NEA Weekly Talk Program

Analysis on Hydropower Dilemma in Nepal

Presented By:

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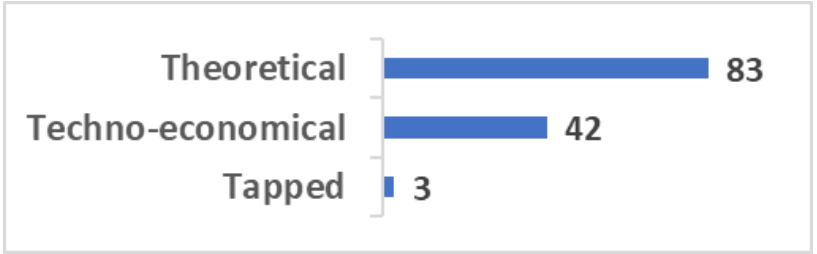
Contents

I. Introduction

Background

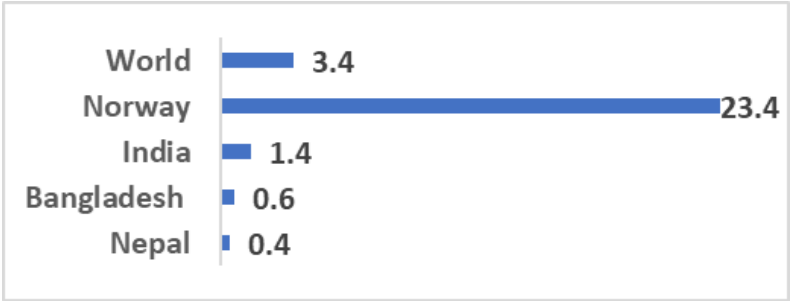
- Electricity scenario of Nepal is dismal despite abundant hydropower potential
- Ambitious Targets
  - SDG – 15 GW Hydropower and per capita consumption 1500 kwh by 2030
  - COP 26 – Net zero emission by 2045
  - NDCs - Reduce energy sector emissions by end-use electrification across all economic sectors
  - Energy Development Roadmap 2024 – 28.5 GW hydropower by 2035 (15 GW – export)
- Targets – more supply focused
- Hydropower targets not coupled with end-use electrification strategies
- Hydropower for domestic consumption or exports – often debated in Nepal.

Hydropower potential in Nepal in GW



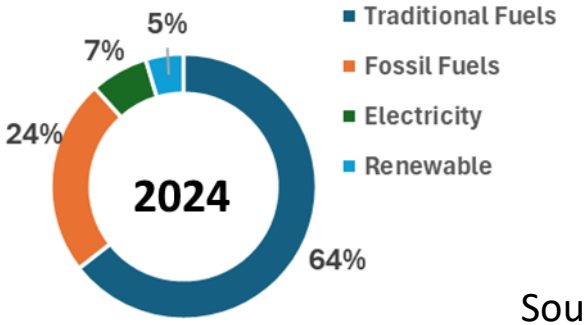
Source: (WECS, 2017)

Per capita electricity consumption of 2024 in MWh



Source: IEA

Nepal's Energy Mix



Source: (MoF, 2025)

Objectives of the study

Overall Objective:

- To analyze the implications of integrating end-use electrification (EEU) and cross-border electricity trade (CBET) policies on energy system and economy of Nepal.

Specific Objectives:

1. To project Nepal's long-term energy demand under various scenarios of end-use electrification across all the economic sectors.
2. To carry out least cost generation expansion planning for Nepal under various demand scenarios and estimate the capacity, investment needs and tradable surplus energy.
3. To examine the macroeconomic impacts of hydropower investments in terms of GDP, employment, trade balance and welfare.

II. Methodology

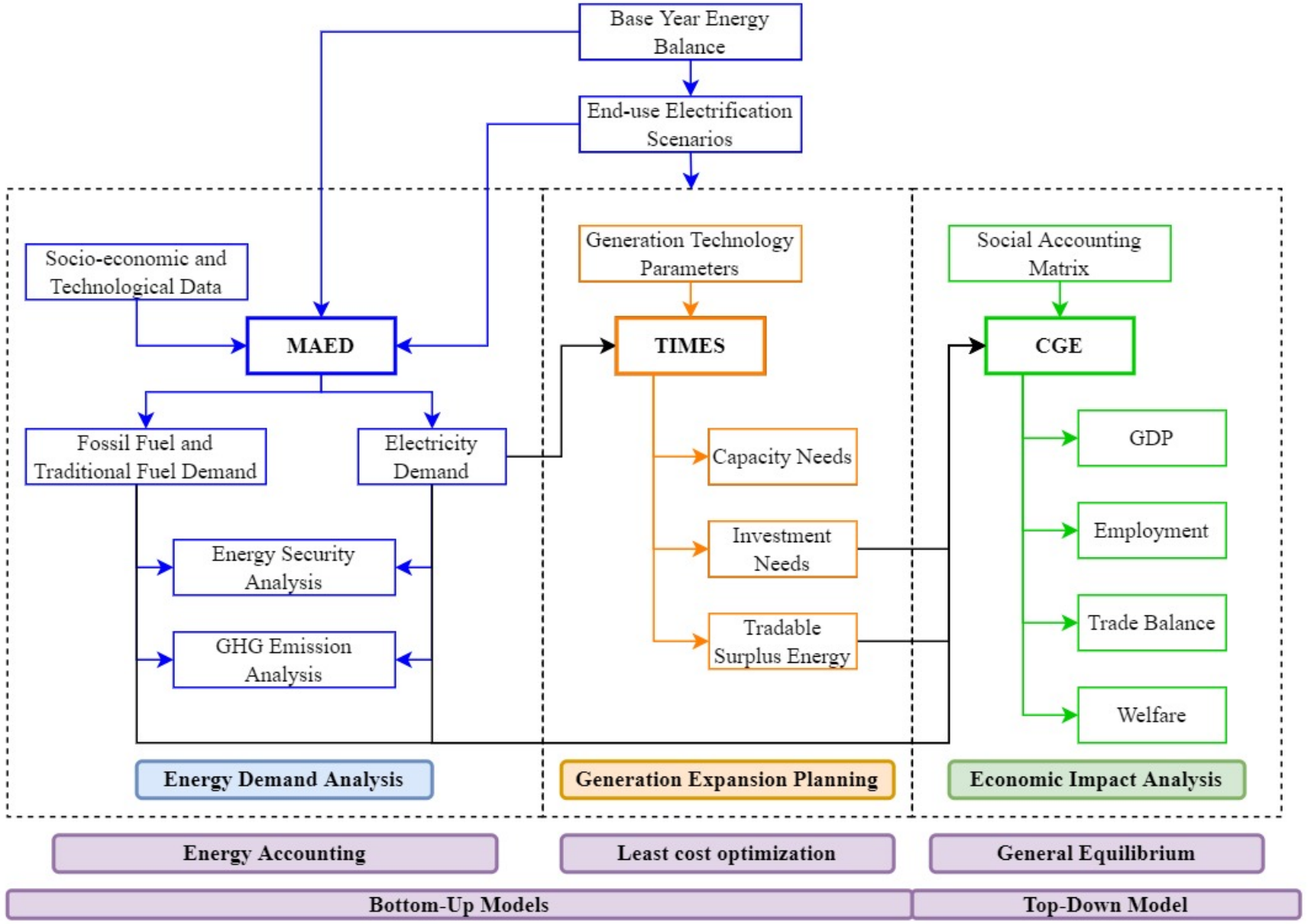
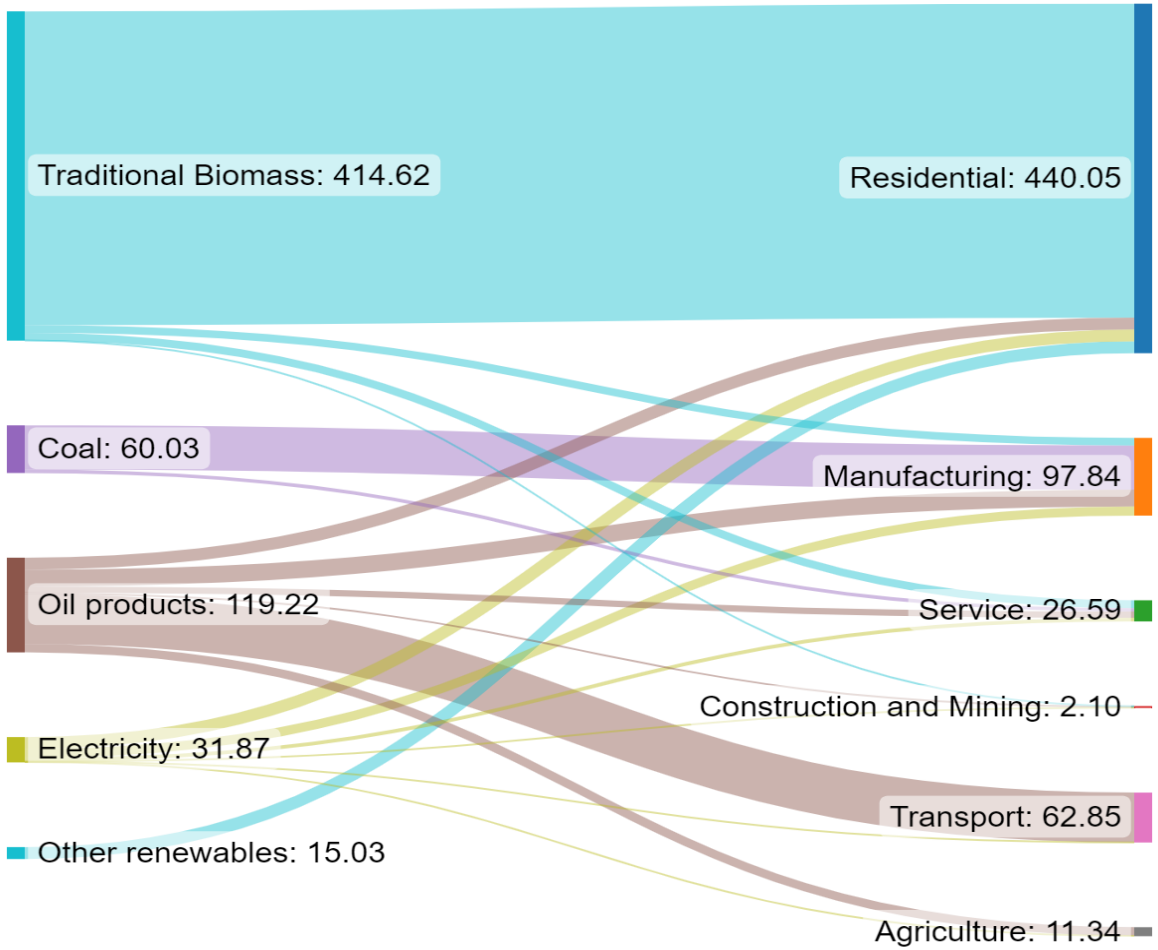


Figure:
Overall methodological framework of the study

III. Energy Balance and Scenario Assumptions

Base Year Energy Balance (2020,PJ)



Source: Author's Calculation

Scenario Assumptions

Table: Scenario Assumptions based on Sectoral End-use Electrification Levels by 2050

Scenarios	Transport		Household cooking and heating	Industrial and Service[b]
	Passenger	Freight		
2020	< 1%	0%	4%	4%
ETL	20%	10%	20%	20%
ETM	50%	30%	50%	50%
ETH	80%	60%	80%	80%

[a]Electrification level is modeled as modal split shares of electric land transport modes.
[b]Thermal needs of agriculture, construction, mining, manufacturing, and service sectors

Electrification Speed →

2025	2030	2035	2040	2045	2050
5%	15%	30%	50%	75%	100%

IV. Results – Energy Demand Analysis

Electricity Demand Forecast

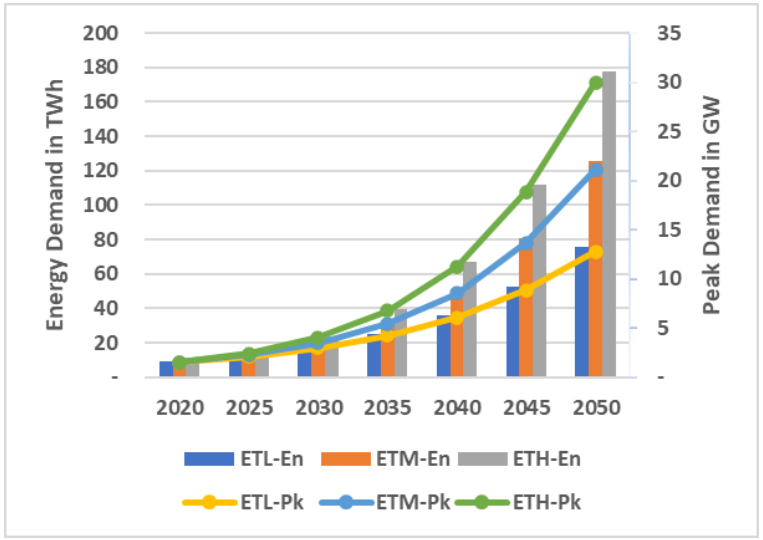


Figure: Electricity Demand Forecast

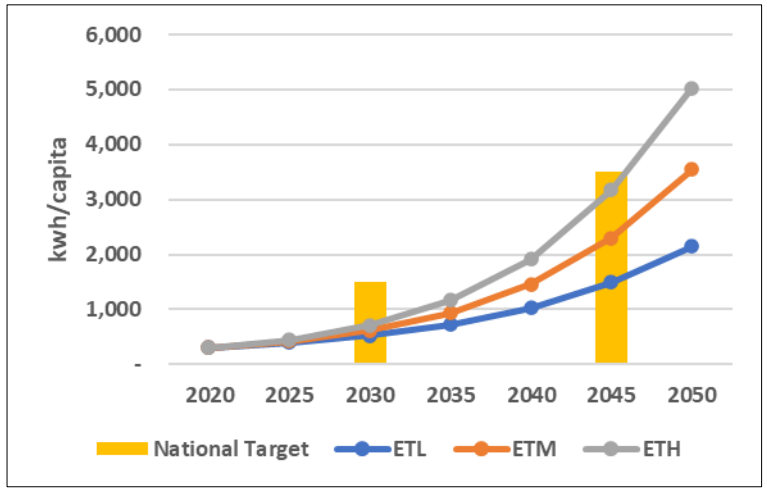


Figure: Per Capita Electricity Consumption

Energy Security and Emissions

Figure: Energy Security

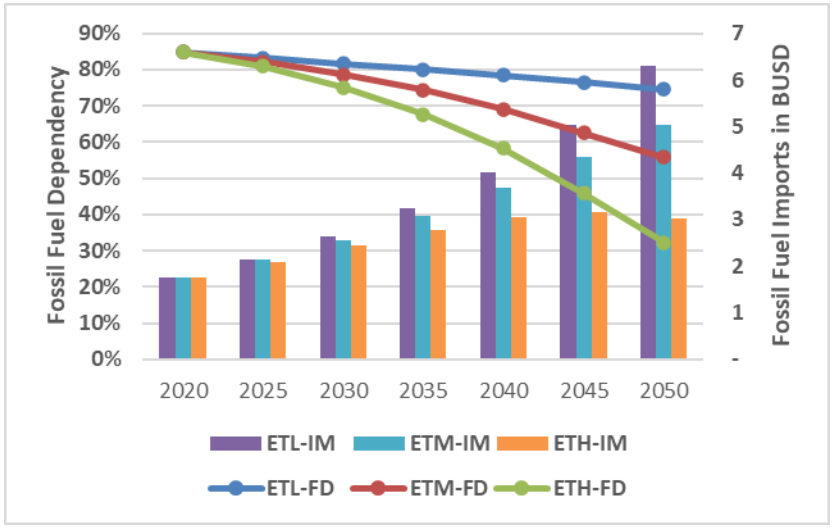
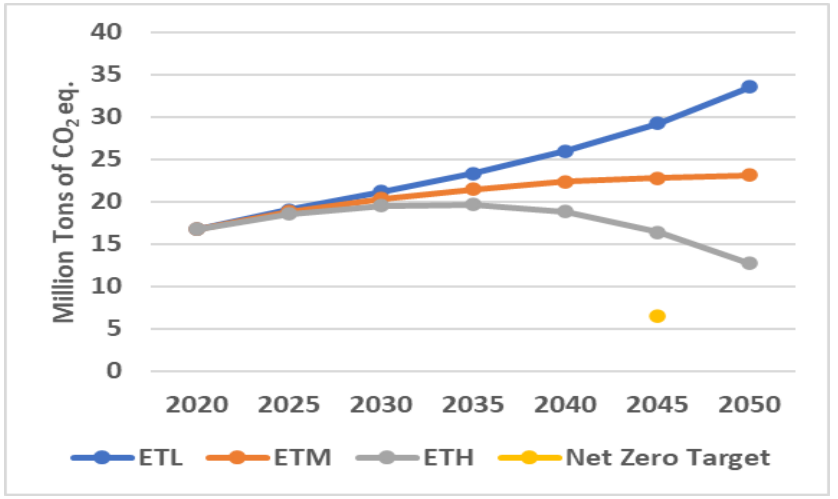
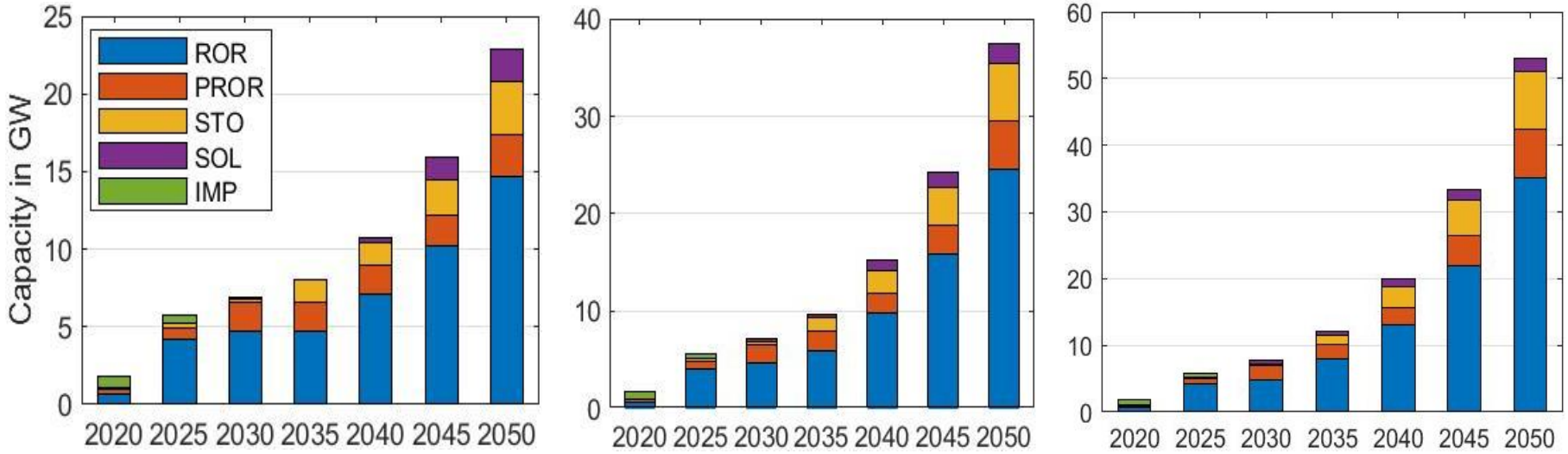


Figure: Energy Sector Emissions



IV. Results – Generation Expansion Planning

Capacity and investment Needs



→ **Figure:** Generation Capacity Needs

Table: Technological Share in Generation Mix of Nepal in 2050

Technologies	National Target	Least Cost Optimization Results		
		ETL	ETM	ETH
Hydro-ROR	30-35%	64%	66%	66%
Hydro-PROR	25-30%	11%	13%	14%
Hydro-Storage	30-35%	15%	16%	16%
Solar	5-10%	9%	5%	4%

Table: Investment Needs (*in 2012 BUSD)*

Period	ETL	ETM	ETH
2020-25	8.27	8.27	8.27
2025-30	3.49	3.80	4.78
2030-35	3.84	6.45	9.96
2035-40	4.88	10.83	16.67
2040-45	9.61	19.10	28.46
2045-50	14.42	28.05	42.09
Total	44.51	76.50	110.22

IV. Results – Generation Expansion Planning

Cross-border Trading of Surplus Energy

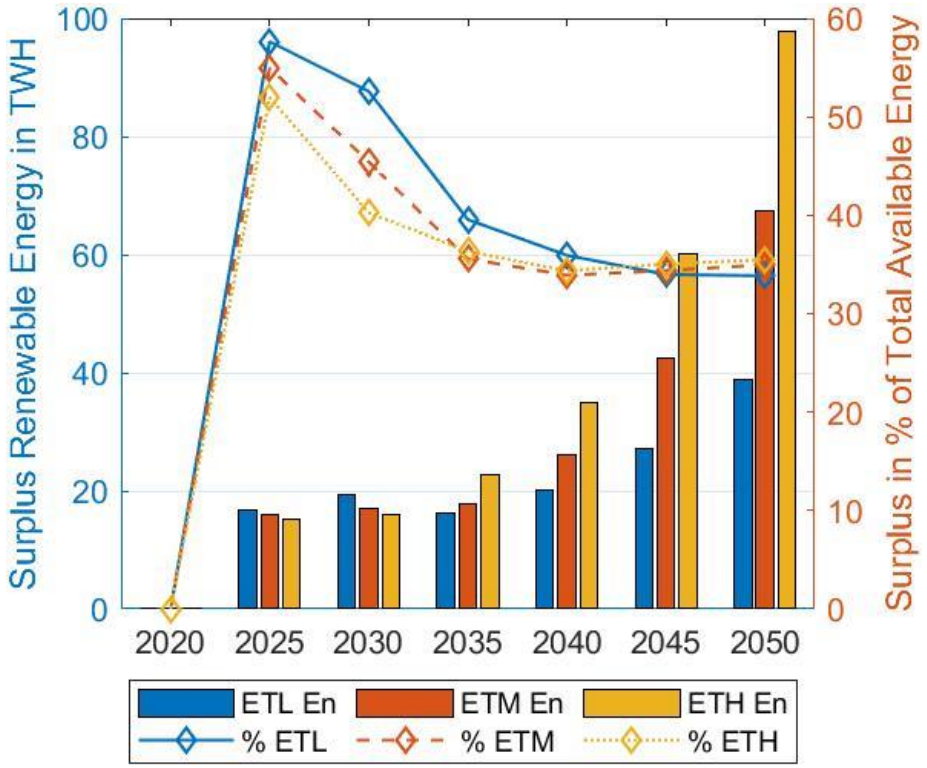


Figure: Surplus generation

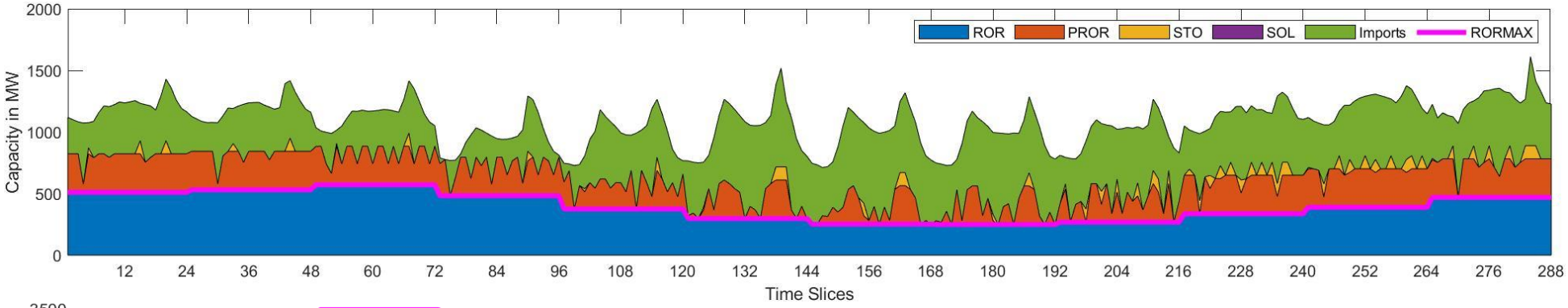
Table: Annual Surplus Trade Revenue

Years	Surplus Trade Revenue (BUSD)		
	ETL	ETM	ETH
2020	-	-	-
2025	1.20	1.15	1.08
2030	1.39	1.22	1.15
2035	1.17	1.27	1.63
2040	1.44	1.86	2.50
2045	1.93	3.04	4.31
2050	2.77	4.82	7.00

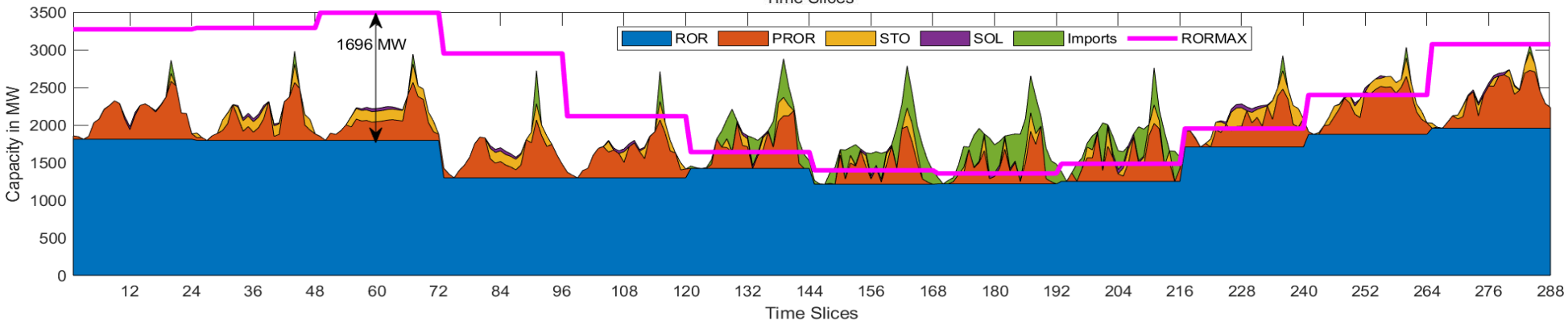
At the electricity price of 7.16 US Cents per kWh, average IEX price in June to August 2022

- Cumulative trade revenue in ETH scenario – 67 BUSD, 61% of total hydropower financing needs

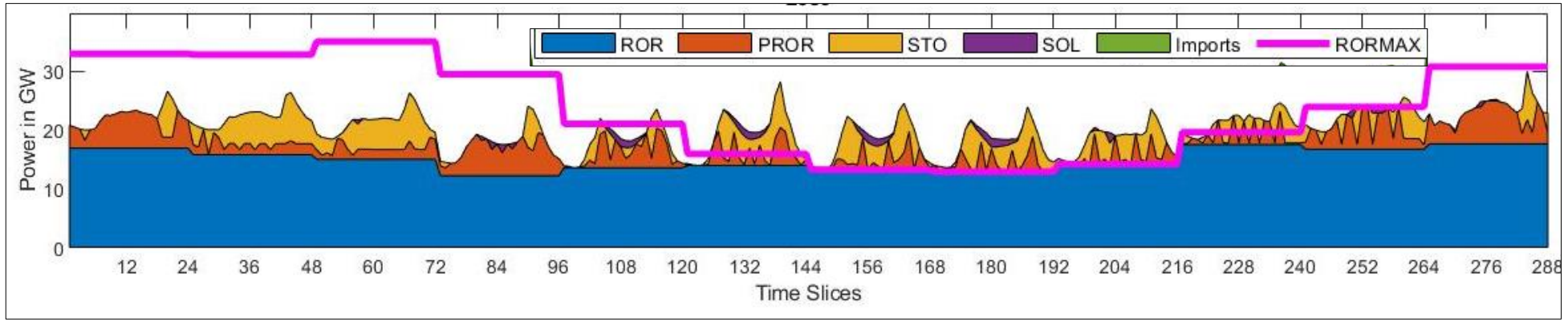
IV. Results – Generation Expansion Planning



2020



2025



2050

← **Figure:** Dispatch in ETH Scenario

IV. Results – Economic Impact Analysis

- The GDP will grow at 5.4% per annum in ETL or baseline scenario.
- 5.86% in ETH-CBET scenario
- Employment increases with increase in hydropower investments.
- Trade deficit decreases in absence of CBET but increase in its presence.
- Current account balance is fixed, increase in income due to CBET revenue gives more economic space to consume imported goods.
- Growth in welfare is minimal in higher hydropower investment scenarios in absence of CBET.
- Major portion of income is used for hydro investment reducing the disposable income available for consumption.
- CBET revenue will raise the income and hence the welfare.
- CBET enables Nepal to finance hydropower projects while maximizing welfare.

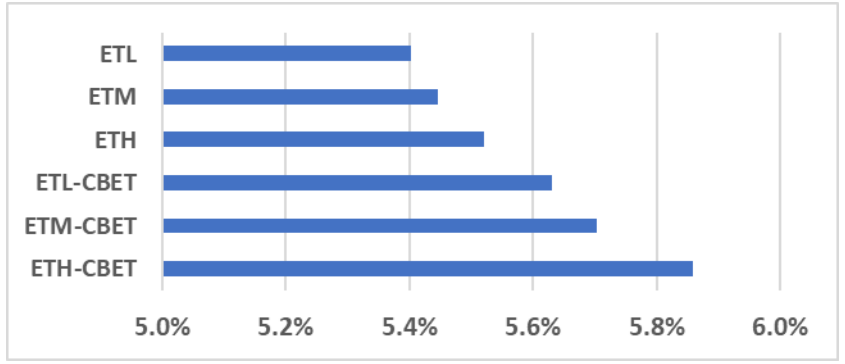


Figure: *GDP Growth Rate*

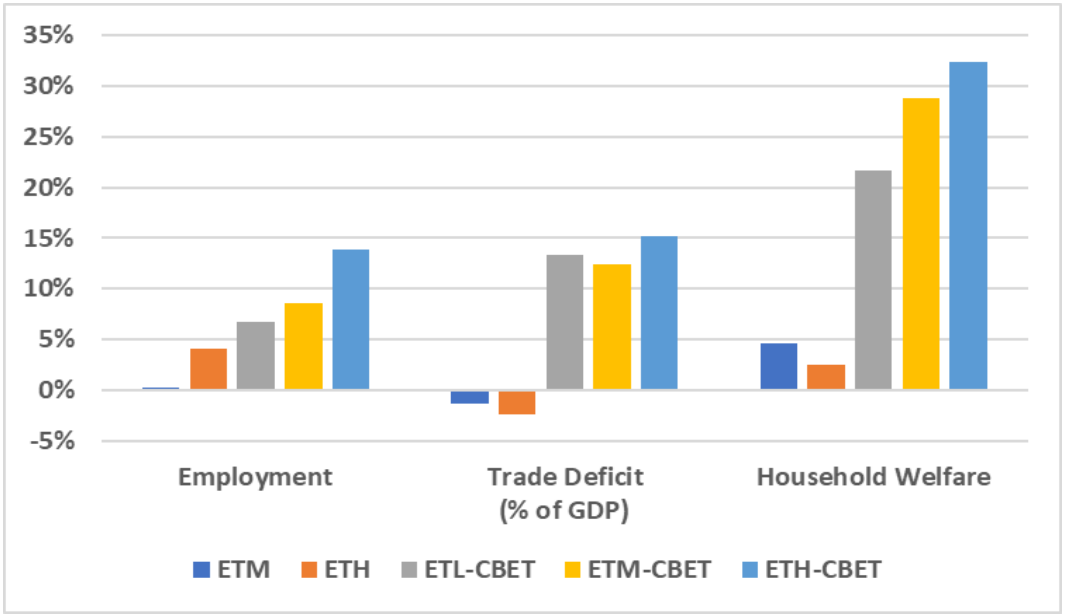


Fig: *Change in Employment, Trade Deficit and Welfare in 2050 compared to Baseline (ETL) Scenario*

V. Conclusion

Summary of the Findings

- Nepal's energy targets require accelerated and widespread end-use electrification beyond 80%.
- Net zero target seems too ambitious as it will require electrification across all sector go beyond 80% in next 20 years from current level of below 5%.
- 100% renewable power mix of Nepal results in significant surplus energy even in least cost generation scenario.
- Trading surplus energy can generate up to 61% financing needs
- Integration of end-use electrification with CBET policies can have positive impacts in macroeconomic indicators.
- Domestic consumption and CBET should be integrated in policy discourse.
- The government shall act timely to place the policies and infrastructures for the end-use electrification especially in transport and manufacturing sectors to avoid the lock-in of fossil fuel.
- Negotiate with the neighboring countries to push existing bilateral CBET into the multilateral trade and regional market integration to create market for its surplus electricity.