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## NDCs and Low Carbon Policies in Nepal: Implications and Challenges

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# **Country Profile**

Total area: 147,180 km2

Mountainous country Altitude varies from 59 m in the south up to 8,848 m in the north (the length along north-south varying from 150 km to 250 km).

Mountains and rugged hills cover almost 75% of Nepal's land area



## Sectoral shares in GDP

- Share of the agriculture in GDP decreasing
- The share of **Transport**, **Communication and Storage** sector in GDP iestimated to be 8.11 % in current fiscal year.



## **Major Natural Resources**

- Water resources Hydropower,
- Forests,
- Diverse other biological resources (biodiversity)

## **Forest Resources**

- Forests
- Forest coverage: 40.36%
- Area coverage by forest and other wooded land: 44.74%.
- More than 25,000 community-based forest management groups across the country are directly engaged in managing about 30 per cent of the country's total forest area.

#### • Carbon Stock

- Total carbon stock in Nepal's forest has been estimated as 1,054.97 million tonnes (176.95 t/ha).
- Tree component, forest soils, and litter and debris constitute 61.53%, 37.80 %, and 0.67% respectively.

# Hydropower

- Technical Potential: 83,000 MW
- Economic Potential: Above 45,000 MW
- At present, only about two percent of this potential is being exploited.
- The government aims to develop 5,373 MW of reservoir projects within 2026.
- Similarly, it aims to develop 1,975 MW of peaking run of river projects.
- There are also 107 projects in different phases of construction; they will add 2,587 MW of electricity generation capacity in the next 10 years.
- Using hydropower is a key low carbon development strategy in the country.

# Nepal's Low Carbon Plans and Policies

# Energy development plan

Nepal is planning to generate clean energy as follows:

- 4,000 MW of hydroelectricity by 2020 and 12,000 MW by 2030;
- 2,100 MW of solar energy by 2030 with arrangements to distribute it through the grid;
- Additional 220 MW of electricity from bio-energy by 2030;
- Additional 50 MW of electricity from small and micro hydropower plants;
- Increase the share of biogas up to 10% as energy for cooking in rural areas; and
- Equip every households in rural areas with smokeless (improved) cooking stoves (ICS) by 2030.

## Forestry Sector Strategy (2016-2025)

- Forestry Sector Strategy (2016-2025) aims to:
  - enhance Nepal's forest carbon stock by at least 5% by 2025 as compared to 2015 level,
  - decrease mean annual deforestation rate by 0.05 percent in Terai (southern plain) and Chure.
- It also aims to:
  - put in place forest carbon trade and payment mechanism,
  - protect 0.2 million ha of forests through the implementation of adaptation plans, and
  - mainstream community/ecosystem-based adaptation by 2025.

#### Environment Friendly Local Governance Framework (EFLGF)

#### **Objectives of LFLGF**:

- to mainstream environment, climate change adaptation and disaster management in the local planning processes.

#### Some of the activities that the framework prioritizes include:

- Promote renewable and clean energy and energy efficient options
- -Increase greenery through tree plantation and management of gardens and parks.
- Plant trees in at least 10% of the current open/barren land
- Promote rainwater harvesting and ponds construction
- Enhance waste management through environment friendly technology

# **Nepal NDCs**

- Qualitative &
- Quantitative

# NDCs (Quantitative)

- 1. By 2050, to achieve 80% electrification through renewable energy sources having appropriate energy mix.
- 2. To also reduce its dependency on fossil fuels by 50%
- 3. By 2020, to increase the share of renewables by 20% and diversifying its use to more industrial and commercial sectors.
- 4. By 2020, to increase the share of electric vehicle up to 20% from 2010 level.
- 5. By 2050, to decrease its dependency on fossil fuels in the transport sector by 50% through effective mass public transport means and promote energy efficient and electrical vehicles.
- 6. To develop electrical (hydro-powered) rail network by 2040.

# NDCs (Quantitative)

- 7. To maintain 40% of the total area of the country under forest cover and forest productivity and products will be increased through sustainable management of forests. Emphasis will equally be given to enhance carbon sequestration and forest carbon storage.
- 8. To pilot a sub-national project on REDD+ to reduce about 14 million tons of CO2-eq by 2020.
- 9. By 2025, to decrease the rate of air pollution through proper monitoring of sources of air pollutants like wastes, old and unmaintained vehicles, and industries.

#### NDC 10. Targets for Cleaner Energy Technologies

- Mini and Micro Hydro Power:
- Solar PV
  - Household:
  - Institutional:

600,000 SHSs 1,500 systems

25 MW

- (solar PV and solar pumping systems)
- Improved water mill: 4,000 units
- Improved Cooking Stoves: 475,000 stoves
- Biogas:
- Household:130,000 unitsInstitutional :1,000 unitsCommunity:200 units

MOPE (2016): NDC

# Dominance of Transport and Industry sectors in GHG Emission from Energy Combustion



- Industry sector will overtake the transport sector in the future under BAU.
- Yet the industry sector is largely ignored in the present NDCs.

### Dominance of Agriculture in GHG emission from the AFOLU sector during 2010-2050 in BAU



- During 2010-2050, GHG Emissions in the Agriculture sector estimated to be more than doubled.
- However, present NDCs do not consider the Agriculture sector.

### Some Observations on Present NDCs

- Their costs and benefits of NDCs yet to be assessed
- Infrastructure needs, implementation challenges and implications of NDCs yet to be analyzed
- Some NDC targets may be redundant or infeasible; e.g. having both fossil fuel reduction target and transport electrification targets may not be needed.
- Most major NDCs are conditional to the availability of external support in terms of financing, technology transfer and capacity building.
- Emission reduction potential of NDCs not assessed.
- Not much focus on the industry sector and role of energy efficiency in production
- Some key areas with significant GHG mitigation potential in the residential/commercial sectors are ignored; e.g., electric cooking and heating.
- Counter measures in livestock management such as feed improvement not included in the NDCs, (model based analysis indicates it to be a cost-effective abatement option).

# Implications of Selected NDC Scenarios

#### NDC Electrification and Fossil Fuel Reduction Scenarios

#### The government NDC electrification related targets are mostly qualitative in nature.

|                            | NDC Scenarios by 2050   |  |   |   |  |
|----------------------------|---|--|---|---|--|
| Sector                     | Electrification   |  |   | Fossil fuel   |  |
|                            | EL1   | EL2  | EL3<br>(High electrification)   | FFR   |  |
| Transport                  | <ul> <li>15% EVs in 2020 and<br/>30% by 2050</li> <li>Introduction of<br/>passenger train in<br/>2040 with a share of<br/>20% in 2040 and 30%<br/>in 2050</li> <li>Fossil fuel reduction:<br/>10% in 2020; 50% in<br/>2050</li> </ul> | <ul> <li>20% EVs in2020 and<br/>40% by 2050</li> <li>Introduction of<br/>passenger train in<br/>2040 with a share of<br/>30% in 2040 and 40%<br/>in 2050</li> <li>Fossil fuel reduction:<br/>10% in 2020; 50% in<br/>2050</li> </ul> | <ul> <li>20% EVs in 2020 and 50% by 2050</li> <li>Introduction of passenger train in 2040 with a share of 40% in 2040 and 50% in 2050</li> <li>Fossil fuel reduction: 10% in 2020; 50% in 2050</li> </ul> | 50% reduction<br>in fossil fuel<br>consumption in<br>2050<br>(3.5% in 2020, |  |
| Residential/Co<br>mmercial | 20% electrification in in cooking and heating 2020; 50% in 2050   | 20% electrification in in cooking and heating 2020; 60% in 2050  | 20% electrification in in cooking and heating 2020; 70% in 2050   | 20% in 2030,<br>33% in 2040)  |  |
| Agriculture                | 20% electrification in 2020; 30% in 2050  | 20% electrification in 2020; 40% in 2050   | 20% electrification in 2020; 50% in 2050  | 10  |  |
| Industrial                 | None  |  |   | 13  |  |

### Total Primary Energy Supply in NDC Electrification and **Fossil Fuel Reduction Scenarios**



EL3





#### Hydropower

Renwables

Coal

- Other oil products (LPG)
- Oil products

Biomass

#### Cumulative TPES during 2010-2050:

- In FFR is 2% lower than in **BAU** and
- In EL3 is 8% below that in BAU

#### Hydropower Implications: Additional Electricity Supply Requirement



51% higher than cumulative electricity supply requirement in EL3 during 2010-2050 ir
BAU;
30% higher in FFR.

### Hydropower Implications: Additional Hydropower Capacity Requirement

| Total Hydropower Capacity (MW) |       |       |        |        |  |  |
|--------------------------------|-------|-------|--------|--------|--|--|
| Scenarios                      | 2020  | 2030  | 2040   | 2050   |  |  |
| BAU                            | 2,333 | 4,232 | 7,887  | 17,028 |  |  |
| EL1                            | 2,484 | 5,327 | 10,941 | 22,229 |  |  |
| EL2                            | 2,483 | 5,510 | 11,687 | 23,249 |  |  |
| EL3                            | 2,483 | 5,680 | 12,316 | 24,216 |  |  |
| FFR                            | 2,340 | 4,662 | 9,830  | 23,198 |  |  |

During **2010-2050**, the total hydropower capacity would increase by:

- 19 times in BAU,
- 7000 MW additional capacity needed in EL3 and
- 6,200 MW additional capacity needed in FFR.

## **Cost Implications**



Total cost: 2% higher in FFR and 6% higher in EL3 cases (compared to BAU).

Investment requirement: 2% higher in FFR and 9% higher in EL3 cases

# Some Challenges to NDC Implementation

- Mountain terrain makes development of infrastructure such as energy efficient roads and railways challenging; they will require technology transfer and financing support.
- Installation of adequate number of charging stations for EVs throughout the country – a prerequisite for large scale EVs
- Phasing out policies for non-electric vehicles
- Improving the forest quality and its carbon productivity a challenge. Technology transfer and capacity development needed.
- Making small farmers adopt options to reduce GHG emission from enteric fermentation a challenge.
- Availability and feasibility of adopting BECCS at smaller scale.
- Developing additional hydropower and other RE capacity to support NDCs.

# A carbon neutrality assessment with carbon price

# Annual GHG Emissions under BAU during 2010-2050, MtCO2eq



In 2050, GHG emissions from AFOLU and energy use are estimated to be about 9 and 5 times of the 2010 levels. Total GHG emission to be about 6 times the 2010 level.

# Energy Related Abatement Options considered include:

#### Transport Sector:

- Fuel cell vehicle
- Biofuel vehicle
- Electric vehicle
- MRT
- Trolley bus
- Electric ropeway
- Electric rail

Industrial Sector:

- CCS in cement manufacturing
- Efficient electric motor
- Vertical shaft brick kiln in brick industry •
- Energy efficient boilers
- (Not included: BECCS)

Residential and Commercial Sector:

- Briquette stove
- Electric cooker
- Electric space and water heaters
- Solar cooker
- LED display TV
- Energy efficient air conditioner/fail

#### Agriculture Sector:

- Solar water pump
- Energy efficient electric pump
- Energy efficient diesel pump

#### Abatement/Sequestration Options Considered in AFOLU Sector and Annual GHG mitigation from the sector with carbon tax



- EF: Replacement of roughage with concentrates
- EF: High genetic merit
- MM: Dome digester, cooking fuel and light
- RC: Midseason drainage
- MS: High efficiency fertilizer application
- MS: Tillage and residue management
- Community forest management
- Improvement of harvesting techniques
- Short-rotation forestry
- Share of "EF: Replacement of roughage with concentrates" decreases from 42% in 2020 to 34% in 2050 in \$10/tCO<sub>2</sub>e and 31% in 2020 to 25% in 2050 in \$75/tCO<sub>2</sub>e
- Share of "Short-rotation forestry" increases from 24% in 2020 to 30% in 2050 in \$10/tCO<sub>2</sub>e and from 22% in 2020 to 27% in 2050 in \$75/tCO<sub>2</sub>e

# Using Sectors in 2030 and 2050 under BAU and Carbon Tax of \$500/tCO2e



- Significant decrease in emission at \$500/tCO2e. Larger role of AFOLU.
- However, even at carbon price of \$500/tCO<sub>2</sub>e, total GHG emission is estimated to be positive: i.e., 0.3 MtCO<sub>2</sub>e in 2030 and 14 MtCO<sub>2</sub>e 2050.
- Carbon Neutrality?

# More options could help for carbon neutrality

- Modeling limitations? Inadequacy of counter measures?
- Additional counter measures needed to attain carbon neutrality; for example:
  - -Improvement in forest management and increasing the the forest/tree coverage area
  - BECCS in industry sector (Availability in small size, and cost?)
  - -Carbon benefit sharing of hydropower exports.

Thank you.