



GHG Emission and Energy Transformation in Nepal

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Outline

- Introduction to Nepal**
- Energy Status in General**
- Green House Gas Reduction**
- Renewable Energy Development**
- Existing Hurdles Future Prospects**





- Introduction to Nepal**

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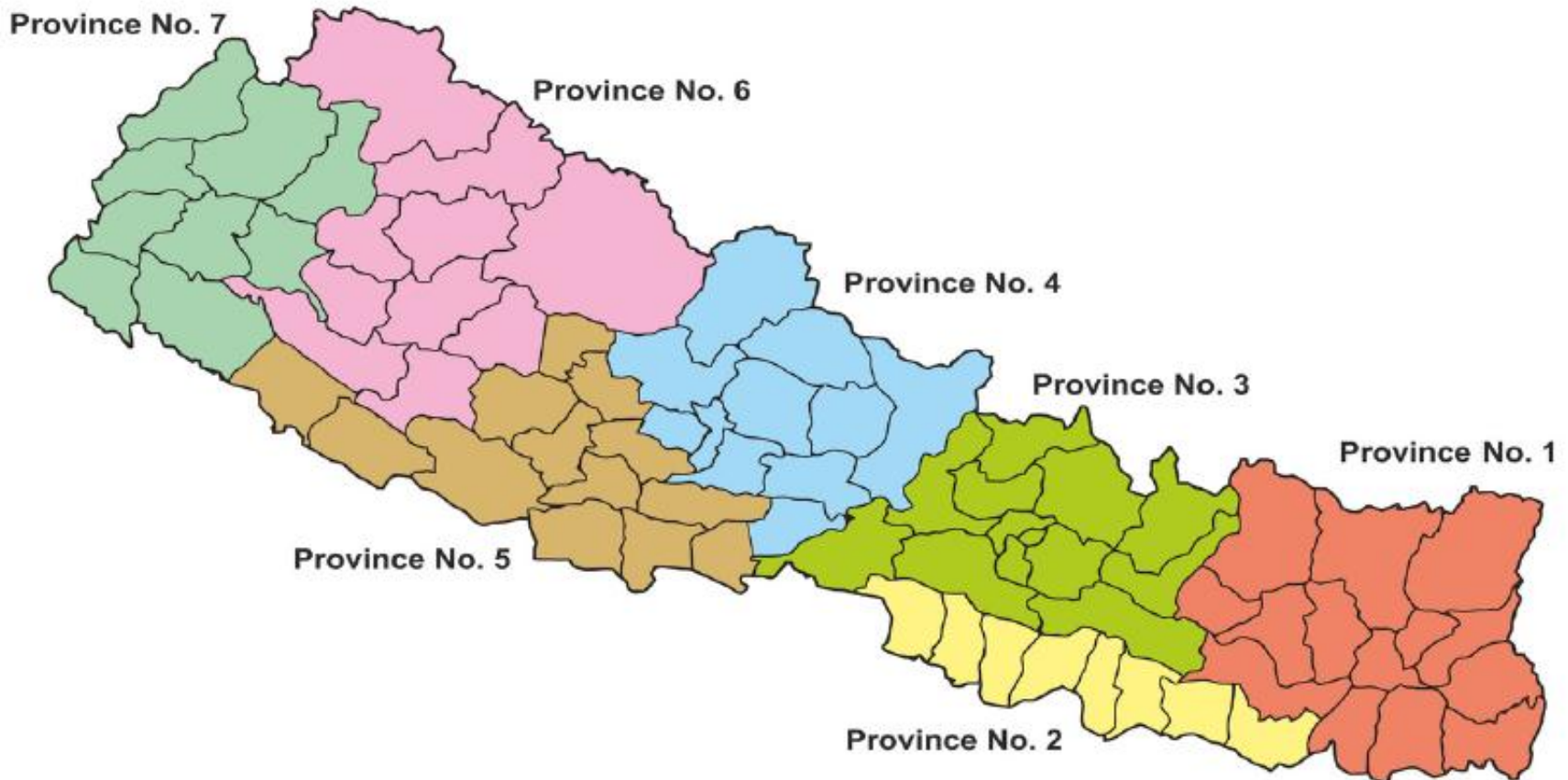
Introduction to Nepal



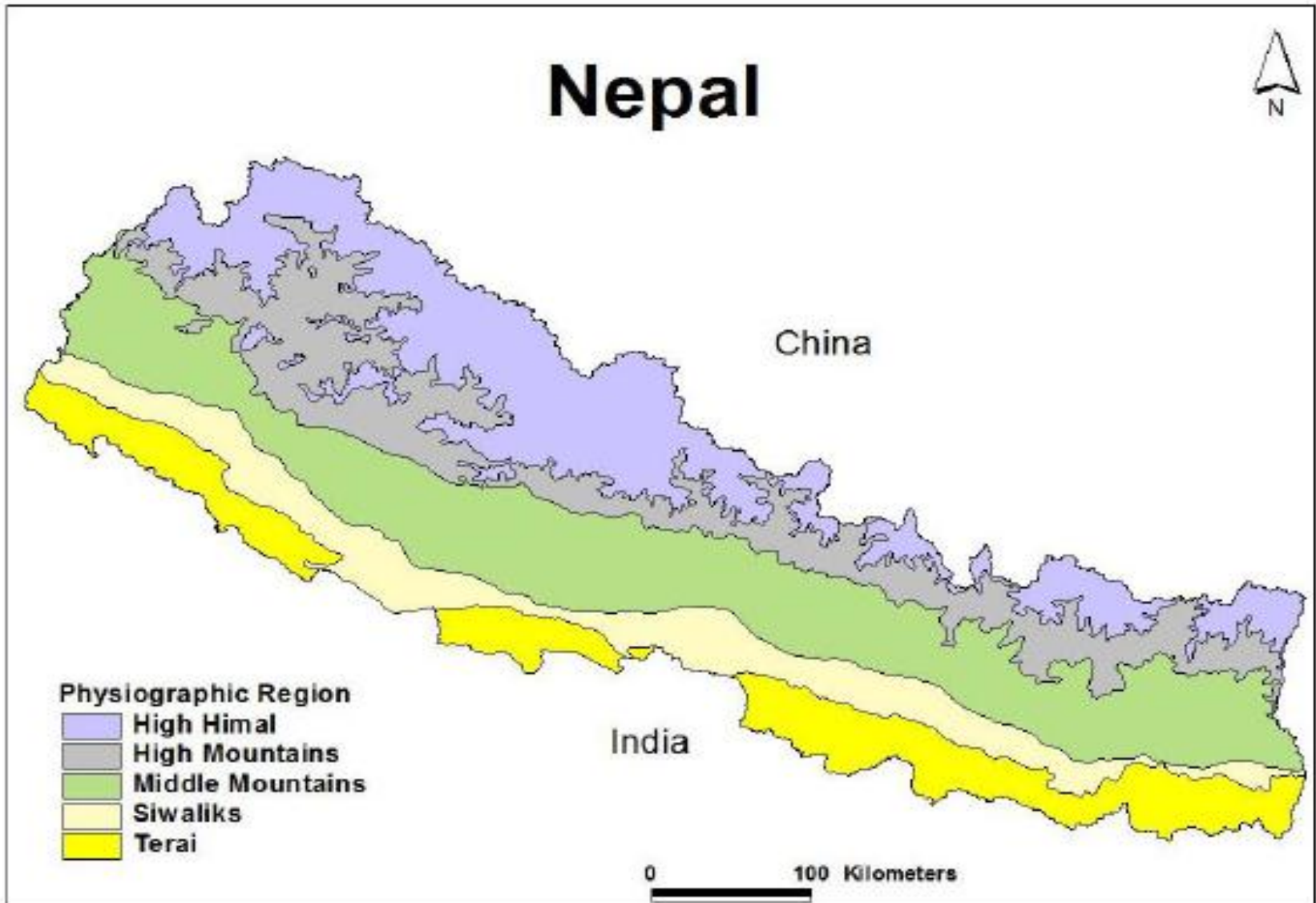
Area=147,181 Sq. km.
Length -885 km
Width~145-241 km
Elevation~70-8848 m
Capital City - Kathmandu
93rd Largest in land mass
41st Most populous
Landlocked (India & China)



Political Division of Nepal



Physiographic Division of Nepal



Physiographic Zones of Nepal

Physiographic Zones	Elevation (m) asl	Area (x1000 ha)	Area (%)	Climate
Terai	< 500	2,111	14	Hot Monsoon & Tropical
Siwalik Hills	500-1000	1,886	13	Hot Monsoon & Tropical
Middle Hills	1000-3000	4,443	30	Warm/Cool Temperate Monsoon
High Mountain	3000-5000	2,959	20	Sub-Alpine & Alpine
High Himal	> 5000	3,350	23	Tundra Type & Arctic



Socio Economic Status

- ❑ Per capita GDP ~ US\$ 1000
- ❑ Total population ~ 30 Millions
- ❑ Population density ~ 200 persons/Sq. km
- ❑ Poverty is widespread with about 25% of the population living below the prescribed poverty line.



Special Features of Nepal

- ❑ Himalayas - Water tower of Asia, lifeline for ~ 1.3 billion people
- ❑ 8 out of 10 highest peaks of world including Mount Everest
- ❑ Birthplace of Lord Buddha
- ❑ Unique Shape of Flag in the world
- ❑ Never Colonized in History
- ❑ 4 Global biodiversity hotpots
- ❑ 60 eco-regions
- ❑ 27 wetland sites
- ❑ 488 protected areas
- ❑ 13 UNESCO heritage sites
- ❑ 1,000 living languages
- ❑ Natural resources of the Himalayas at an imminent risk of degradation from climate change impacts

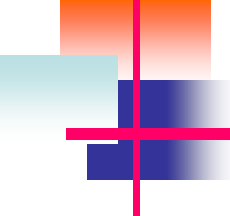


Flag



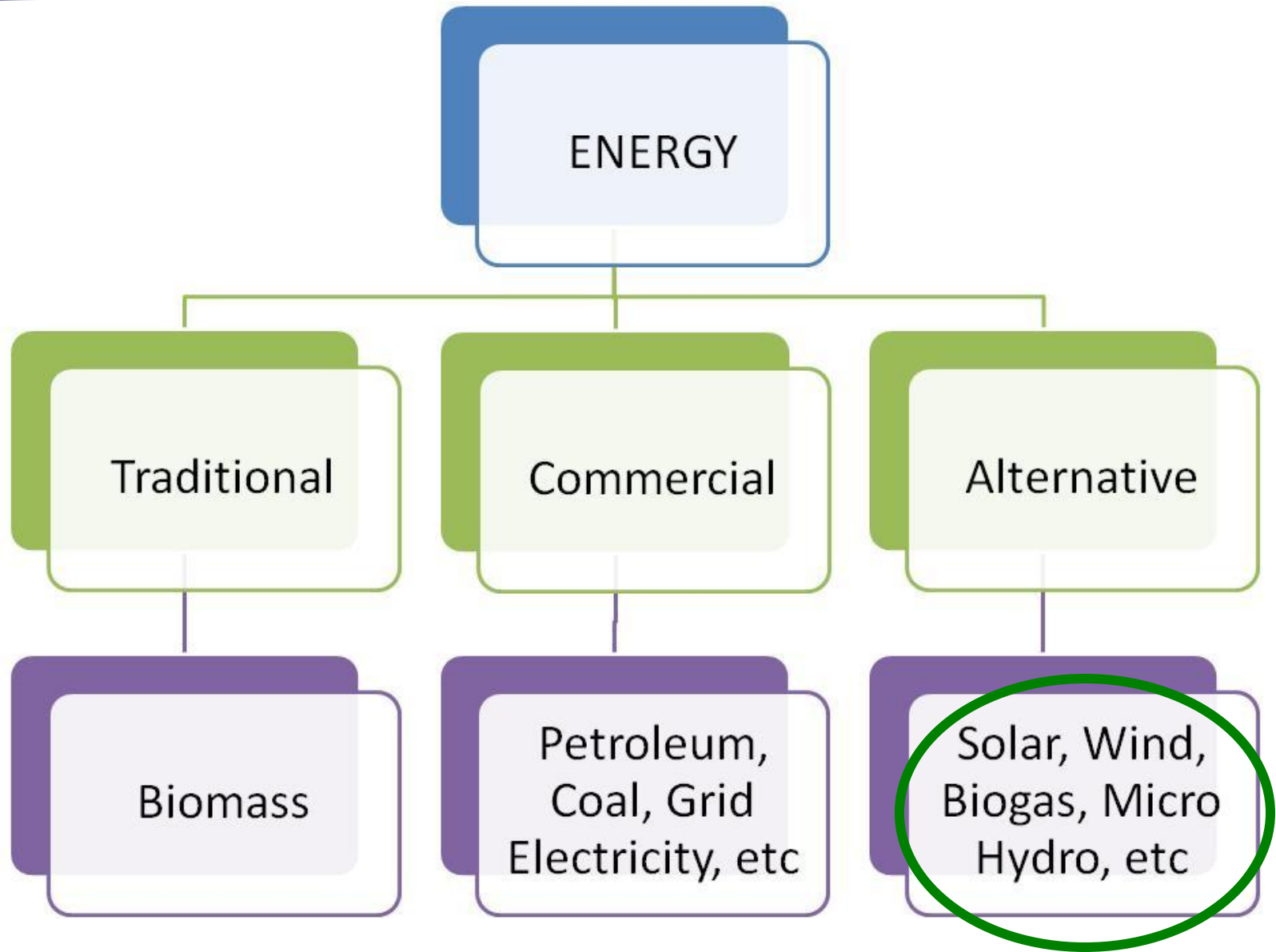
Emblem



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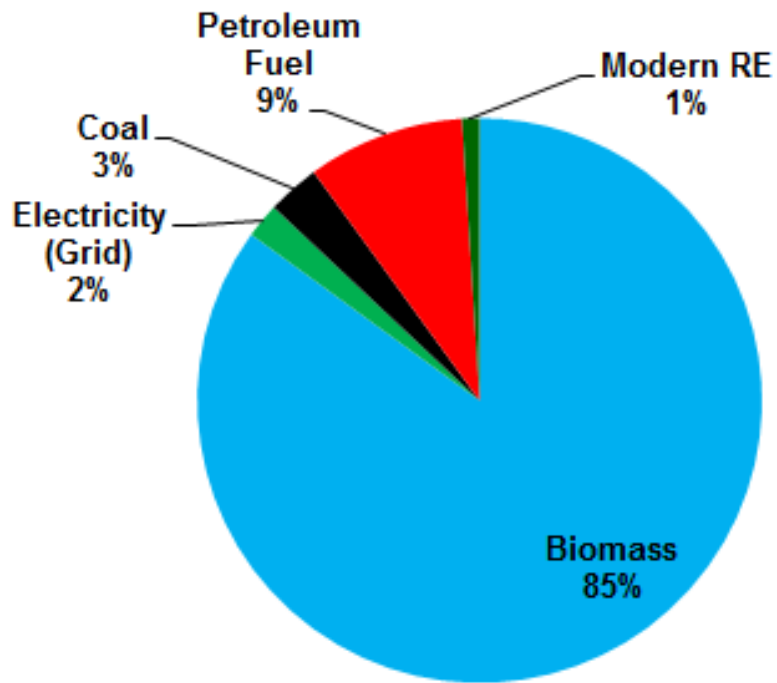


Energy Mix Scenario

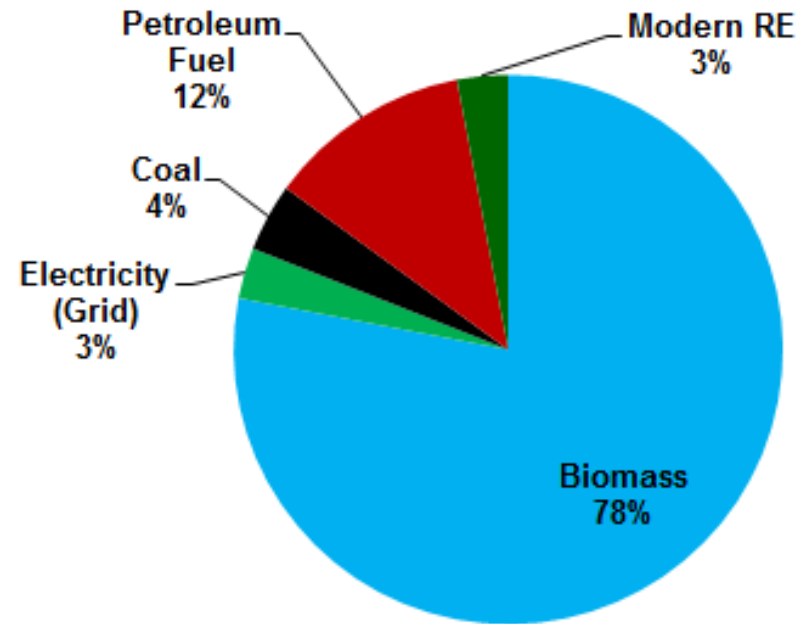


Changing Energy Mix Scenario

Year 2010



Year 2015

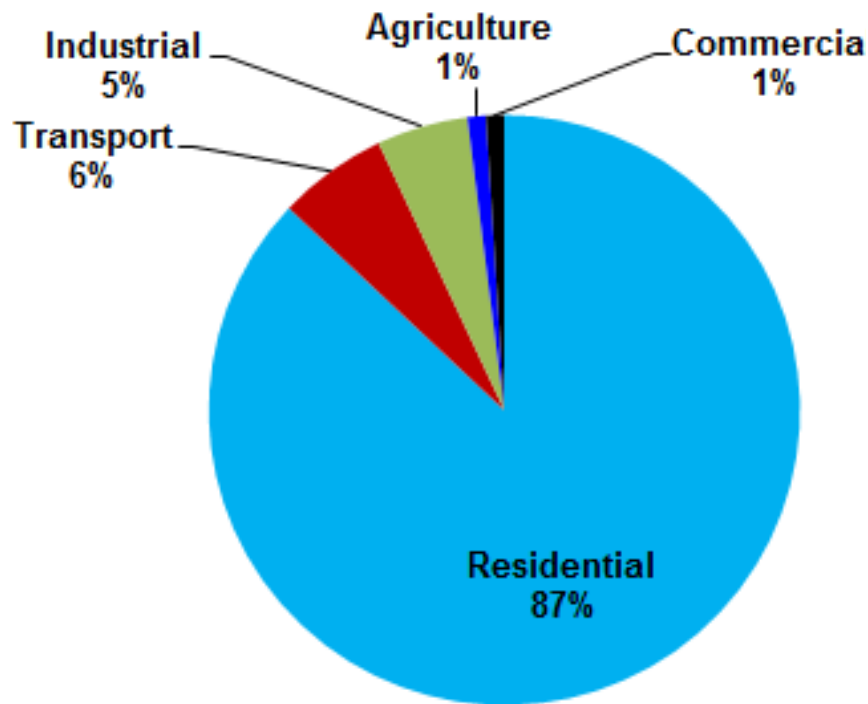


Source: Economic Survey, 2014/2015

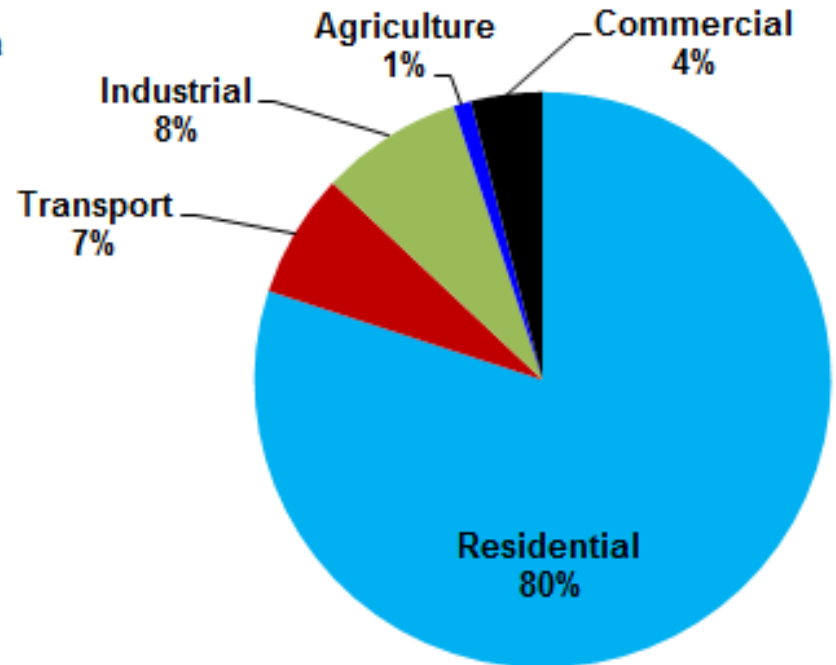


Sectoral Energy Consumption

Year 2010



Year 2015



Source: Economic Survey, 2014/2015



Energy Mix from Different Sources

SN	Fuel Types	Share (%)
1	Fuel Wood	70.47
2	Agriculture residue	3.48
3	Animal Dung	3.68
4	Coal	3.97
5	Petroleum	12.53
6	Electricity	3.39
7	Renewables	2.89

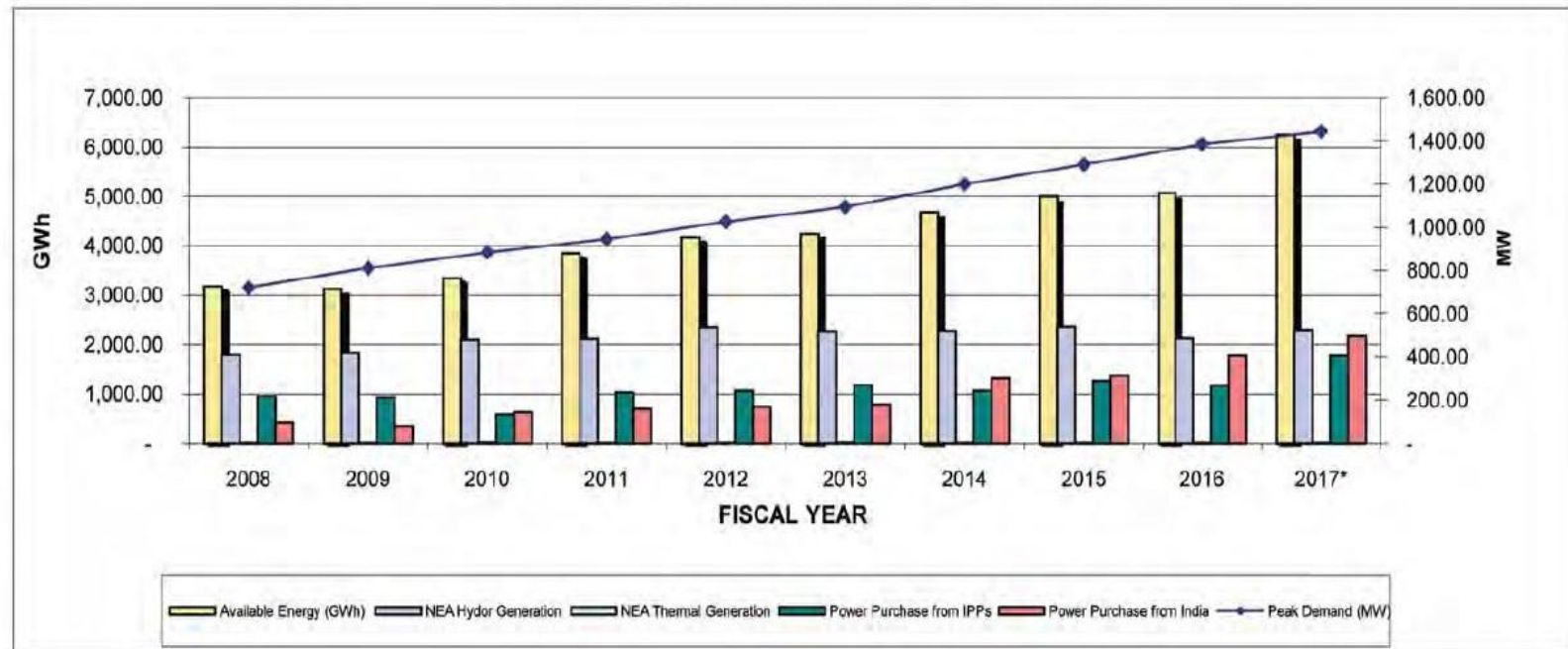


National Scenario of Electrical Power

- Total installed capacity~ 1000 MW (Hydro)
- Thermal Power ~ 50 MW
- Accumulated Solar PV Systems~ 40 MW
- Under Construction~ 3100 MW (Hydro)
- Access to grid electricity~ 70%
- Planned Hydropower Projects: 10,000 MW
- Installed Wind Power : Negligible
- Biomass Power: None



Available Energy & Peak Demand



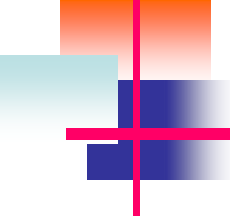
Particulars	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*
Peak Demand (MW)	721.73	812.50	885.28	946.10	1,026.65	1,094.62	1,200.98	1,291.10	1,385.30	1,444.10
NEA Hydro Generation	1,793.14	1,839.53	2,108.65	2,122.08	2,357.43	2,273.11	2,288.23	2,366.88	2,133.14	2,305.17
NEA Thermal Generation	9.17	9.06	13.01	3.40	1.56	18.85	9.65	1.24	0.08	0.28
NEA Generation Total (GWh)	1,802.31	1,848.59	2,121.66	2,125.48	2,358.99	2,291.96	2,297.88	2,368.12	2,133.22	2,305.45
Power Purchase from India	425.22	356.46	638.68	694.05	746.07	790.14	1,318.75	1,369.89	1,777.68	2,175.04
Power Purchase from IPPs	958.42	925.74	591.43	1,038.84	1,073.57	1,175.98	1,070.47	1,268.93	1,166.24	1,777.24
Power Purchase Total (GWh)	1,383.64	1,282.20	1,230.11	1,732.89	1,819.64	1,966.12	2,389.21	2,638.82	2,943.92	3,952.28
Available Energy (GWh)	3,185.95	3,130.79	3,351.77	3,858.37	4,178.63	4,258.08	4,687.09	5,005.70	5,077.14	6,257.73

Note :- Peak demand is for all areas covered by integrated system including supply to India

* Provisional figures

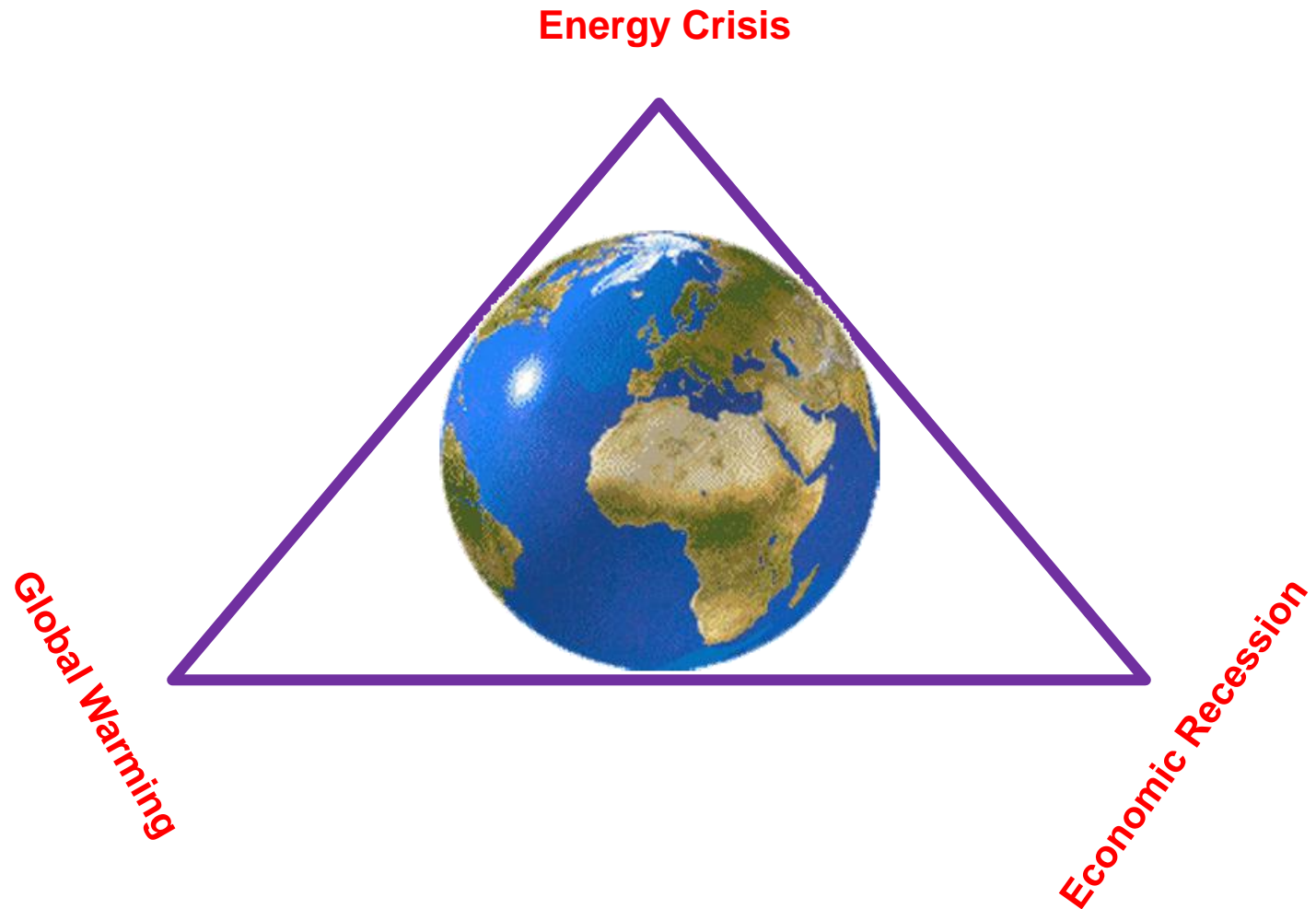
Source: A Year in Review, F/Y 2016/17, NEA



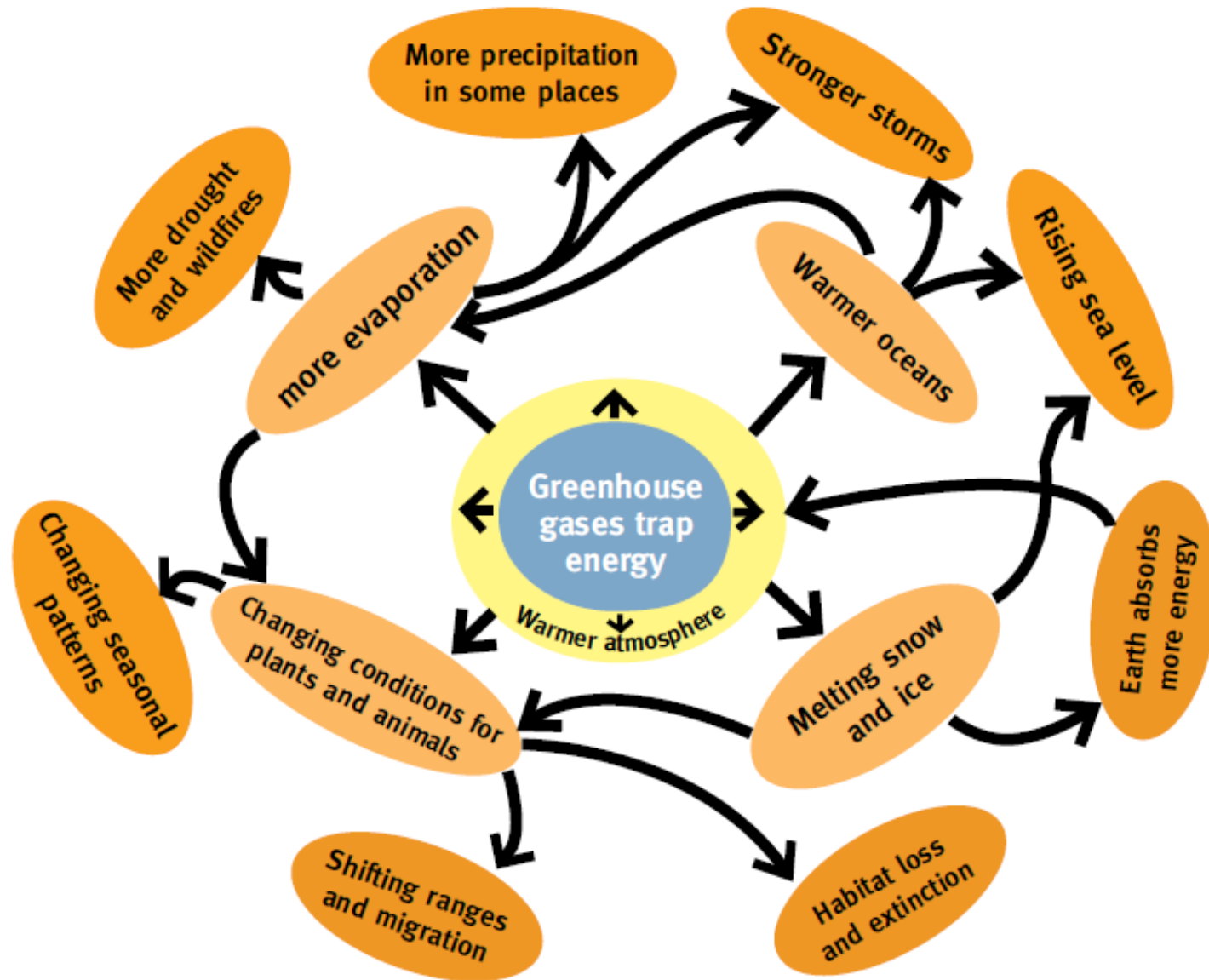
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Existing Global Crises



Why GHG Reduction Necessary?



Net GHG Emission at Different Times

Year	CO ₂ (Gg)	CH ₄ (Gg)	N ₂ O (Gg)	Net CO ₂ Eq. Emission (Gg)
1990/1991	912.96	1005.82	1.39	26472.68
1994/1995	9747.00	948.00	31.00	42685.00
2000/2001	-9882.14	667.53	30.55	15912.99



Climate Change Scenario in Nepal

- ❑ Increase in temperature at an annual rate of 0.06°C in average
- ❑ Himalayas Warming/ Century $>$ the global average of 0.74°C (Du et al. 2004; IPCC 2007).
- ❑ Glaciers retreating at a faster rate than before (30-60 meter between 1970-1989).
- ❑ Higher temperature increment for winter compared to the monsoon season
- ❑ Higher Altitude higher rate of temp. rise



Areas of Concern due to Climate Change

Although emits only 0.025 percent of total GHG emissions in the world Nepal is 4th vulnerable country in the world due to climate change.

- Agriculture & Food Security
- Public Health
- Water Resources & Energy Security
- Forest and Biodiversity
- Infrastructures and Urban Settlement
- Climate Induced Disasters

Source: NAPA Report, 2010



Initiatives for Adaptation

- ❑ **NAPA, 2010- Strategic Tool**
- ❑ **250 adaptation options**
- ❑ **Thematic Working Groups (TWG), nine integrated projects prioritized**
- ❑ **LAPA Framework, 2011 to integrate adaptation and resilience**
- ❑ **Agriculture, forestry, health, water and sanitation, watersheds and micro-finance -main entry points**
- ❑ **Education, local infrastructure, disasters and other environment-related areas may also be taken as entry points**
- ❑ **In 2013, LAPA implemented in 69 VDCs and 1 municipality of 14 districts**



GHG Reduction Practices-1



Solar PV



Solar Thermal



Wind



Biogas

Photo courtesy: AEPC, BSP-Nepal and Bajra Foundation, Nepal



GHG Reduction Practices-2



Electric Vehicle in use



Microhydro power plant



Courtesy: Kantipur

Safa Tempo- Electric vehicle



Traditional Water Mill



GHG Reduction Practices-3

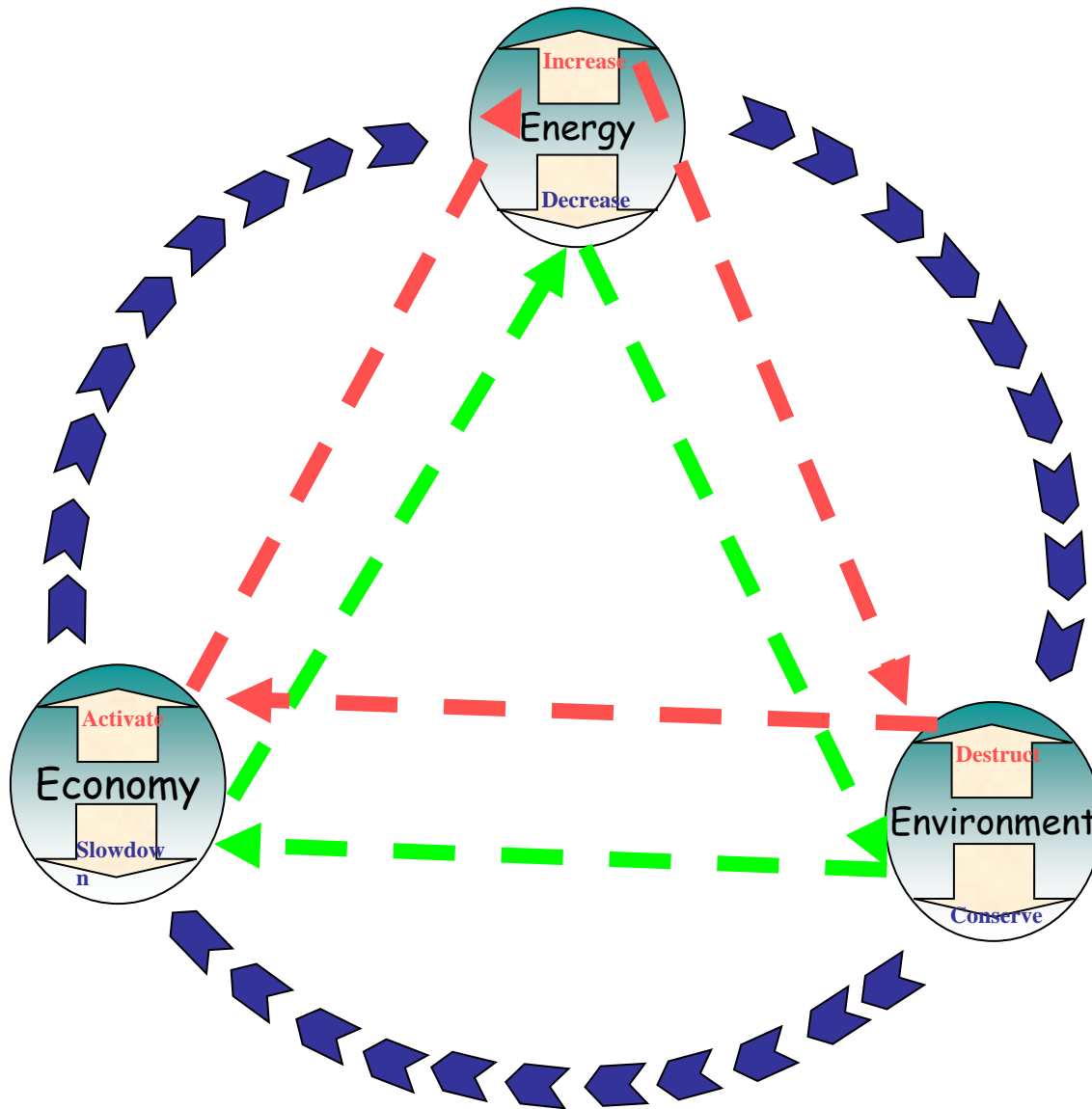
- Forest coverage- 44.74% of the entire area, increasing
- Promotion of RETs
- Planned to Implement Mass Transport System



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Possible Solution



Potential Energy Generating Sectors



Hydropower- 83,000 MW
106 years of history

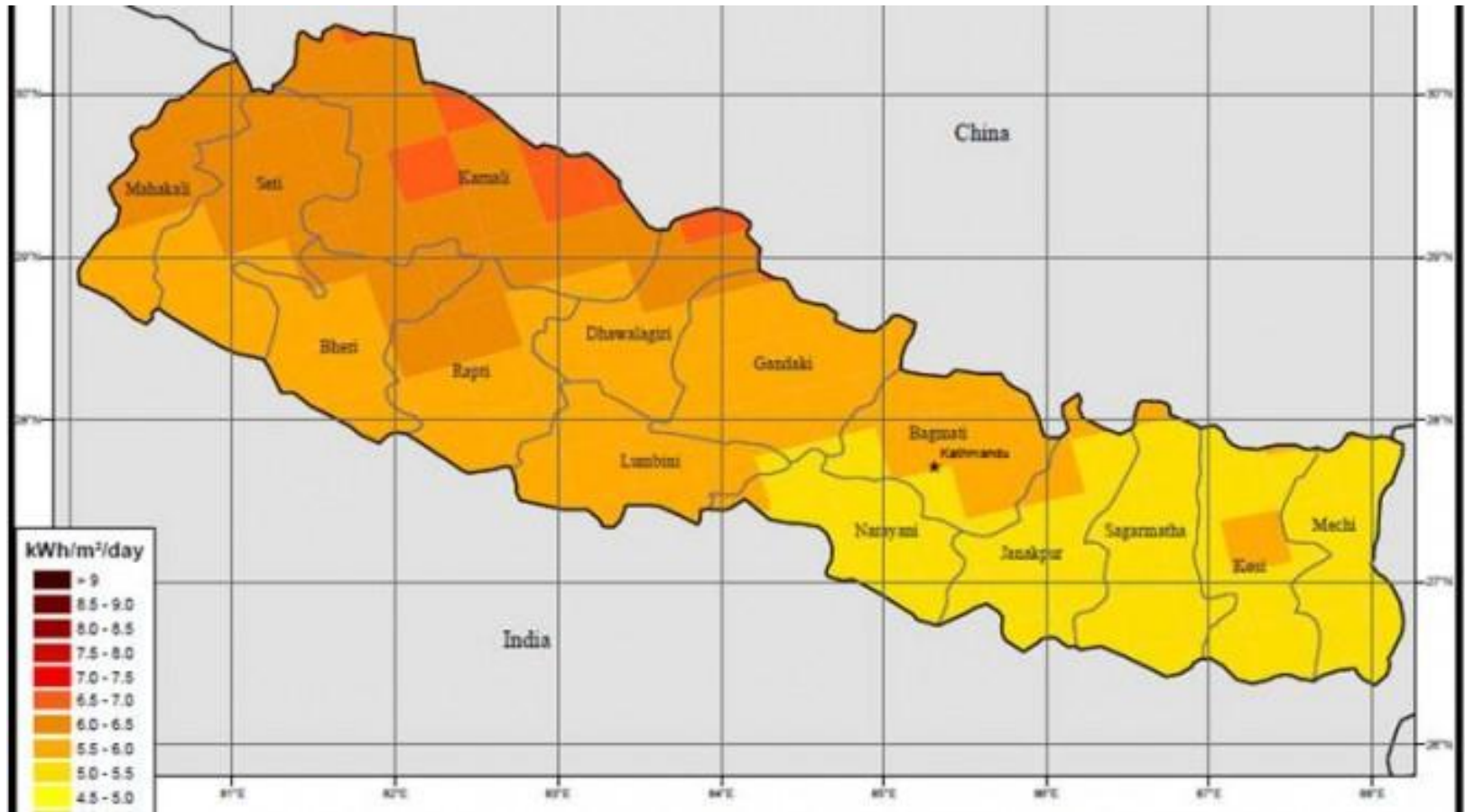


Solar Photovoltaics- 4.7 kWh /
m²/ day, ~ 300 days of sunshine
~ 40 years of history



Wind Mills -3.387 MWh / m²
(annual average)
~ 20+ years of history

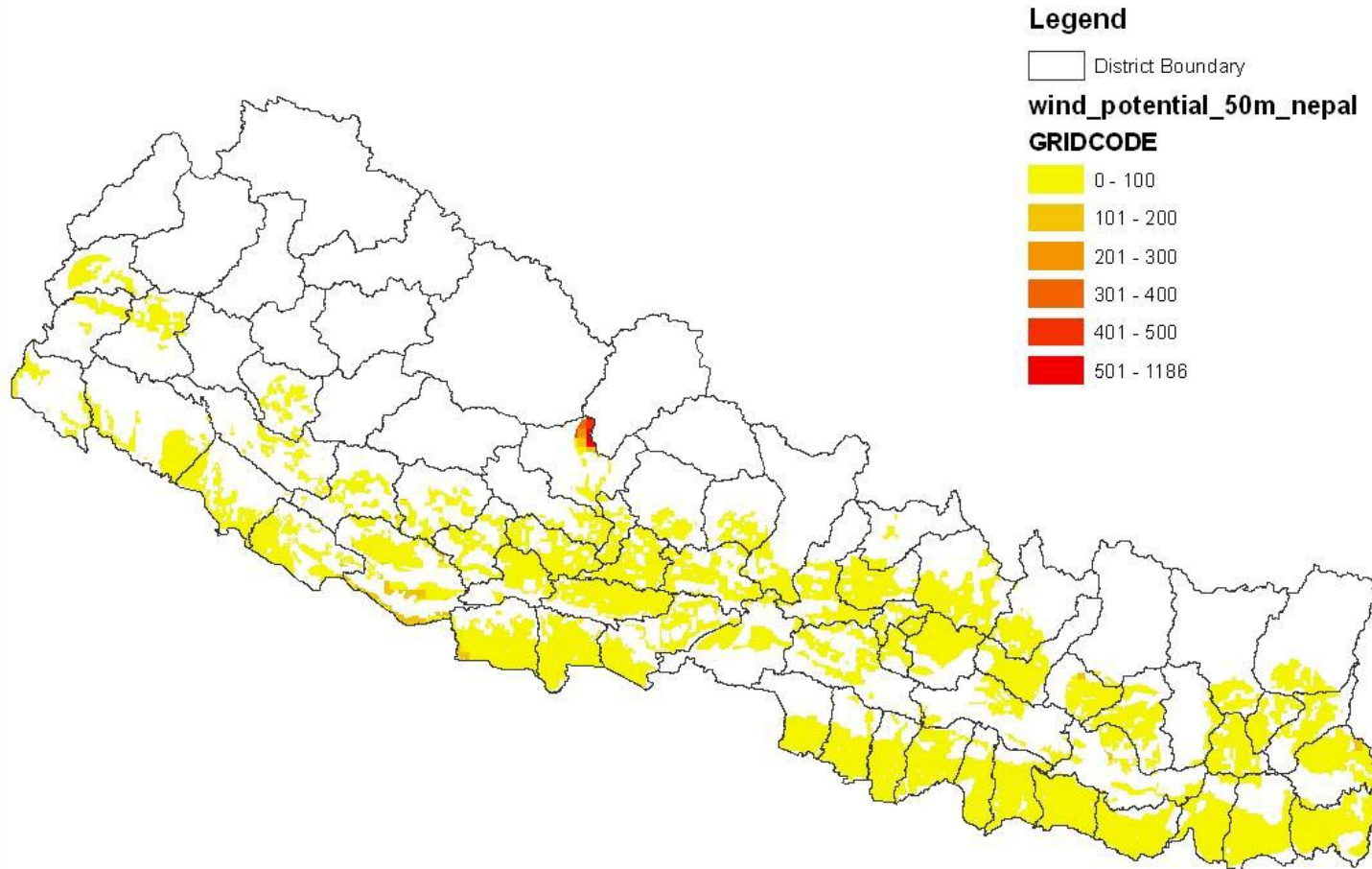
Potential of Solar Power Development



Solar : 2100 MW (grid connected)

Source: Solar and Wind Energy Resource Assessment in Nepal (SWERA), 2008

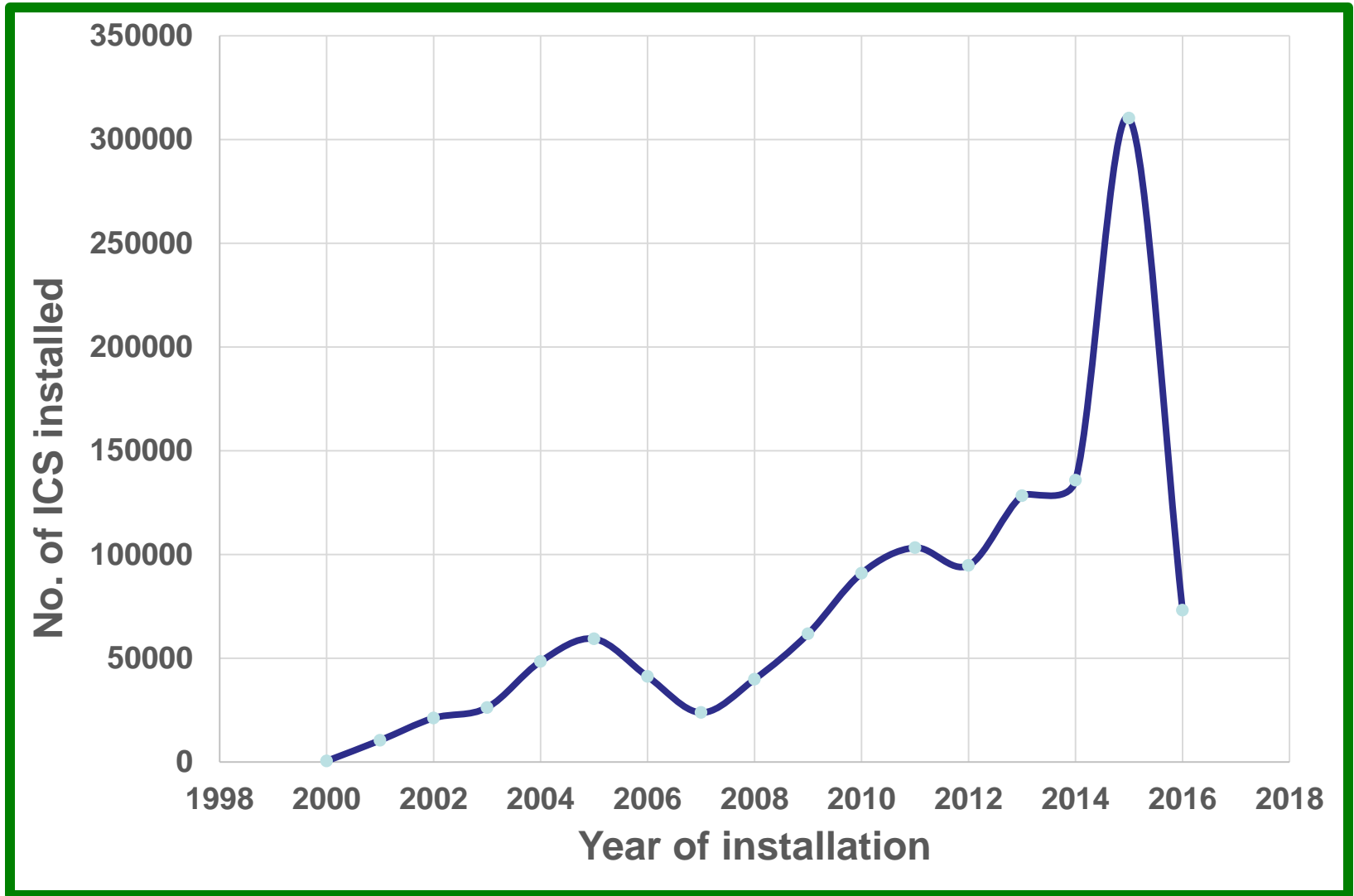
Potential of Wind Power Development



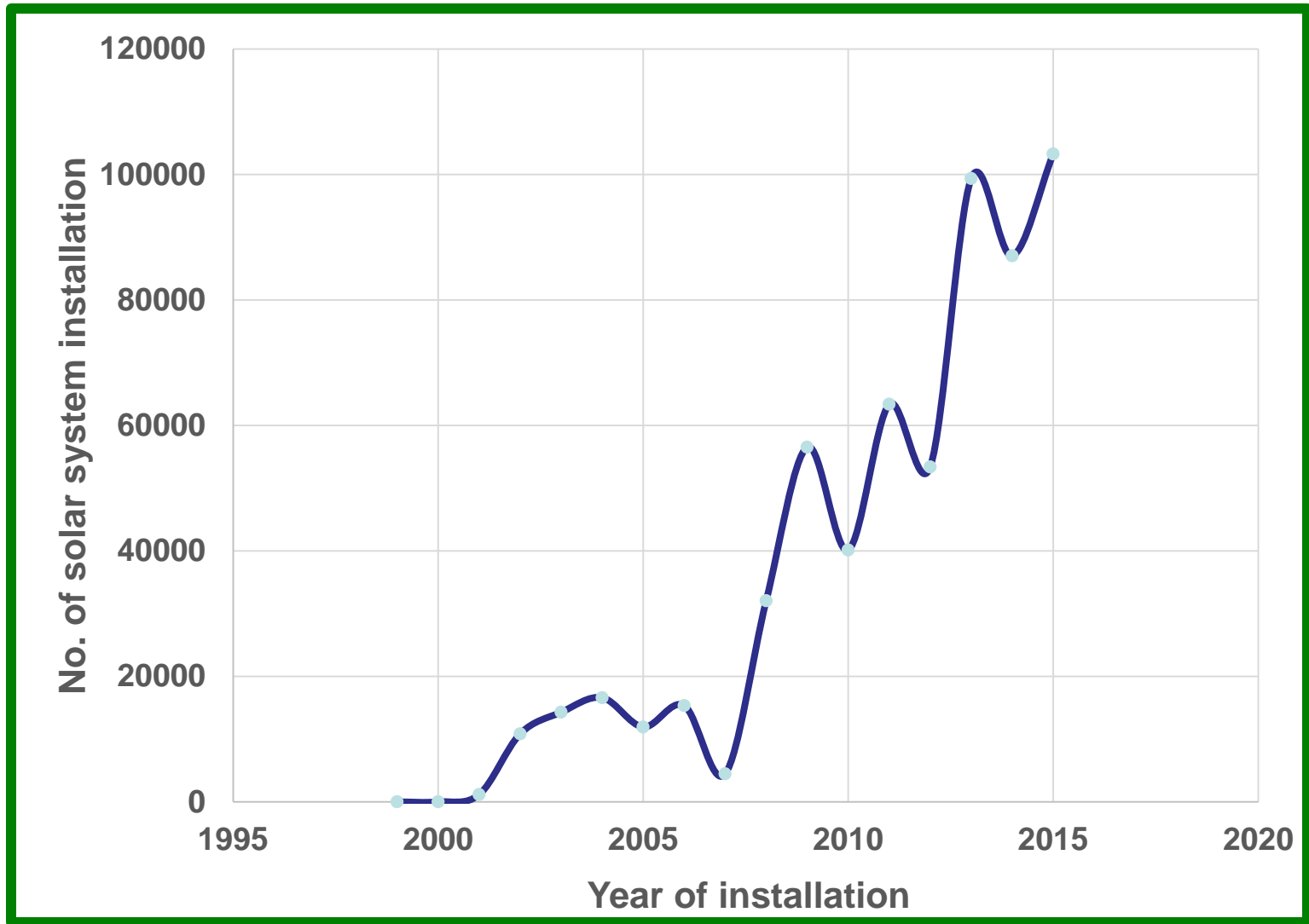
Commercially viable wind potential is estimated to be only about 3000 MW.

Source: Solar and Wind Energy Resource Assessment in Nepal (SWERA), 2008

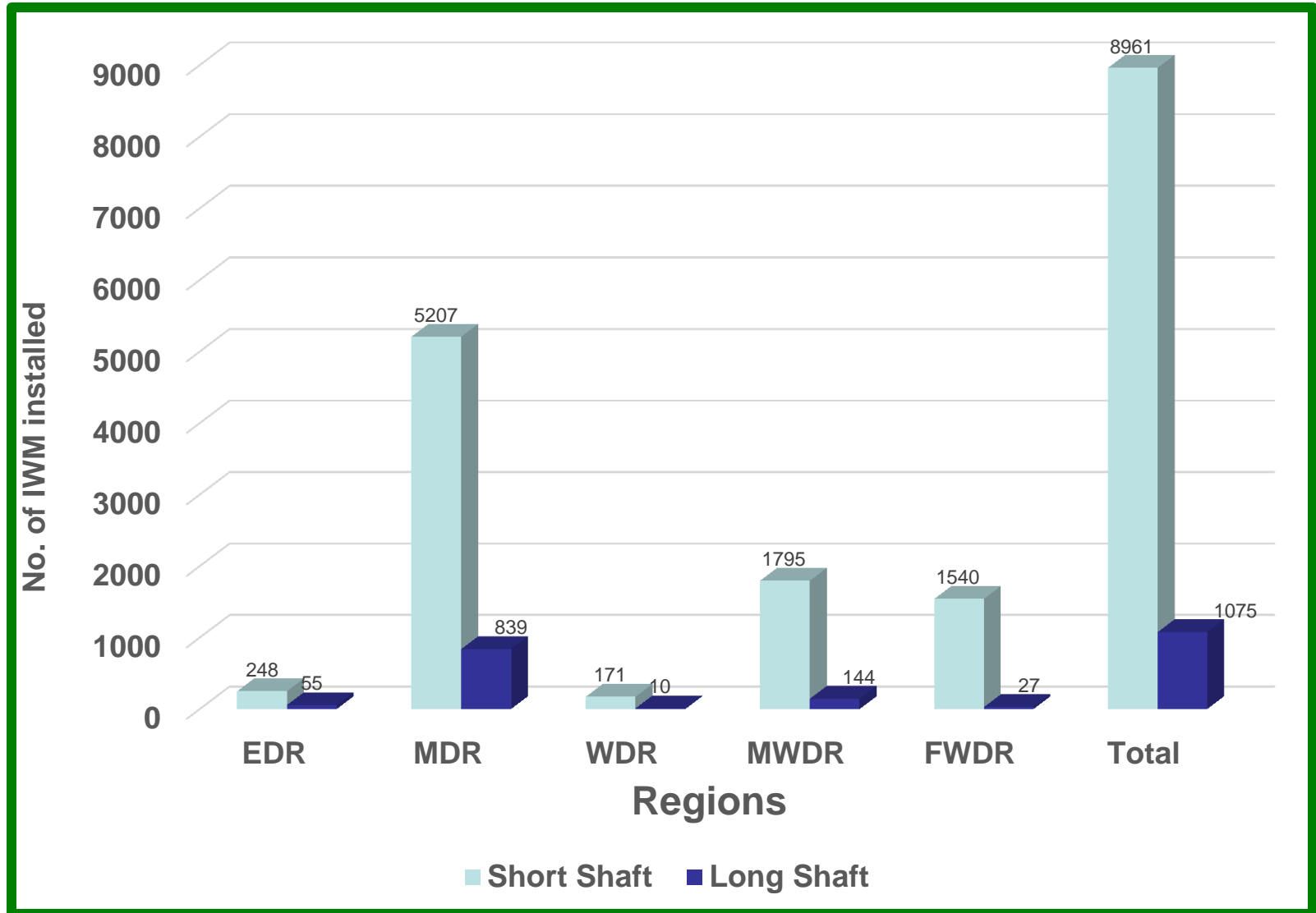
Trend of ICS Installation



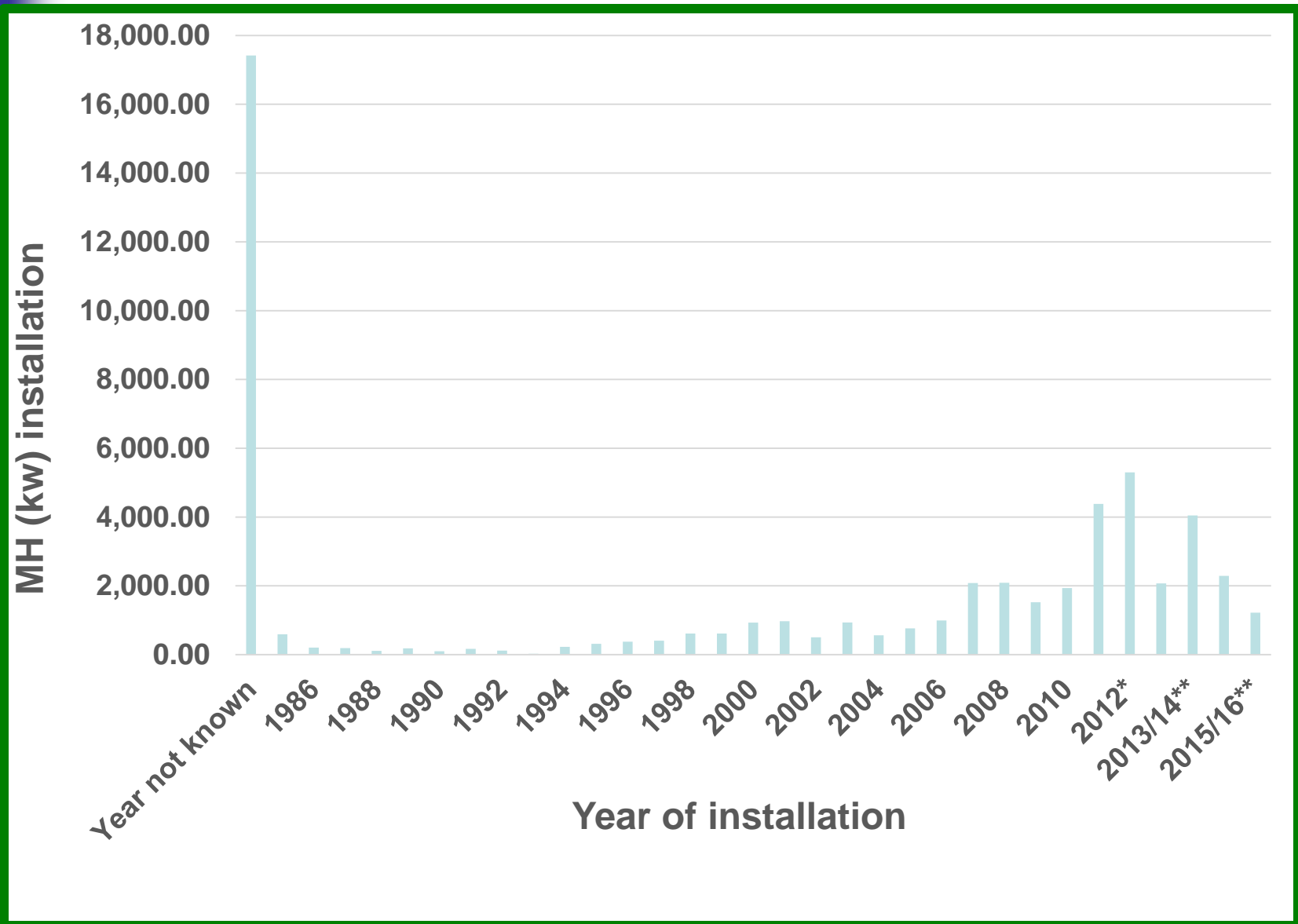
Trend of Solar PV System Installation



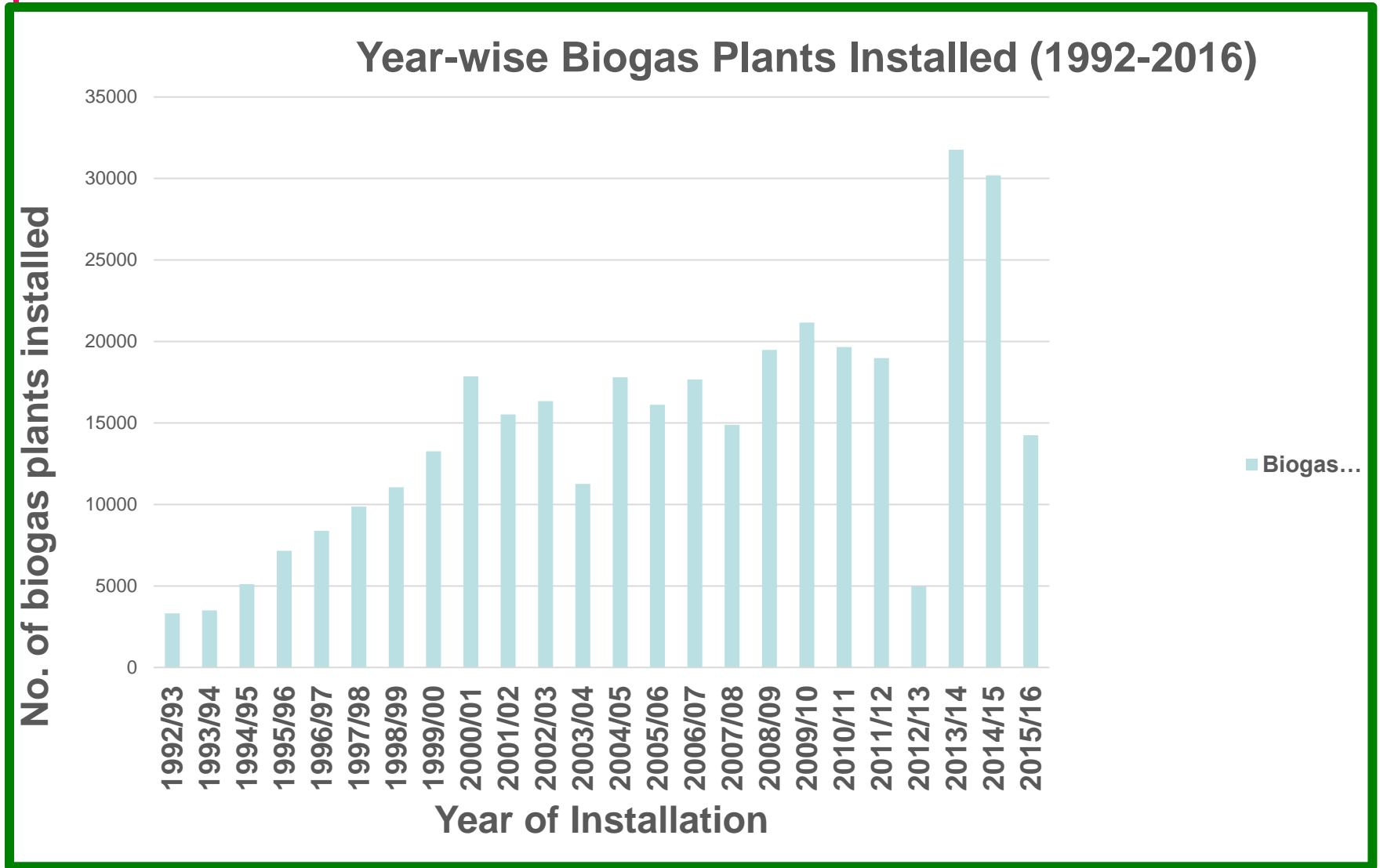
Regional Installation of IWM



Trend of Micro Hydro Plant Installation



Trend of Biogas Plant Installation



Accumulated Values of Off-Grid RETs

SN	Accumulated Off-Grid Installation	Total
1	Improved Cook Stoves (ICS)	1,269,424
2	Improved Water Mills (IWM)	10,036
3	Solar PV installations	609,793
4	Micro-Hydro installations (kw)	54,275
5	Bio-Gas Plant Installations	349,591



Responsible Organizations

Role	Level	Organization	Remarks
Policy Formulation and Evaluation	National	Ministries (Energy, P& Env, S&T,), WECS	Other Ministries
Implementation (National)	National	NEA, AEPC, DoED	
Research	National	NAST, Universities	R&D Inst.
Development	All	NEA, Private, Donors (National & Int'l)	Changing
Monitoring and Evaluation	National	NPC	
Implementation (Local)	Province & Local	Provincial & Local Governments, Community Groups	Recently Formed
Investment	National & Local	Government, Public, Private, Int'l Agencies	Banks



Policy Document for Hydropower

- ❑ 1990- hydropower development was under the domain of government utility
- ❑ 1992- hydropower development was opened for private sector
- ❑ 1992, 2001 Hydropower Development Policies
- ❑ 1992-Water Resources Act 1992
- ❑ 1992- Electricity Act (Under Review-2017)
- ❑ 1992-Foreign Investment and Technology Transfer Act
- ❑ 1996-Environment Protection Act - 1996 (Regulation-1997)
- ❑ 2002-Water Resources Strategy
- ❑ 2005- National Water Plan
- ❑ 2006-Rural Energy Policy
- ❑ 2008-National Electricity Crisis Resolution Action Plan
- ❑ Nepal Government's policy and plan of 10,000 MW in 10 years (2010-2020) and 25,000 MW in 20 years (2010-2030)

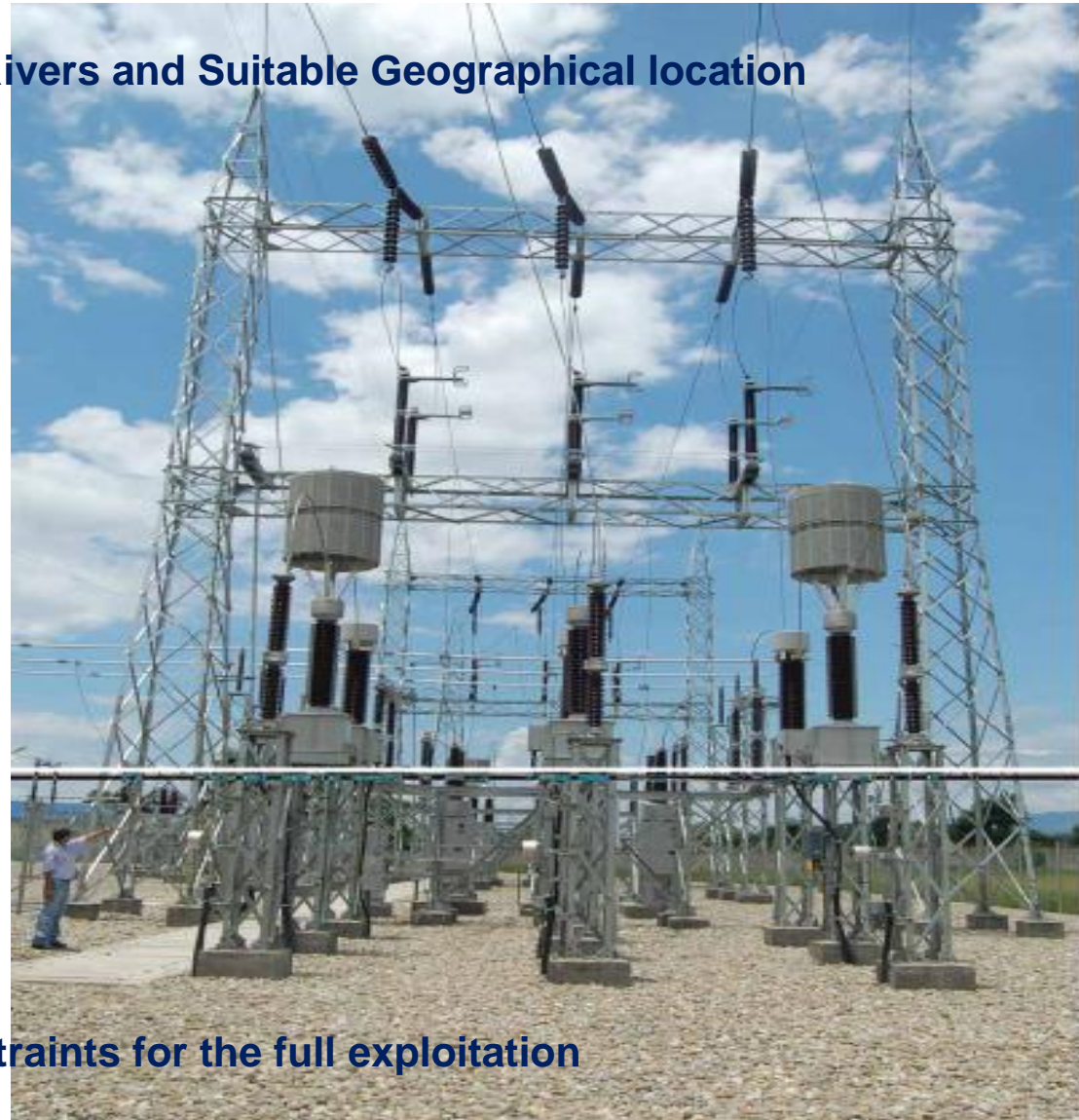


Hydropower

Strength : High Current Rivers and Suitable Geographical location



Weakness: Resource constraints for the full exploitation



Glimpse of Hydropower Sites



11/22/2017

GHG Emission and Energy Transformation Seminar- 2017, Hangzhou, PRC



Major RE Projects

- 25 MW Grid Connected Solar PV Plant**
- Solar Street Lamps in All Municipalities of Nepal**
- Implementation of Grid Connected Solar PV Systems with Net Metering**
- Many Small and Big Hydropower Projects in Pipeline**



Nearly Completed Hydropower Projects

- ❑ Chameliya (30 MW)
- ❑ Kulekhani -3 (14 MW)
- ❑ Upper Trishuli- 3A (60 MW)
- ❑ Upper Trishuli-3B (37 MW)
- ❑ Rahughat (40 MW)
- ❑ Upper Tamakoshi (456 MW)



Major Hydropower Projects in Pipeline

- Tanahu (140 MW)
- Rasuwagadi (111 MW)
- Sanjen (42.5 MW)
- Upper Sanjen (14.6 MW)
- Middle Bhotekoshi (102 MW)
- Upper Arun (335 MW)
- Upper Modi (42 MW)
- Tamakoshi V (95 MW)
- Chainpur Seti (210 MW)
- Dudhkoshi Storage (300 MW)
- Tamor Storage (762 MW)
- Uttar Ganga Storage (828 MW)
- Andikhola Storage (180 MW)
- Upper Seti (127 MW)
- Nalsyaughat (400 MW)
- Budhi Gandaki Storage (1200 MW)
- Pancheshwor (6,720 MW)



Run – off - River

- ❑ Arun III (402 MW)
- ❑ Tamor / Mewa (100 MW)
- ❑ Budhi Ganga (20 MW)
- ❑ Likhu 4 (51 MW)
- ❑ Upper Modi A (42 MW)
- ❑ Upper Marshyangdi A (121 MW)
- ❑ Kabeli A (30 MW)
- ❑ Khimti II (27 MW)

Storage

- ❑ Kaligandaki II (660 MW)
- ❑ West Seti (700 MW)
- ❑ Karnali Chisapani (10,800 MW)
- ❑ Dudh Koshi (300 MW)
- ❑ Aandhi Khola (180 MW)
- ❑ Langtang Khola (218 MW)
- ❑ Kankai (60 MW)
- ❑ Madi Ishaneshow (86 MW)



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Hurdles for Development of RETs

- ❑ **Hydropower – Political Instability, Policy Barrier, Slow Implementation, Lack of Transmission Line, Difficulty in Land Acquisition, Resource Constraints, Poor Infrastructure**
- ❑ **Solar – High installation cost, No Power cuts, Technical & Financial Constraints**
- ❑ **Wind- Difficult Terrain, Poor Infrastructure, Bad Experiences in the past**
- ❑ **Bioenergy- Less Competitive compared to other resources**



Way Forward- Let's do it.

I hear and I forget
I see and I remember
I do and I understand



Confucius (551–479 BC)





Thank you all.

Very special thanks to organizers, HRC and other supporting agencies of PRC.

