – 2011
- After Dhaubadi solar wind mini grid, GoN has been allocating budget for solar and solar wind mini in each fiscal year

History of Development of Mini Grid

List of Solar Wind Mini Grid Subprojects - AEPC

S.N.	Project Name	District	Installed Capacity (kW)			Year of Installation
			Solar PV Plant	Wind Turbines	Total	
1	Dhaubadi SWMG	Nawalparasi	2	10	12	2010
2	Bhorleni SWMG	Makawanpur	15	10	25	2013
3	Tatopani SWMG	Jumla	11	15	26	2014
4	Kamalbazaar SWMG	Achham	11	20	31	2015
5	Harrekanda-Taranga SWMG	Surkhet	5	3	8	2015
6	Chisapani SWMG	Sindhuli	15	20	35	2016
7	Parakatne SWMG	Bajhang	7	15	22	2016
8	Mityal SWMG	Palpa	15	10	25	2017
9	Narakot SWMG	Jumla	50	30	80	2017
10	Saptami SWMG	Panchthar	50	20	70	2018
11	Pamakham SWMG	Bhojpur	40	10	50	2019*
	Total Capacity (kW)		221	163	384	*Planned Year

History of Development of Mini Grid

List of Solar Mini Grid Subprojects - AEPC

S.N	Project Name	District	Solar PV Plant (kWp)	Year of Installation	Current Status
1	Dubung SMG	Tanahu	18	2015	Working
2	Harkapur SMG	Okhaldhunga	31	2016	Working
3	Chysmitar SMG	Khotang	17	2016	Working
4	Kaduwa SMG	Khotang	21	2016	Working
5	Ramitekhola SMG	Morang	30	2017	Working
6	Olane SMG	Panchthar	25	2017	Working
7	Rithachaupata SMG-1	Darchula	21	2018	Working
8	Rithachaupata SMG-2	Darchula	13	2018	Working
9	Gutu SMG	Surkhet	100	2018	Working
10	Sugarkhal SMG	Kailali	75	2018	Working
11	Malladehi SMG	Baitadi	30	2019	Working
12	Hilepani SMG	Okhaldhunga	50	2019	Under Construction
13	Susta SMG	Nawalparasi	100	2020	Bid Evaluation
13	Thabang SMG	Rolpa	150	2020	Bid Evaluation
14	Parakatne SMG	Bajhang	30	2020	Planned Subproject
	Total Capacity (kWp)		711		

Overview of Mini Grid Projects

Existing Mini Grid Programs/Projects under AEPC

- NRREP
- SASEC/ADB Project
- MGEAP/WB Project
- RERL/UNDP Program
- GoN Programs

Existing Mini Grid Programs/Projects

NRREP Program

- **Name of the Program:** “National Rural and Renewable Energy Program”
- **Supported by GoN**
- **Program Period:** July 2017 onwards
- **Program Target:** based on GoN fiscal year budget

Existing Mini Grid Programs/Projects

SASEC/ADB Project

- **Name of the Project:** "South Asia Sub Regional Economic Cooperation Power System Expansion Project"
- **Supported by GoN and the Asian Development Bank (ADB)**
- **Contract between GoN and ADB on 11 July 2014**
- **Project Period:** Jan 2015 – Dec 2021
- **Project Target:** 4.3 MW Mini Hydro and 500 kW Solar and Solar/Wind Hybrid Mini Grids

Existing Mini Grid Programs/Projects

MGEAP/WB Project

- **Name of the Project:** "Nepal: Private Sector-Led Mini-Grid Energy Access Project"
- **Supported by the GoN and the World Bank (WB)**
- **Project Period:** April 2019 to April 2023
- **Project Target:** 3.8 MW Cumulative
- **Three Types of Subprojects:**

(a) Greenfield Micro/Mini Hydro and Solar/Wind Mini Grids - 2.8 MW/10 Subprojects

(b) Up gradation of Mini Grids – 0.5 MW/2 Subprojects

(c) Grid Interconnection of Mini Grids – 0.5 MW/2 Subprojects

Existing Mini Grid Programs/Projects

MGEAP/WB Project

- **Project Financing Detail:**

✓World Bank Support: USD 7.61 Million

✓GoN Matching Fund: USD 6 Million

✓Private Sector Investment: USD 3.6 Million

✓ Total Project Cost: USD 17.21 Million

Existing Mini Grid Programs/Projects

RERL/UNDP Project

- **Name of the Project:** “Renewable energy for Rural Livelihood”
- **Supported by the GoN and the GEF, UNDP**
- **Project Period:** July 2014 to July 2019
- **Project Target:** Technical assistance to develop 10 MW Mini/Micro Hydro and 2.5MW of Large Solar PV systems
- **Project Financing Detail:**

➢ UNDP: USD 2 Million

➢ GEF: USD 3 Million

➢ Total Project Cost: USD 5 Million

Existing Mini Grid Programs/Projects

GoN Programs

- **Name of the Program:** “Himali Tatha Uchha Pahadi Solar Mini Grid Program”
- **Supported by the GoN**
- **Program Period:** Multi Year
- **Program Financing Detail:** NPR 220 Million for fiscal year 2019/2020

- **Name of the Program:** “Ujjyalo Nepal Program”
- **Supported by the GoN**
- **Program Period:** Multi Year
- **Program Financing Detail:** NPR 150 Million for fiscal year 2019/2020

Overview of Mini Grid Projects

Current Status of Mini Grid Projects

- Completed Micro/Mini Hydro Projects
- Completed Solar and Solar Wind Mini Grid Projects

Current Status of Mini Grid Projects

Completed Micro/Mini Hydro Projects (AEPC)

S.N.	Program/ Project	Nos.	kW	HH
1	ESAP - I	230	1,900.30	21,006
2	ESAP - II	484	6,694.67	68,919
3	REDP/RERL	474	10,620.20	108,490
4	KiND	1	400.00	3,893
5	NRREP	627	13,163.22	130,504
Total		**1,816**	**32,778.39**	**332,812**

Note:
MHP: Micro Hydro Power, PHP: Pico Hydro Power, KiND: Khimti Neighborhood Development Project

Source: AEPC

Current Status of Mini Grid Projects

Completed Solar and Solar Wind Mini Grid Projects (AEPC)

S.N.	Program/ Project	Nos.	kW	HH
1	AEPC	13	350	1750
2	SASEC	7	365	1825
3	RERL	5	33	256
Total		**25**	**748**	**3831**

Note:
SMG: Solar Mini Grid, SWMG: Solar Wind Mini Grid

Source: AEPC

Overview of Mini Grid Projects

Type of Mini Grid Projects

- Off Grid: Mini grid projects in the area without the reach of National Grid

- On Grid: Mini grid projects connected to the National Grid after Grid encroachment

Grid Connected MHPs:

S.N.	Description	Power (kW)
1	Syaurebhumi MHP, Nuwakot	23 kW
2	Leguwa Khola Micro Hydro Co-Operative, Dhankuta	40 kW
3	Chimal MHP, Taplejung	93 kW
4	Midim Khola MHP, Lamjung	100 kW

Overview of Mini Grid Projects

Type of Mini Grid Projects

Micro/Mini Hydro Classification by Capacity:

S.N.	Description	Power (kW)
1	Pico Hydro	Up to 10 kW
2	Micro Hydro	Above 10 kW up to 100kW
3	Mini Hydro	Above 100kW up to 1MW

Overview of Mini Grid Projects

Case Studies of Mini Grid Projects

- Dhaubadi Solar Wind Mini Grid, Nawalparasi
- Sugarkhal Solar Mini Grid, Kailali
- Dubung Solar Mini Grid, Tanahu
- Sarlahi DC Solar Mini Grid
- Khamari Khola Micro Hydro, Surkhet

Case Studies of Mini Grid Projects

Dhaubadi Solar Wind Mini Grid

- First Solar Wind Mini Grid in Nepal
- Supported by ADB and implemented by AEPC
- Installed Date: 2011
- Location: Dhaubadi, Nawalparasi
- Size: 12 kW
- Project Beneficiaries: 45 households and a Police Station

Case Studies of Mini Grid Projects

Sugarkhal Solar Mini Grid

- Supported by ADB and implemented by AEPC
- Installed Date: April 2019
- Location: Sugarkhal, Kailali
- Size: 75 kWp
- Project Beneficiaries: 215 households and enterprises

Case Studies of Mini Grid Projects

Dubung Solar Mini Grid

- Supported by UNCDF and implemented by AEPC
- Private Sector Investment by Saral Urja Pvt. Ltd. (Business Model)
- Managed and operated by Dubung Solar Electricity Company
- Installed Date: 2015
- Location: Dubung, Tanahu
- Size: 1 kWp
- Project Outcome: 155 households and enterprises

Case Studies of Mini Grid Projects

Sarlahi DC Solar Mini Grid

- Supported by RERL
- Location: Sarlahi
- Size: 6 kWp
- Distribution voltage: 216 Vdc
- Project Outcome: 42 households

Case Studies of Mini Grid Projects

Khamari Khola Micro Hydro

- Supported by ESAP and implemented by AEPC
- Installed Date: February 2014
- Location: Babiyachaur, Surkhet
- Size: 53 kW
- Project Outcome: 620 households and 35 enterprises such as metal workshop, agro processing mill, rural carpentry etc.

Case Studies of Mini Grid Projects

Khamari Khola Micro Hydro

Metal Workshop

Agro Processing Mill (Women Entrepreneur)

Lessons Learned

- Engineering designs and standards to reflect disaster risk is crucial to infrastructure resilience
- Planning for post disasters in resilience to reduce vulnerability to multiple hazards
- Mainstreaming the National and International Regulatory Framework in energy projects
- Budget allocation for DRR management

Disaster Risks

- Natural Hazards
- Recent Events of Disaster
- Disaster Affected Mini Grid Projects
- Regulatory Framework (National)
- Regulatory Framework (International)
- Existing DRM Institutions
- Current Provisions for Climate/Disaster Resilience for Mini Grid Projects (AEPC)

Disaster Risks

Natural Hazards

Earthquake	Flood
Landslide	Soil Erosion
Inundation	Lightning
Drought	Snow Storm
Hail Storm	Avalanche
Glacial Lake Outburst	Heavy Rainfall
Rainfall Deficit	Wind Storm
Cold Wave	Heat Wave
Forest Fire	***Tornado***

Source: National Policy for Disaster Risk Reduction, 2018

Disaster Risks

Recent Events of Disaster

- Flood in August 2014
- Earthquake in April 2015
- Flood in August 2017
- Bara Parsa Tornado 31 March 2019

Recent Events of Disaster

Flood in August 2014

- Torrential rains caused heavy floods and landslides in 23 districts
- Causalities: 202 People
- Affected families: 36,949 (184,745 People)
- Affected districts: 23
- Worst affected districts: Banke, Bardiya, Dang and Surket

Source: Final Evaluation of Flood Operation 2014 Supported by the IFRC in Nepal

Recent Events of Disaster

Flood in August 2014

The landslide created a mud dam blocking the Sunkoshi river near Jure in the Sindhupalchowk district

Karnali River Bank

Recent Events of Disaster

Earthquake in April 2015

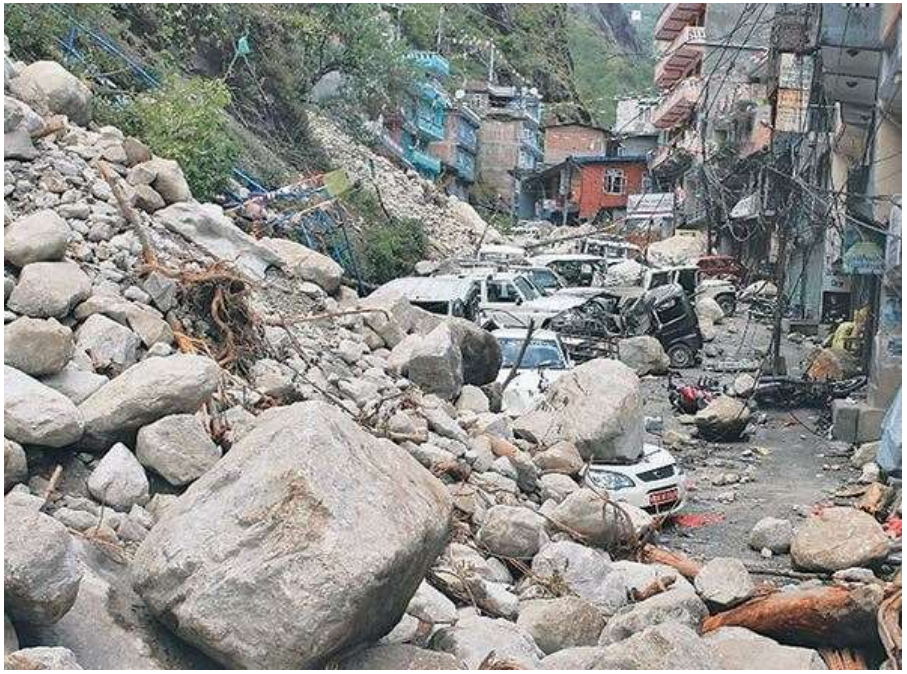
- Causalities : 8622 People
- Injured: 16,808
- Districts affected: 39
- People displaced: 2.8 million
- Economic losses: USD 10 billion

Source: International Center for Integrated Mountain Development (ICIMOD)

Recent Events of Disaster

Earthquake in April 2015

Upper Bhotekoshi Hydropower 45 MW damaged



Araniko highway land slide
Source: Kantipur

Recent Events of Disaster

Earthquake in April 2015

After Earthquake Triggers Avalanches

The Devastating Aftermath of an Avalanche on Everest

Recent Events of Disaster

Flood in July 2016

Tatopani Bazaar, Sindhupalchowk

Bahrabise Bazaar, Sindhupalchwok

Source: Himalayan Times

Recent Events of Disaster

Flood in August 2017

- Torrential rains caused heavy floods and landslides in 23 districts
- Causalities: 134 People
- Affected population: 1.7 Million
- Affected districts: 35
- Severely affected districts: Rautahat, Morang, Jhapa and Sarlahi
- Economic losses: USD 584.7 Million
- Economic Losses (Energy Sector): USD 2.1 Million

Source: Post Flood Recovery Needs Assessment, National Planning Commission

Recent Events of Disaster

Flood in August 2017

People are forced to watch their field swept away by the flood

Many animals are dying due to flood

Recent Events of Disaster

Flood in August 2017

Airports are flooded, Biratnagar

Transmission lines are damaged

Recent Events of Disaster

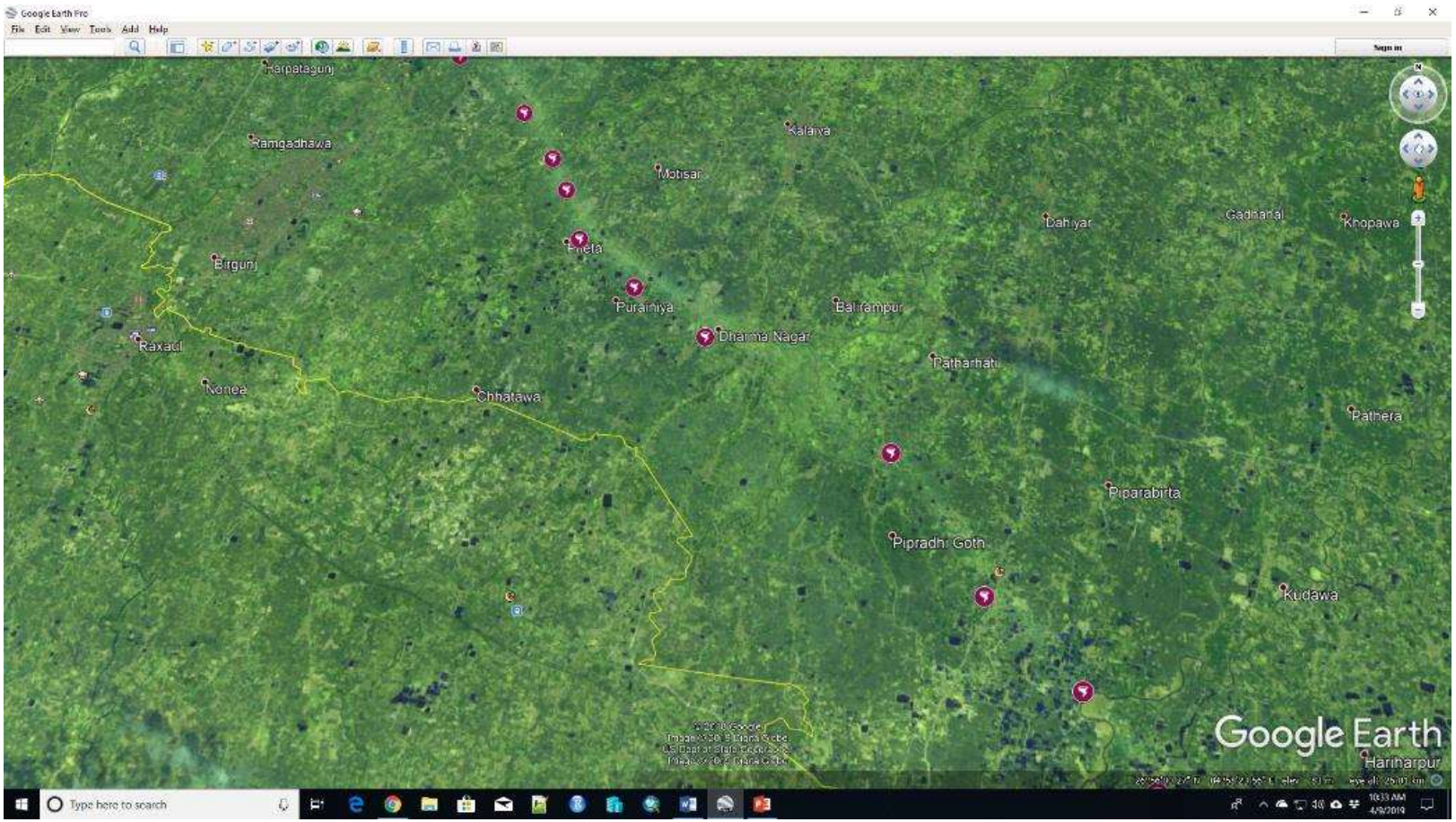
Bara Parsa Tornado 31 March 2019

- Nepal's first ever recorded tornado
- Causalities: 28 People
- Injured: over 600 People
- Characteristics of Tornado: 200-250 meters and covered at least 30 kilometers

Source: Department of Hydrology and Meteorology

Recent Events of Disaster

Bara Parsa Tornado 31 March 2019



Source: Small Earth Nepal & DHM

Recent Events of Disaster

Bara Parsa Tornado 31 March 2019

Damaged the transmission line of 70 MW from India to Nepal

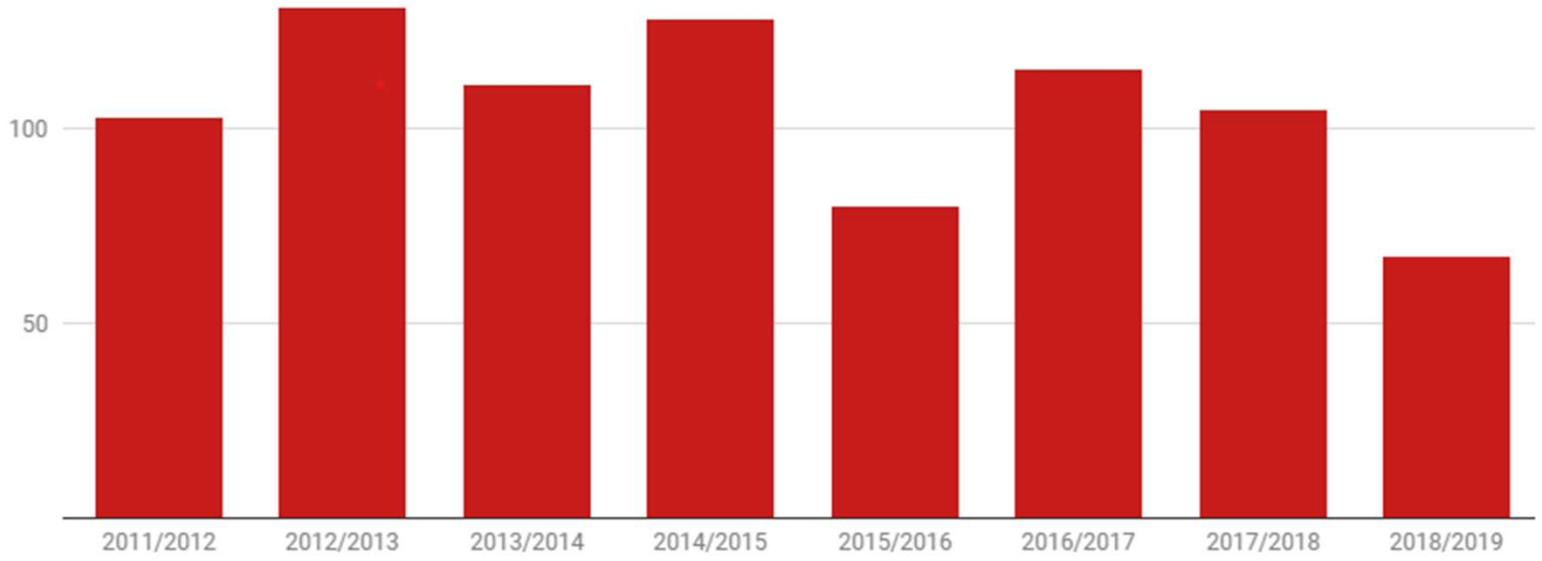
Recent Events of Disaster

Bara Parsa Tornado 31 March 2019

H-Pole Damaged

Recent Events of Disaster

Lightning



- Causalities: 840 People
- Period: 2011/2012 to 2018/2019

Source: Nepal Emergency Operation Center

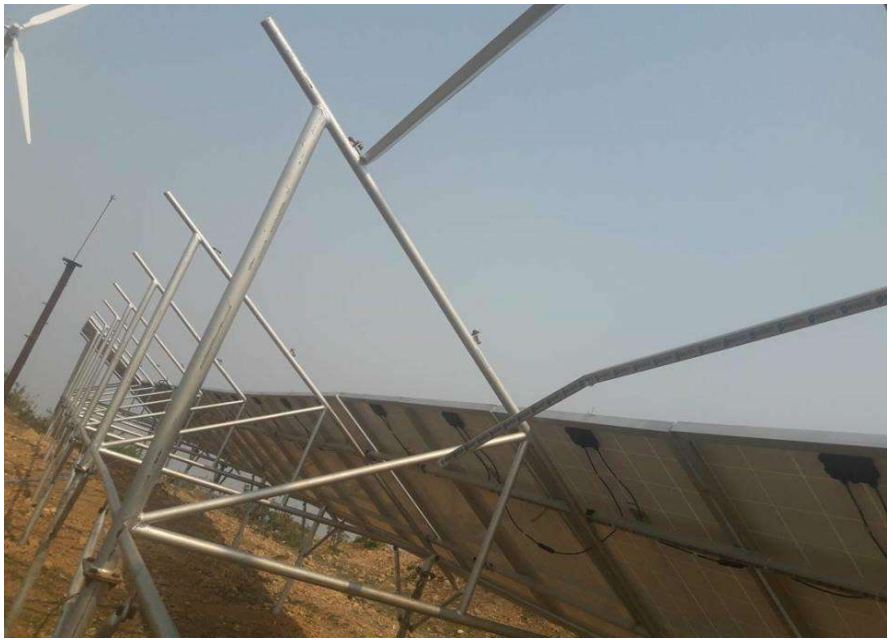
Disaster Risks

Disaster Affected Mini Grid Projects

- Kamal Bazzar Solar Wind Mini Grid (Damaged by Wind Storm)
- Chisapani Solar Wind Mini Grid (Damaged by Lightning)
- Saptami Solar Mini Grid (Damaged by Landslide)
- Morang Solar Mini Grid (Damaged by Wind Storm)
- Korung Khola Micro Hydro (Damaged by Flood)
- Chyane Gumu Khola Micro Hydro (Damaged by Earthquake 2015)
- Simli Khola Micro Hydro (Damaged by Lightning)
- Chari Khola Micro Hydro (Damaged by Earthquake 2015)

Disaster Affected Mini Grid Projects

Kamal Bazaar Solar Wind Mini Grid (Damaged by Wind Storm)



PV modules blown away

- Location: Accham
- Size: 31 kWp

Disaster Affected Mini Grid Projects

Chisapani Solar Wind Mini Grid (Damaged by Lightning)

Surge Protector and Circuit Breaker blown away

- Location: Sindhuli
- Size: 35 kWp

Disaster Affected Mini Grid Projects

Saptami Solar Wind Mini Grid

- Supported by ADB and implemented by AEPC
- Installed Date: November 2018
- Location: Saptami, Panchthar
- Size: 70 kW
- Project Outcome: 110 households and enterprises

Disaster Affected Mini Grid Projects

Saptami Solar Wind Mini Grid (Damaged by Landslide)

Date: 2019

Disaster Affected Mini Grid Projects

Morang Solar Mini Grid (Damaged by Storm)

Roof CGI sheet blown out

- Location: Morang
- Size: 8kWp

Disaster Affected Mini Grid Projects

Morang Solar Mini Grid (Damaged by Storm)

Addition of more truss

After rehabilitation

Disaster Affected Mini Grid Projects

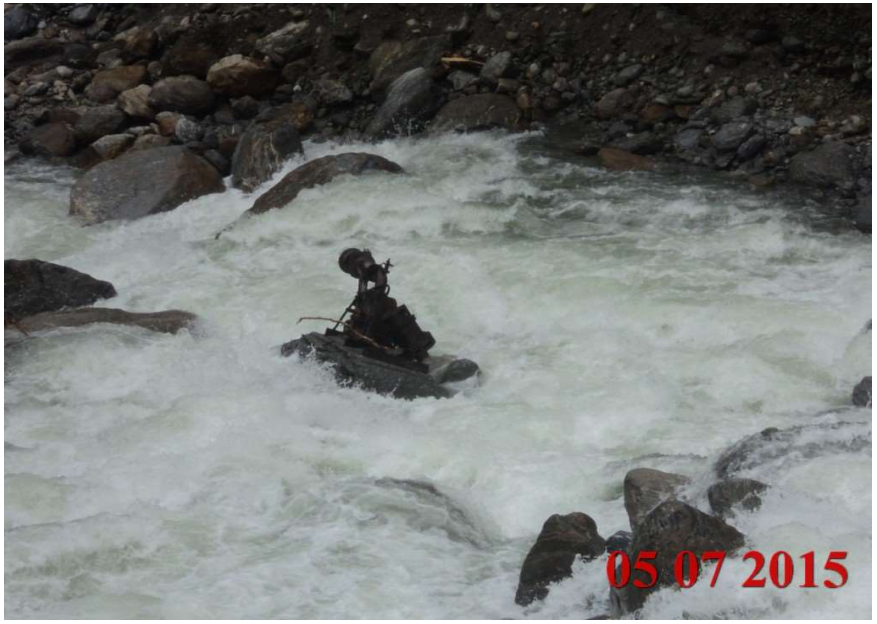
MHPs Damaged by Earthquake

- Total earthquake damaged MHPs - 274 Projects
- Maintained by Community Themselves - 97 Projects
- Rehabilitation supported by RERL - 56 Projects
- Rehabilitation supported by GoN Fund (Additional Financial Support) - 11 Projects
- Rehabilitation under DFID Fund - 49 Projects
- Agreement signed for rehabilitation - 4 Projects

Disaster Affected Mini Grid Projects

Korung Khola Micro Hydro (Damaged by Flood)

Powerhouse completely washed away



Turbine and Generator in the River

Project Size: 30kW, Dolakha
Damaged Date: June 2015

Disaster Affected Mini Grid Projects

Korung Khola Micro Hydro (Damaged by Flood)

Transmission Line Poles Damaged

Disaster Affected Mini Grid Projects

Chyane Gumu Khola Micro Hydro (Damaged by Earthquake 2015)

Powerhouse completely damaged

Powerhouse after rehabilitation

- Installed Date: November 2011
- Location: Kalinchok, Dolakha
- Size: 76 kW

Disaster Affected Mini Grid Projects

Chyane Gumu Khola Micro Hydro (Damaged by Earthquake 2015)

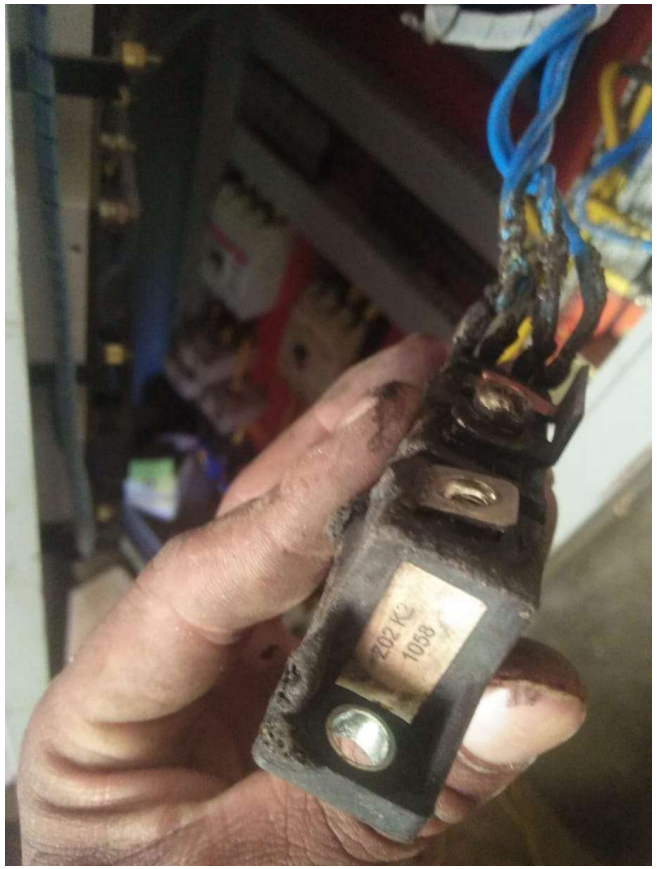
Penstock and anchor block damaged

Penstock and anchor block after rehabilitation

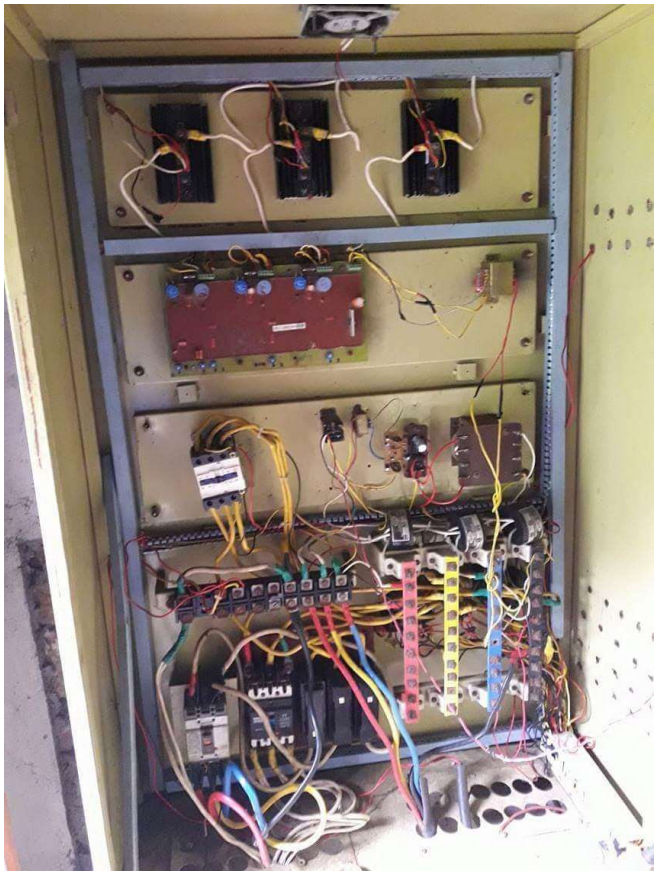
- Major civil components and electro mechanical equipment were badly damaged

Disaster Affected Mini Grid Projects

Simli Khola Micro Hydro (Damaged by Lightning)



Circuit Breaker blown away



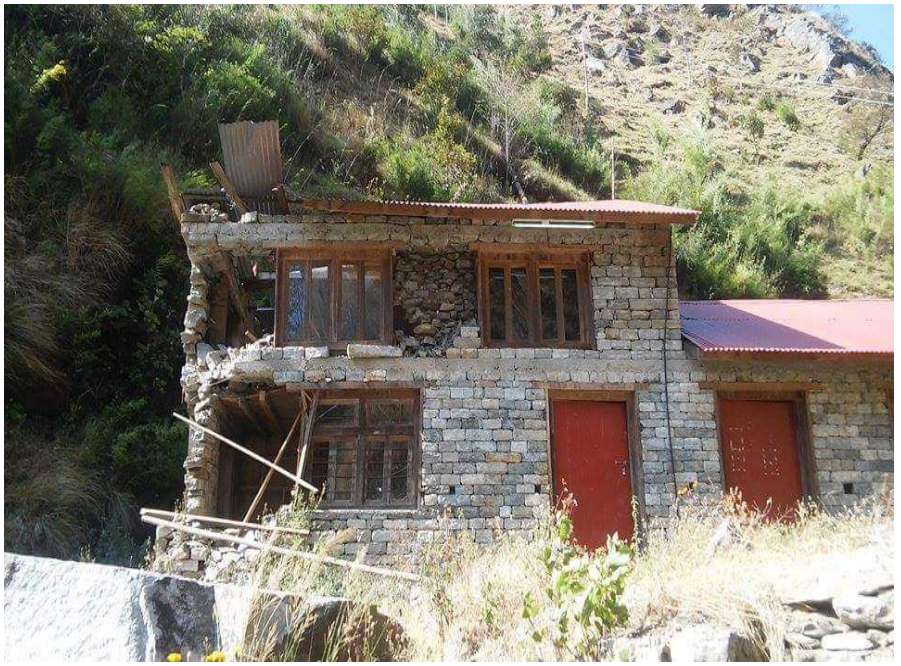
ELC damaged

- Location: Rukum
- Size: 29 kW

Disaster Affected Mini Grid Projects

Chari Khola Micro Hydro (Damaged by Earthquake 2015)

Powerhouse before earthquake



Powerhouse after earthquake

- Location: Ramechhap
- Size: 80 kW

Disaster Affected Mini Grid Projects

General

Inundation of NEA Biratnagar Distribution and Consumer Services

Inundation of NEA 132/33 kV Duhabi Grid Substation

Disaster Risks

Regulatory Framework (National)

- Climate Change Policy, 2011
- National Disaster Response Framework, 2013
- The Constitution of Nepal, 2015
- National Reconstruction Rehabilitation Policy, 2015
- Basic Guideline Related to Settlement Development, Urban Planning and Building Construction, 2016
- National Urban Development Strategy, 2016
- Disaster Risk Reduction and Management Act, 2017
- Local Government Operation Act, 2017
- National DRR Policy and Action Plan, 2017-2030
- National Policy for Disaster Risk Reduction 2018

Disaster Risks

Regulatory Framework (International)

- **Hyogo Framework 2005 – 2015**

Nepal's key policy response to HFA

- Adoption of the cluster approach (2008 onward)
- National Strategy for Disaster Risk Reduction (NSDRM), 2009
- District Disaster Preparedness Response Plan, 2011
- Local DRM Plan Guideline, 2012
- National Disaster Response Framework (NDRF), 2013
- Post-Disaster Recovery Framework (PDRF), 2016

Disaster Risks

Regulatory Framework (International)

- **Sendai Framework 2016 – 2030**

Current Status of Nepal on Four priority areas of Sendai Framework

- Understanding disaster risk – data are collected, complied and maintained by MoHA in online DRR portal
- Strengthening disaster risk governance to manage disaster risk – despite notable regulations due to timely reform, risk management approach is response-centric
- Disaster preparedness for effective response and 'build back better': Relatively successful disaster response, past work on early warning, developing contingency plans, conducting relief operations and emergency management
- Investing in disaster risk reduction for resilience – approaches of DRR mainstreaming into plans and budget are lacking

Disaster Risks

Regulatory Framework (International)

Other International Frameworks

- Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR)
- Paris Agreement
- Sustainable Development Goals
- Addis Ababa Action Agenda
- Global Platform for Disaster Risk Reduction, Cancun, Mexico
- New Urban Agenda 2016

Disaster Risks

Existing DRM Institutions

Institutional Arrangement for Disaster risk management (DRM)

- Office of the Prime Minister and Council of Ministers
- Ministry of Home Affairs (MoHA)
- Ministry of Federal Affairs and Local Development (MoFALD)
- Ministry of Education (MoE)
- Ministry of Urban Development
- National Planning Commission (NPC)
- Central Natural Disaster Relief Committee (CNDRC),
- Department of Water Induced Disaster Management under Ministry of Irrigation

Disaster Risks

Current Provisions for Climate/Disaster Resilience for Mini Grid Projects (AEPC)

- Environmental Assessment Review Framework, 2014 (SASEC)
- Environmental and Social Safeguard Policy, 2018
- Environmental and Social Management Framework, 2018 (MGEAP)
- Design Guidelines of Solar and Solar Wind Mini Grid
- Design Guidelines of Micro/Mini Hydro
- Technical Specifications and Design Guidelines of Solar and Solar Wind Mini Grid (Draft)
- Technical Specifications and Design Guidelines of Micro/Mini Hydro (Draft)

Thank You