PNG National Power Sector Forum, 2025

Global Insights: Success story of electrification in Nepal

by

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- **Nepal's Generation capacity, Demand and electrification efforts**
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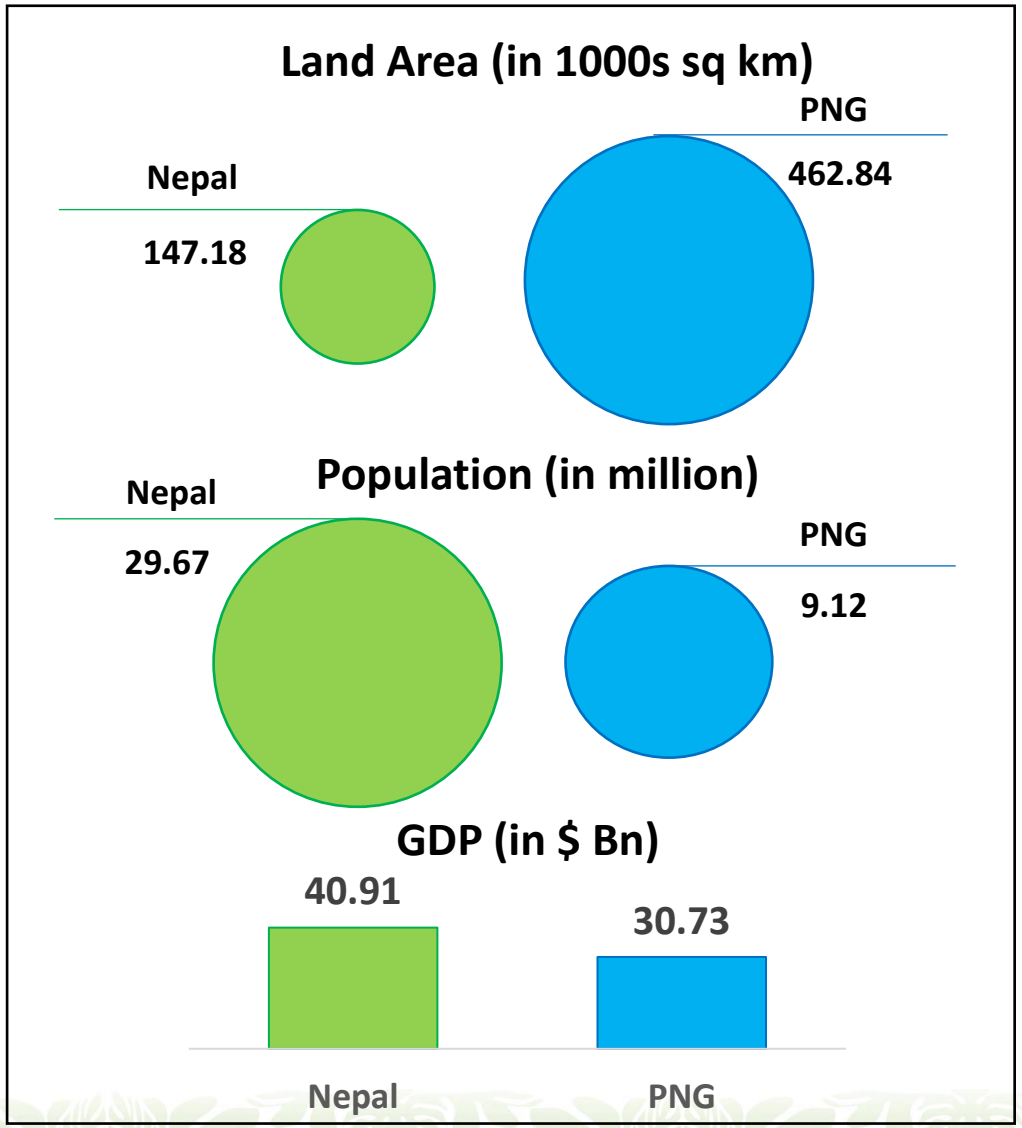
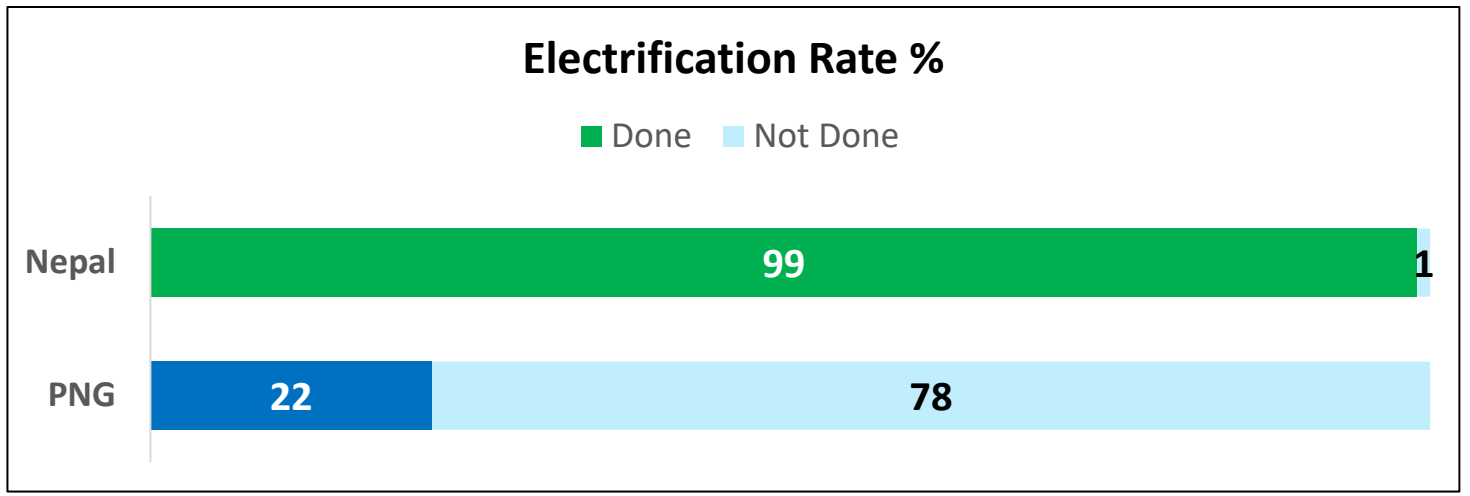
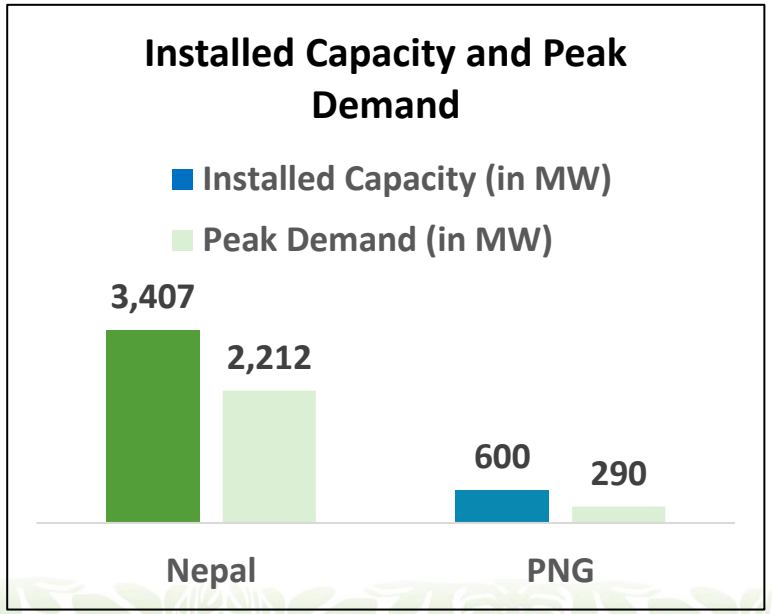
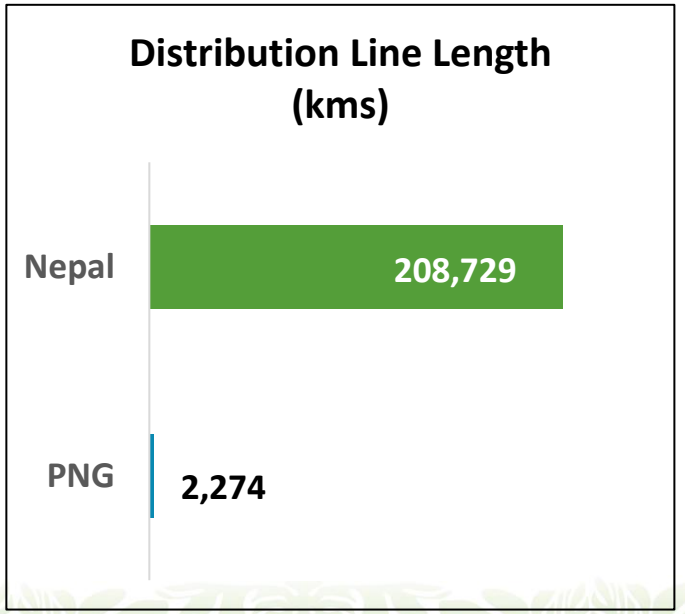
- Bilateral cooperation
- Major Projects with Multilateral/Bilateral Cooperation and Export scenarios
- Electricity consumption plan and demand escalation
- **Nepal's electrification success factors and Replicability to PNG**

Nepal in comparison to PNG: Smaller land area and greater electrification



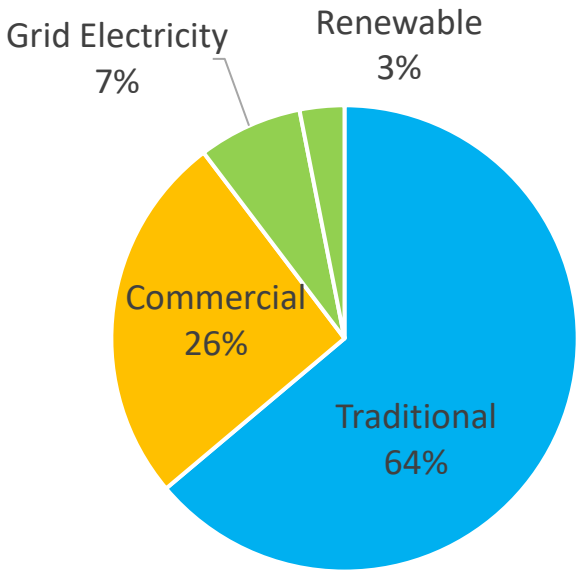




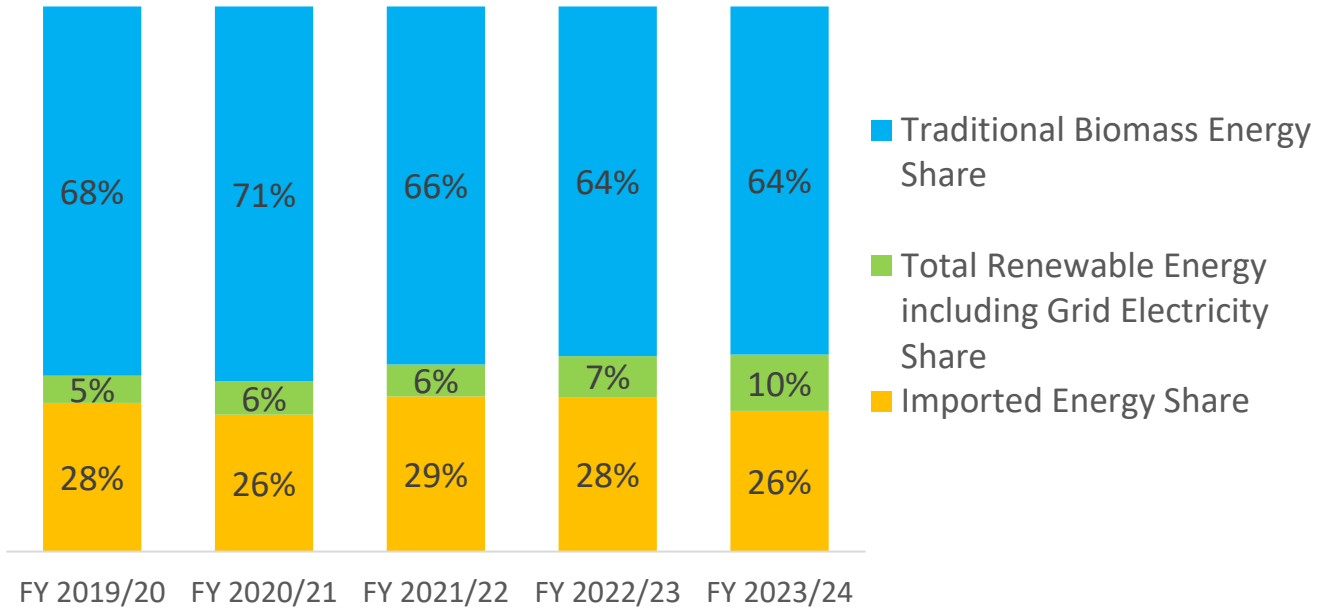


Nepal's economy is still driven by traditional (biomass) and imported fossil fuels

Nepal's Energy Consumption by Fuel & Sector type



Trends in Nepal's Energy Consumption by Fuel & Sector type



Low per capita electricity consumption

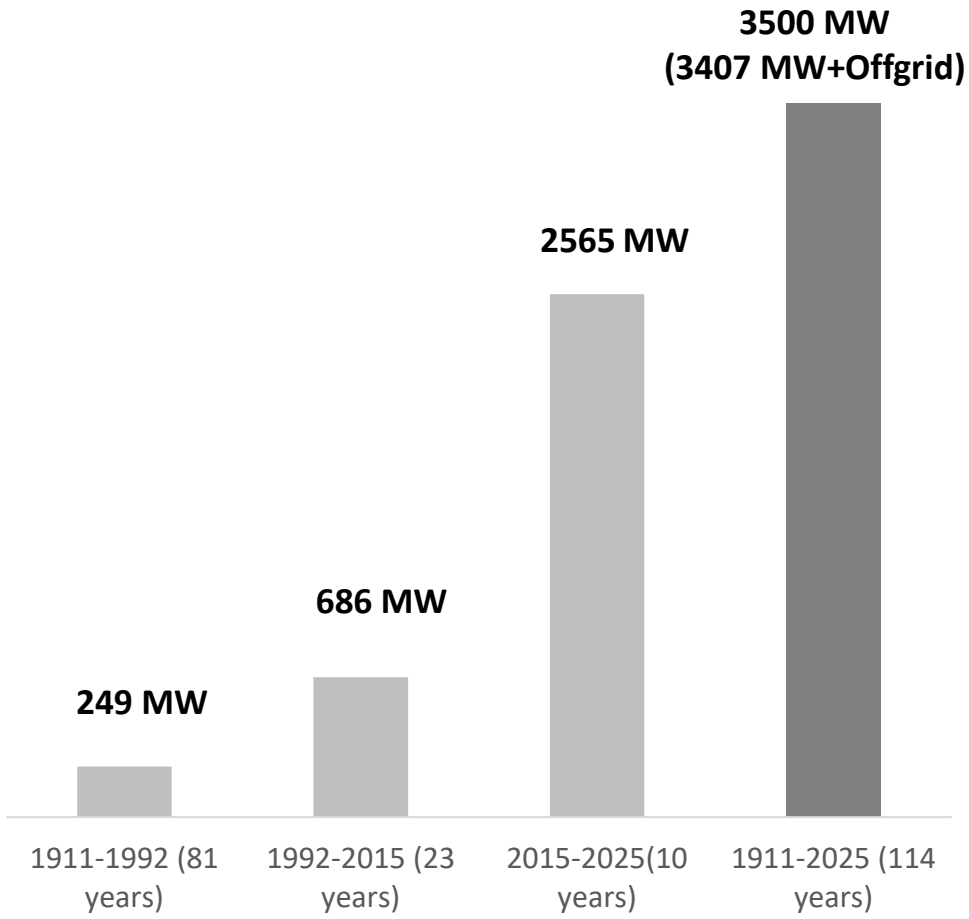
400 kWh

Source: MoF 2024, WECS 2024, NEA 2024

- **While still dominant, share of traditional sources has been reducing, and grid electricity has been increasing**
- **The country aims to reduce traditional energy to 59% and increase grid electricity to 38% by 2035**

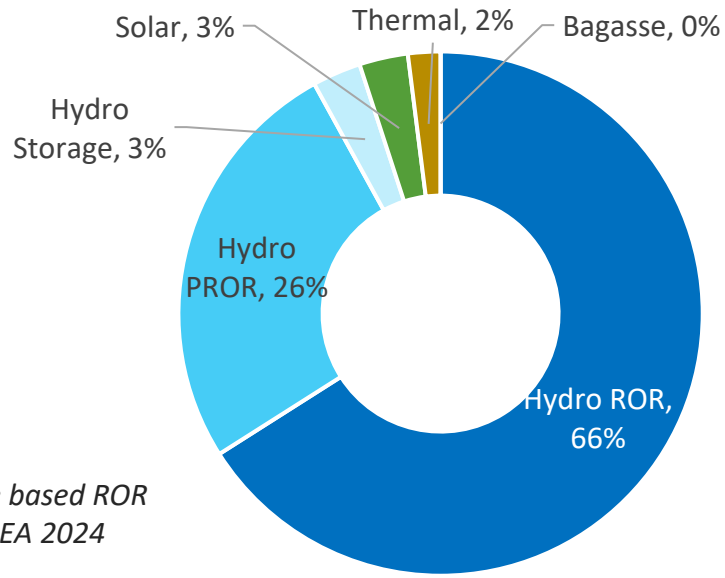
Nepal continues to add electricity generation capacity, driven by vast Hydro resources

Capacity addition: 4X in 10 years



1992: Electricity Act, 2015: New constitution (Federal Nepal)

95% of Grid connected capacity is Hydro

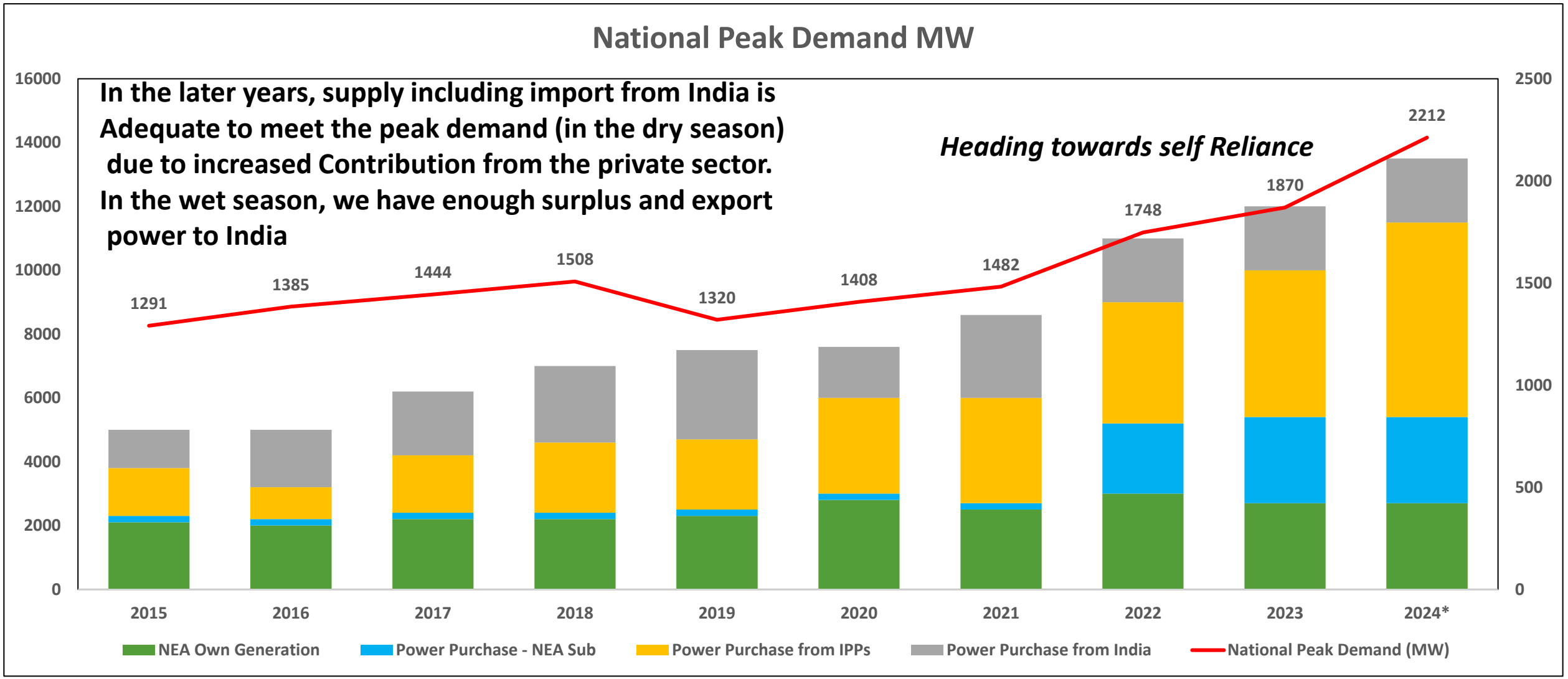


ROR: Run of River, PROR: Pondage based ROR
Source: MoF 2024, WECS 2024, NEA 2024

Significant electricity generation potential exists, most of which remains untapped

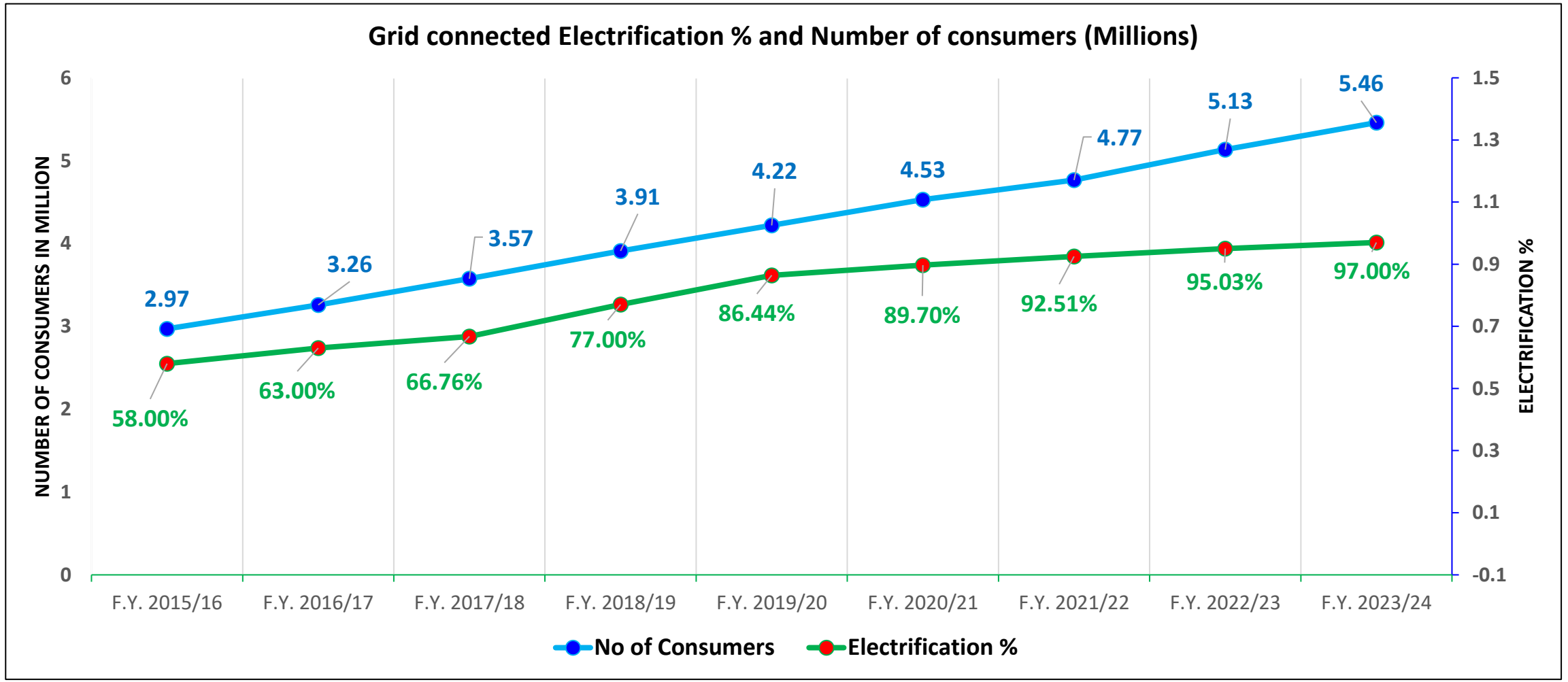
Hydro potential	Solar potential	Wind potential
72.5 GW	11.9 GW	3.0 GW
Source: WECS study, 2020	*Neupane D. et al 2022*	*AEPC, 2003*

Generation capacity is adequate to meet current domestic demand

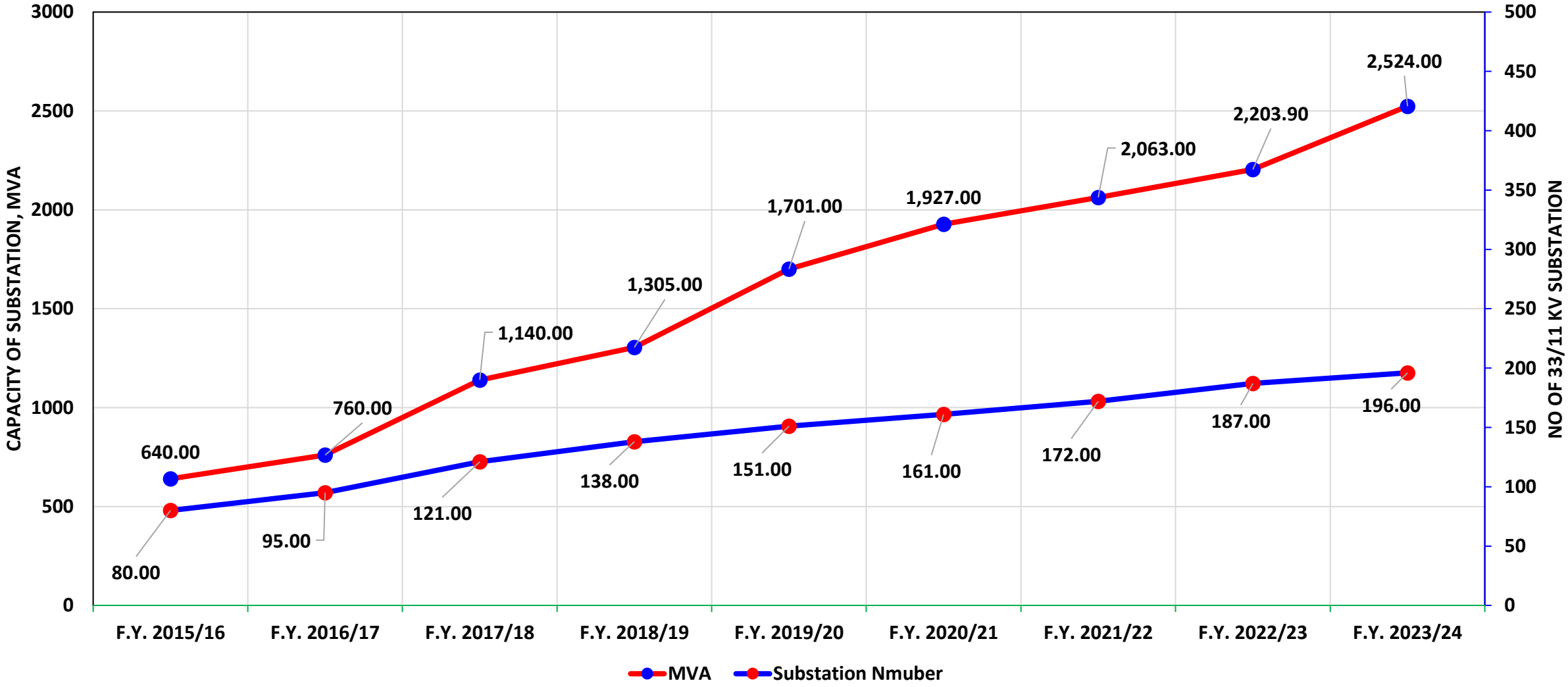


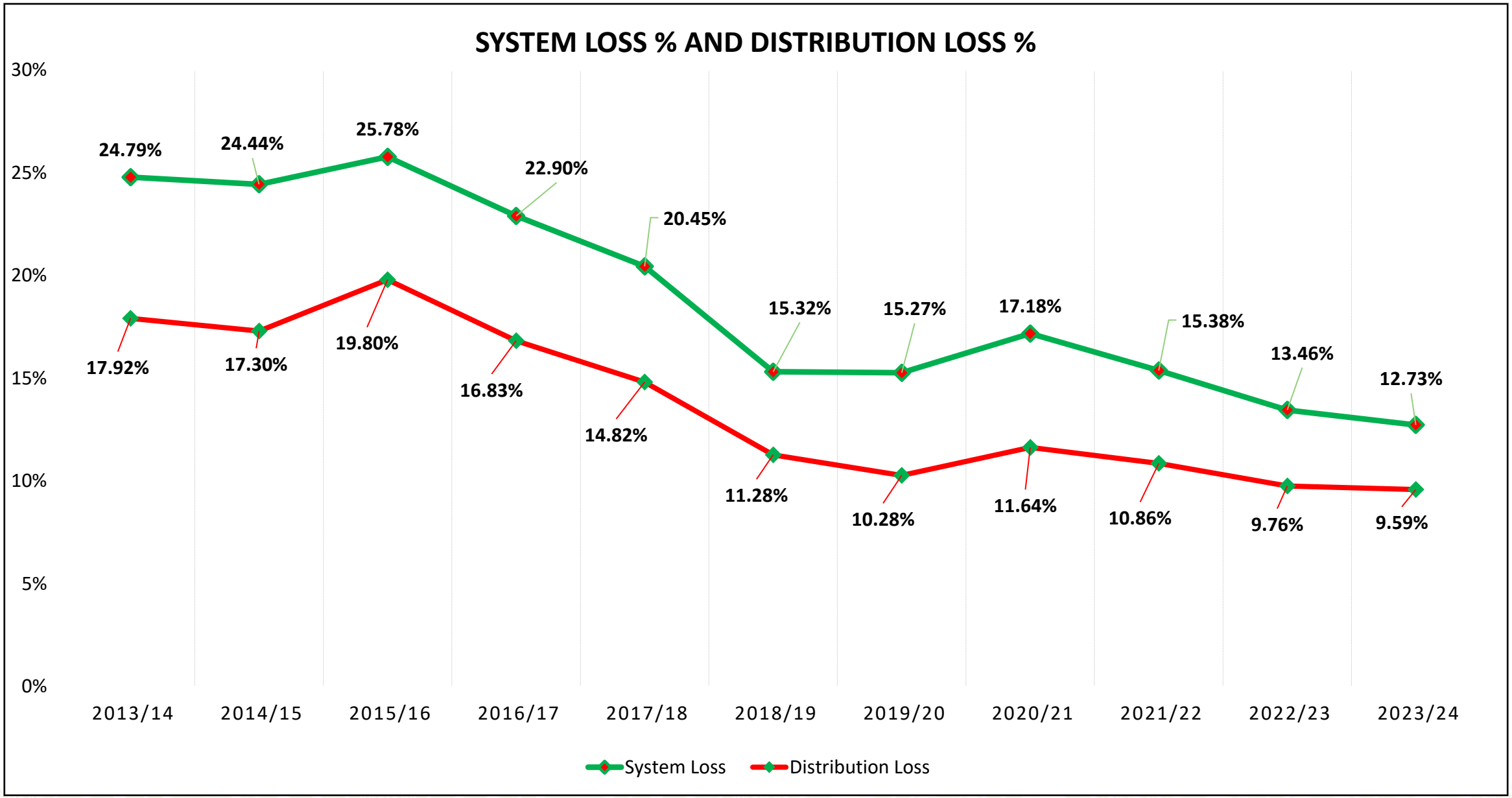
Nepal's Electrification Effort: 8% annual growth in new consumers (last 8 years) and 99%* electrification rate achieved)

(Includes 2% contribution from off-grid)

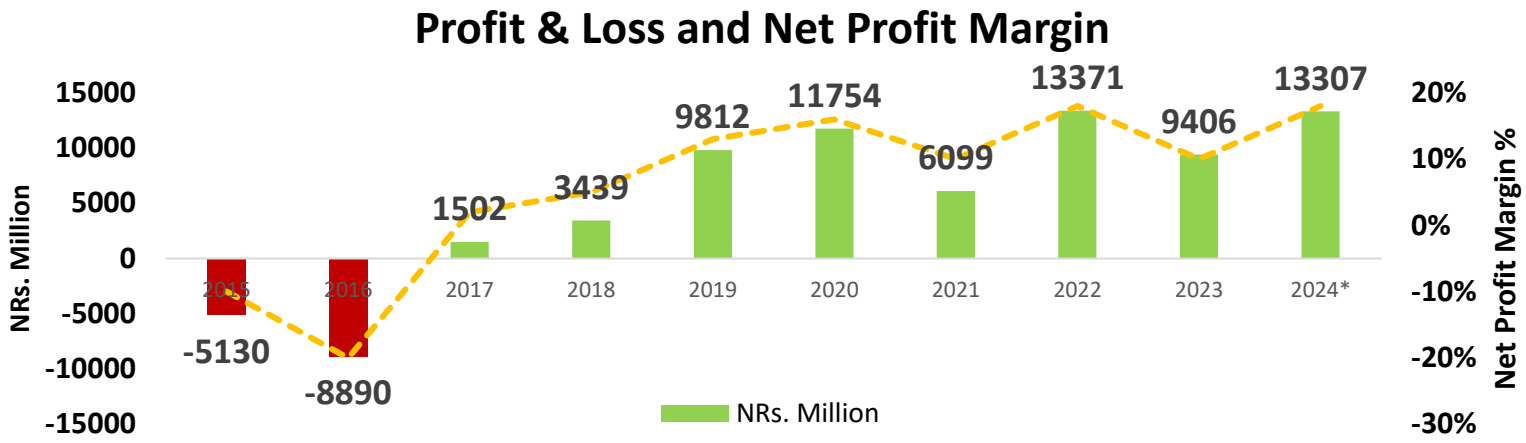


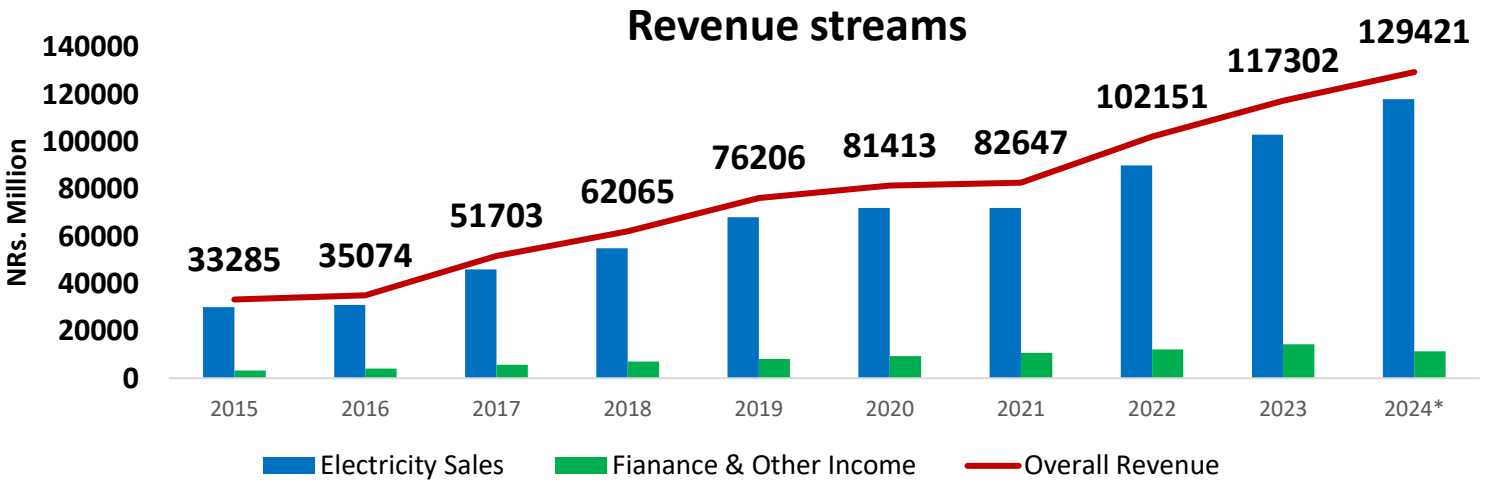
33/11 kV Substation Number and MVA Capacity





Nepal Electricity Authority (NEA)'s Turnaround





How Turnaround?

- **Tariff hike decided which was pending since 12 years.**
- **Energy crisis mitigation plan brought by government and T/L for import of power from India made possible.**
- NEA's leadership played an appreciable role in implementing the action plan and internal management.
- **Private sectors also came with accelerated generation and supply system improved.**
- Load shedding was gradually removed and revenue increased remarkably.
- **Loss reduction activities were carried out which aided in increased revenue further.**
- Transmission **connectivity with India** was enhanced and more power exchange happened. Reliability and stability enhanced.
- **T and D lines and substations were reinforced** and expanded all over the country.

Policy support for Electrification

- ✓ **Policy goals – *Encouraging electrification***
  - Access to energy for all
  - Each household to be electrified within two years … Cooking gas to be eventually replaced by electricity
  - Increase per capita electricity consumption to 1,500 kWh by 2030 (400 kWh as of 2023)
  - Free electricity for lifeline consumers (20 kWh per month)

- ✓ **Programmatic actions**
  - **Subsidy** on electrical appliances, **Demand escalation** programs for increasing household electricity demand
  - Expand transmission and distribution infrastructures to **promote internal consumption** of domestically produced electricity
  - Scale up generation capacity to **28,500 MW by 2035: 13500 MW for internal use and 15000 MW for export.**

- ✓ **Resources**
  - **Leverage private sector finance**, bilateral and regional cooperation to develop hydroelectric plants

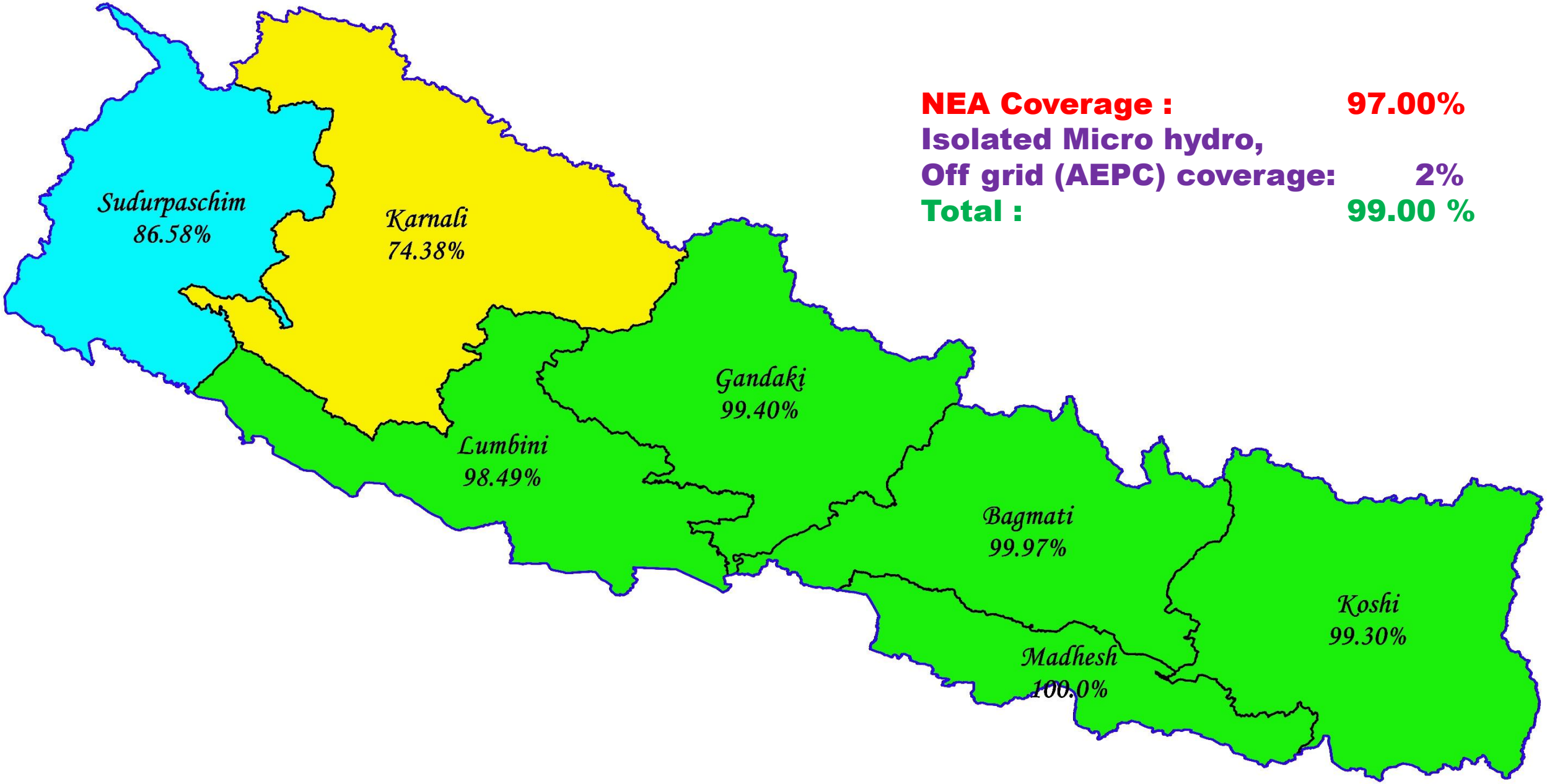
Resource support from Government and Donor agencies for electrification

- Rural electrification programs through 8 different projects have been executed with funding from GoN and NEA together with grant and loan assistance of KfW, ADB, EIB and AIIB.
- **Donor supported projects :**
  - ✓ WB: Grid solar and energy efficiency projects,
  - ✓ EIB: Nepal distribution system upgrade and expansion project
  - ✓ AIIB: Nepal distribution system upgrade and expansion project
  - ✓ KfW: Reconstruction and Improvement of Electricity Distribution System

- **ADB's support: A dedicated directorate called PMD under NEA is executing numerous projects being supported by ADB in various thematic areas:**
  - Distribution system and augmentation Project
  - Rural electrification and distribution system Reinforcement in Province No. 2
  - Distribution system strengthening of Kathmandu, Lalitpur, Bhaktapur, Pokhara and Bharatpur
  - Installation of smart meters in Kathmandu valley.
  - Distribution system Automation in the underground distribution system.
  - Fast charging stations for EVs.

- **Last Mile Electrification Plan:**
  - ✓ Task force led by the MoEWRI and with the representations from NEA, AEPC was constituted in 2022 December when the population access had reached around 93 %
  - ✓ Task force submitted its report on 2023 June which came out with the following:
    - Present status of electrification
    - Areas and households to be electrified by AEPC and NEA, Technologies for electrification and estimated budget were identified.
    - Integrated action plan to implement the electrification work. Both the entities (NEA and AEPC) have plans for completing their works by July 2026.

Electrification Status



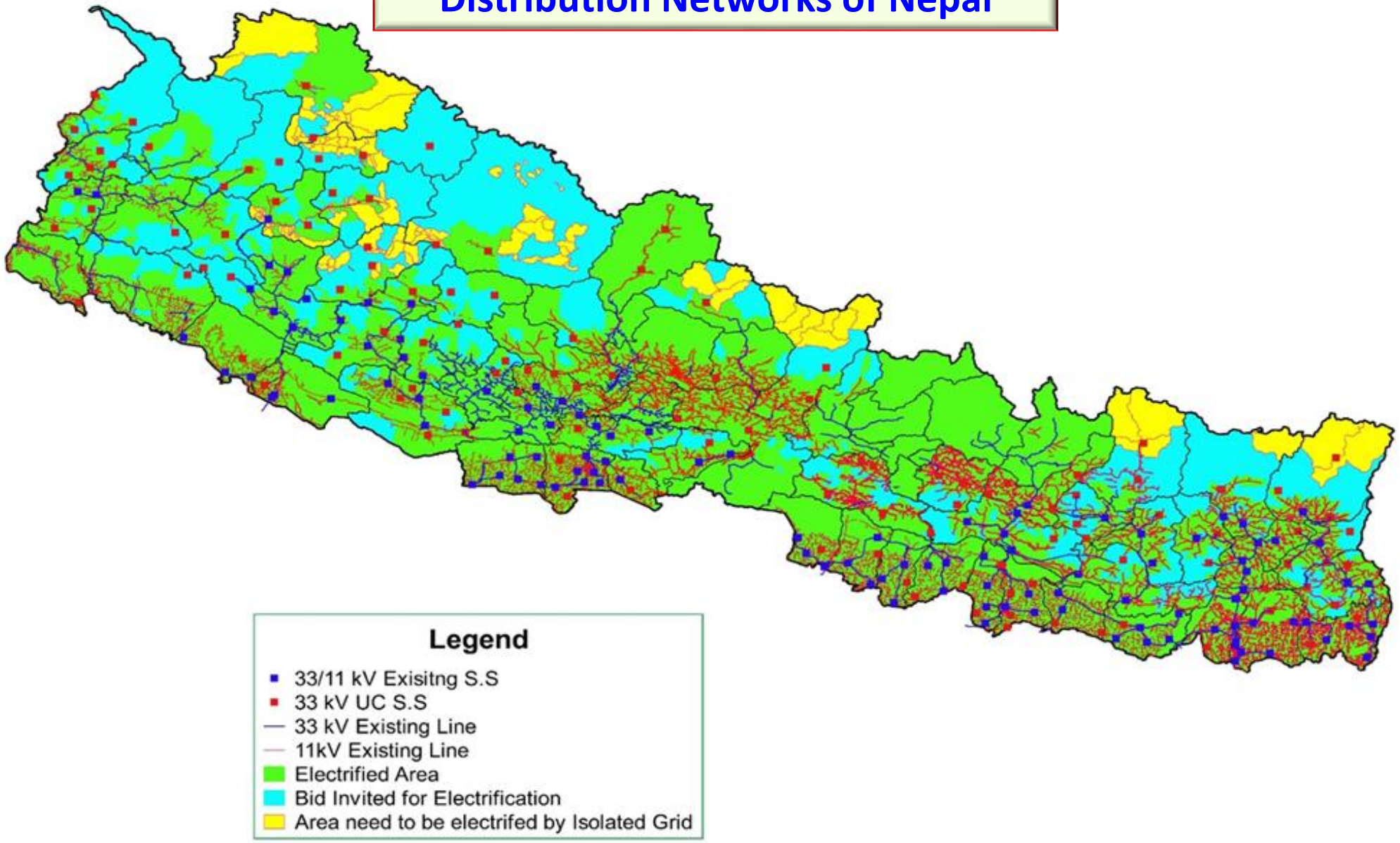
NEA Coverage : **97.00%**

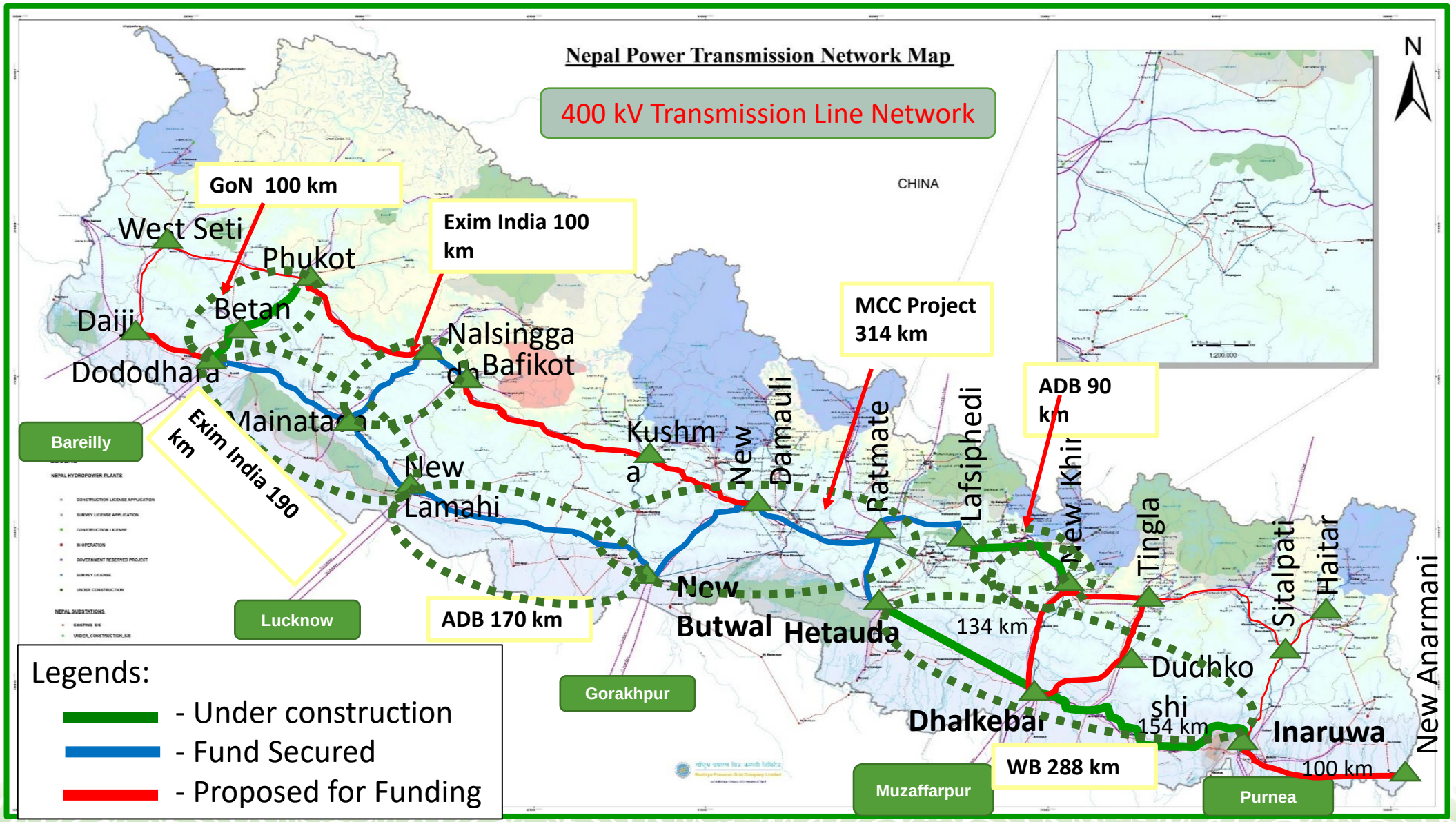
Isolated Micro hydro,

Off grid (AEPC) coverage: **2%**

Total : **99.00 %**

Distribution Networks of Nepal





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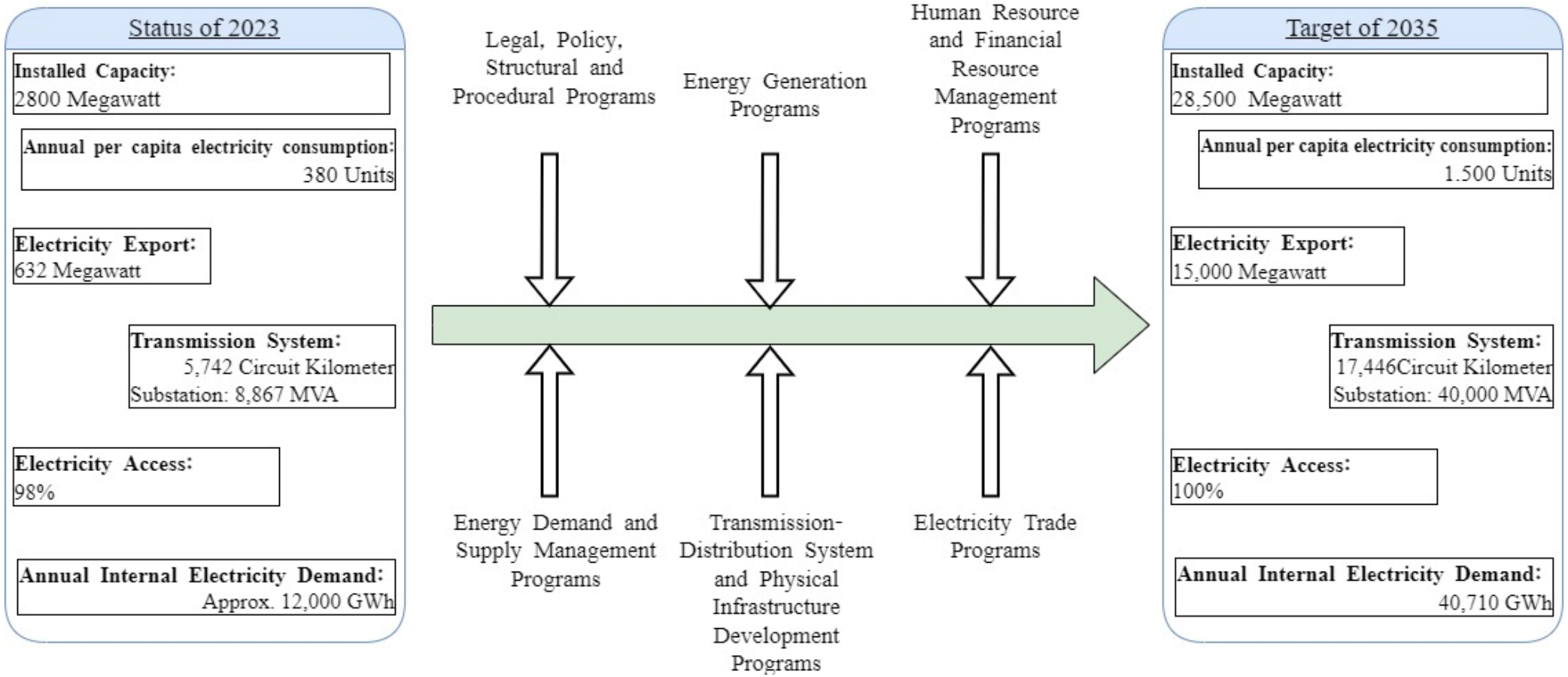
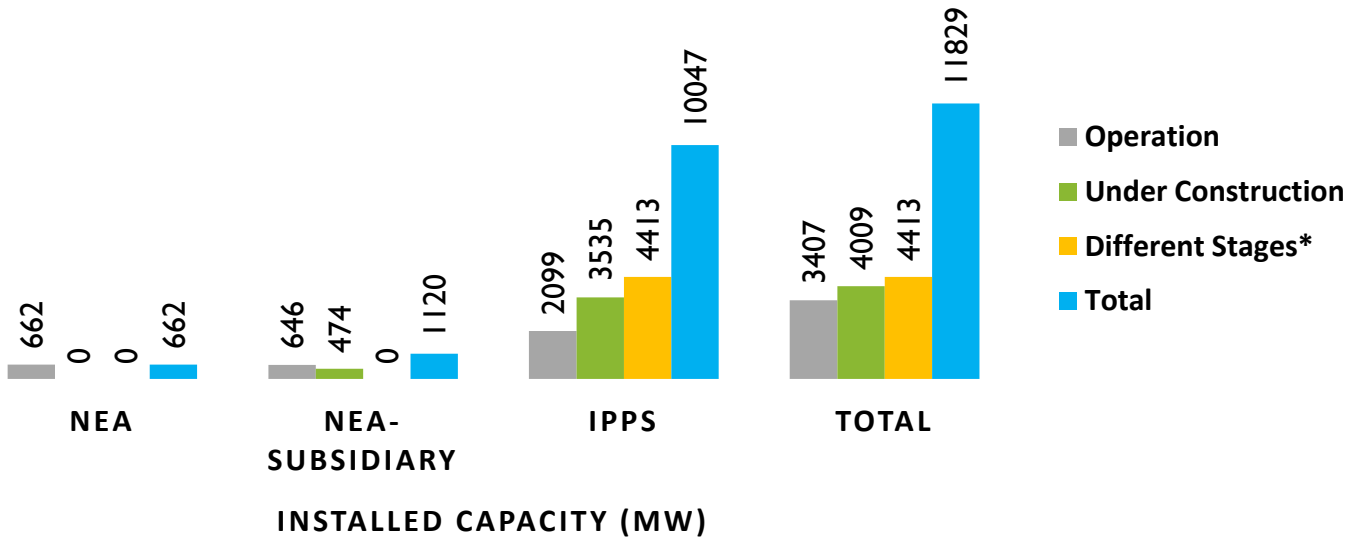
Managing power surplus: Domestic demand escalation power export for Clean Energy Transition

Energy Development Roadmap , 2023-2035



8,400 MW of further capacity addition is under development



- Total Installed Capacity of Nepal: **3,407 MW**
- Total PPAs Signed for IPPs' Power Projects : **11,168 MW**
- Peak Demand (**Sep 23, 2024):** National - **2337 MW,** System- **2892 MW**

% Contribution in Installed Capacity

NEA	:19% (662 MW)
NEAa Subsidiary	:19% (646 MW)
IPP	:62% (2099 MW)
Total	: 3407 MW

Some sizable Projects being developed by IPP:

Upper Tamor (Taplejung)	:255 MW
Upper Trishuli (Rasuwa)	:216 MW
Lapche Khola(Dolakha)	:160 MW
Kaligandaki gorge(Myagdi)	:180 MW
Budhigandaki kha(Gorkha)	:226 MW
Budigandaki (Gorkha)	:340 MW
Super Tamor (Taplejung)	:166 MW

Solar Projects totaling 960 MW under PPA processing via Competitive Bidding

Bilateral co-operation to support electricity exports

- Nepal signed historic **Power Trade Agreement back in 2014** envisioning joint government mechanism for developing various cross border interconnections and engaging on seamless cross border power trade.
- Accordingly, some 11 number of 400 KV cross border interconnections lines have been identified out of which one 400 KV line **(Dhalkebar-Muzzafpur)** is operational, one **(Butwal – Gorakhpur)** is under construction and another two viz. **Duhabi-Purnia and Lamki-Barelly** (with all study completed), are to be completed by 2028. A dedicated 400 KV line**(Dhalkebar-Sitamarhi)** is almost completed to evacuate Arun 3's power to India. These five lines have about 9000 MW capacity. Remaining lines will also be built gradually as generations in Nepal come in.
- An intergovernmental framework agreement for long term power trade from Nepal has been signed which speaks of exporting **10000 MW in 10 years** time frame from Nepal to India. This has opened up market assured investment in Nepal by the developers including India. As a result, **around 5000 MW projects including Arun-3, Arun-4, Lower Arun, West Set and SR6, Phukot Karnali etc. are at various stages of development by India.**
- Nepal is already **exporting surplus power in the wet season to the tune of 1000 MW**, though it imports almost the same amount of power to meet the deficit in the dry season. Nepal has been the net exporter in year 2024.
- Similarly, one cross border line (Kerung-Rasuwagadhi-Ratmate) with China is also under study and a MoU on Energy Cooperation has been signed with Bangladesh with similar government mechanisms for power trade and investment in the generation projects.

Mega Projects Under Different Stages of Development through Multilateral /Bilateral Cooperation

Dudhkoshi Storage Project (670 MW):

Study financed by ADB is completed. Cofinancing by ADB(lead), WB,EIB, AIIB, OFID, SDF for construction is under finalization.

Tanahu Storage Project (140 MW):

Cofinanced by ADB, JICA and EU is under advanced stage of construction.

Lower Tanahu (126):

ADB and JICA are planning to fund it. Study ongoing.

Upper Arun (1063):

Study financed by WB is completed. Cofinancing by WB (lead), ADB,EIB etc. for construction is under finalization.

Arun-4 (490-630 MW):

Ready for development jointly by Sutluz Jal Vidut Nigam Ltd. (SJVNL) and NEA.

Lower Arun(669 MW):

Under construction by Sutluz Jal Vidut Nigam Ltd. (SJVNL) (awarded through competitive bidding)

Upper Karnali(900 MW):

Construction to start jointly by GMR, SJVNL, IREDA of India and NEA of Nepal.

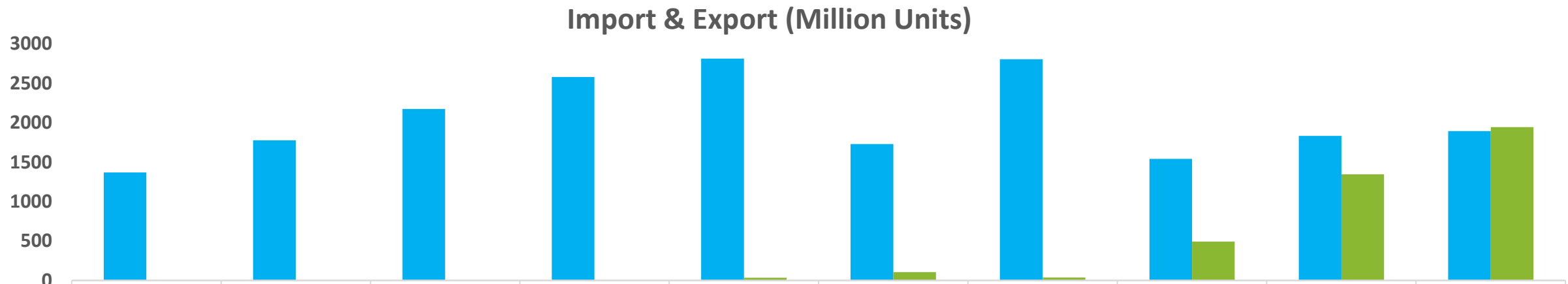
Phukot-Karnali(480 MW):

MoU signed by NHPC, India and VUCL, Nepal. DPR being reviewed.

West Seti/SR6(750+450=1200MW) :

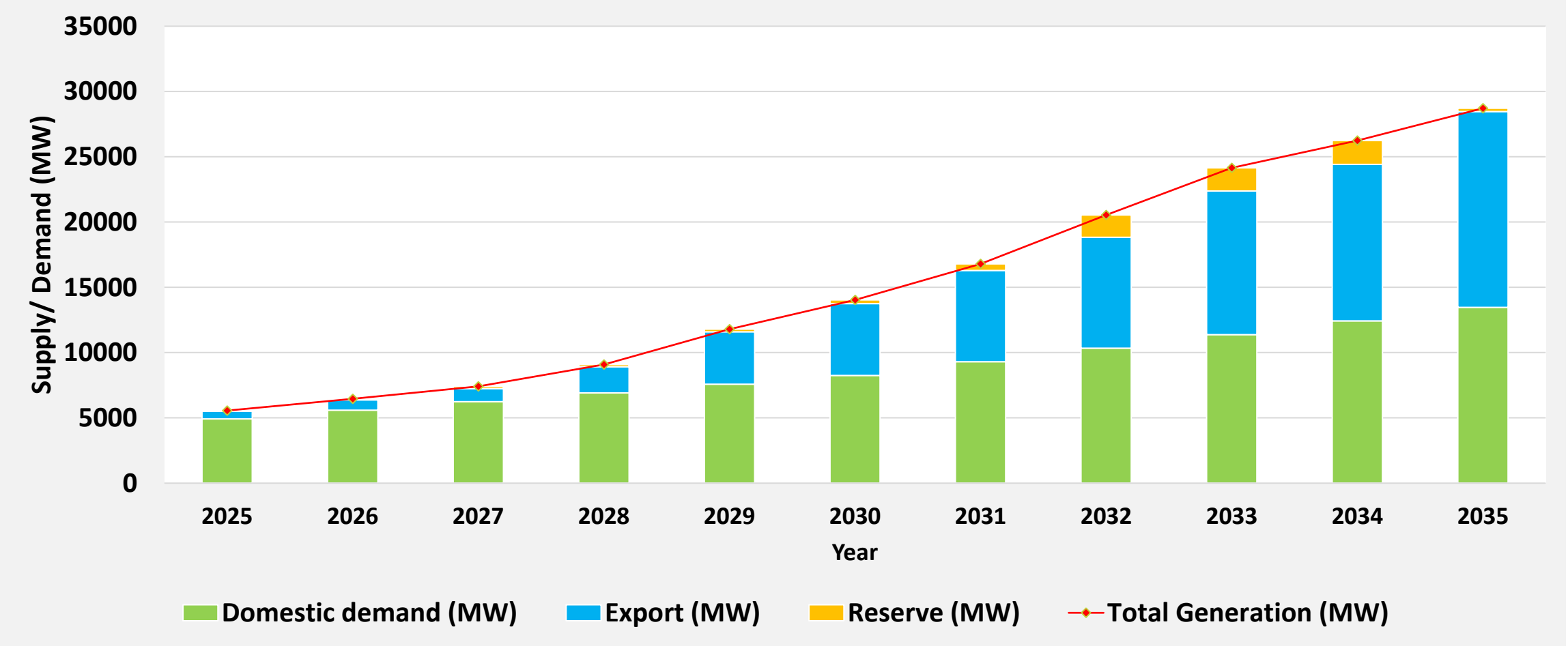
MoU signed by NHPC, India and IBN, Nepal for updating the completed study and starting construction.

Nepal's electricity exports have been growing in recent years



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024*
Import	1370	1778	2175	2582	2813	1729	2806	1543	1833	1895
Export	3	3	3	3	35	107	38	494	1346	1946

Expecting to transition towards a major electricity exporting economy



Source: Energy Development Roadmap and Action plan, 2024, MoEWRI

Electricity consumption plan and strategies

- Domestic consumption to be increased to 13,500 MW by 2035.
- Export to be increased to 15,000 MW (10,000 MW to India and 5,000 MW to Bangladesh) by 2035
- To use 13,000 MW by 2035:
  - ✓ Develop sufficient T & D infrastructure
  - ✓ Complete 100% electrification
  - ✓ Electrify economic sectors: Agriculture, Transportation (Charging stations), commercial, domestic (clean cooking), industry(including hydrogen), construction and mining etc.
  - ✓ If generation is surplus at any time until these things are done, increase export. If domestic consumption increases, reduce export.
  - ✓ For export, develop sufficient cross border lines jointly with neighboring countries and develop in-country lines from the projects up to the border points together with 400 KV east-west electric highway.
- ✓ To export 15000 MW to India and Bangladesh:
  - Continue joint study and development of additional cross border transmission lines base on incoming generation designated for export.
  - Negotiate with Indian parties and Bangladesh and enter into medium and long term power sale agreement.
  - Continue selling power in competitive market through power exchange.
  - Get electricity act 2024 passed and develop trade guidelines to encourage private developers to participate in trading market.

Key economic sectors for demand creation and transition to clean energy

Source: WECS study for Demand creation, 2024 with Average GDP growth rate: 7.727% (Electrification Scenario)

Sector	Base year demand in GWh (2021)	Additional Energy demand in GWh that would be created by			Major area for demand
		2030	2040	2050	
Agriculture	203	18.31	366.48	1168.5	100% electric water pumping
Commercial	24	3888	14004	43694	Primary end use of Commercial electric cooking
Industrial	2281	11893	41100	116925	Primary end use of motive power, Boiler and Furnaces
Residential	-	9219	14256	19361	Primary end use of domestic electric cooking
Transport	2.07	2448	5523	11556	Primary end use of public transport, private transport and freight transport
Construction and mining	-	77	400	1484	Electrification of Large and powerful equipment

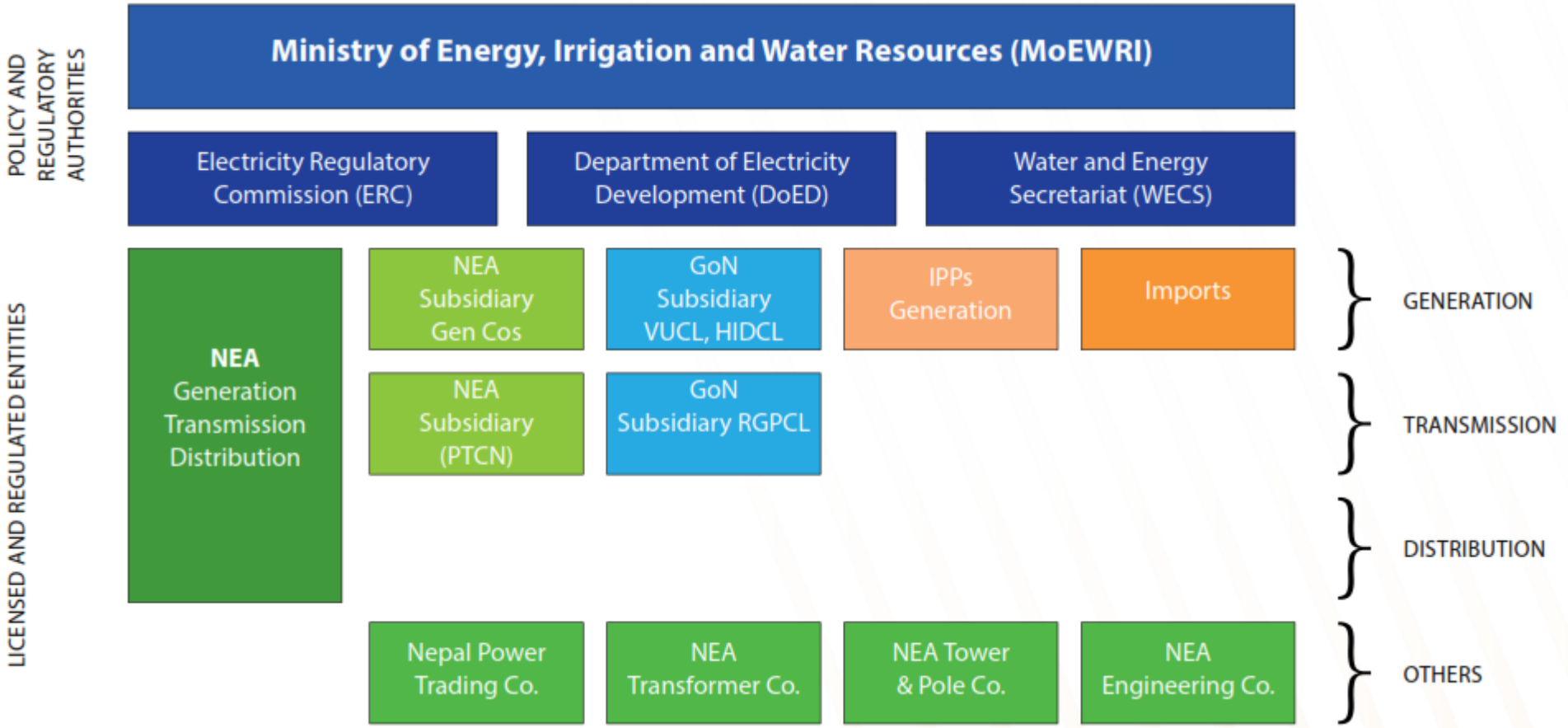
With the creation of demand as stipulated in six potential economic sectors, The share of electricity in the overall energy pie which is currently around 10% will reach 15.5% ,25.5%, 39% and 80.7% in the year 2030, 2035, 2040 and 2050 respectively.

Nepal's electrification success factors and Replicability to PNG

- Policy back up: Electricity crisis Mitigation Plan, 2015, Five year periodic plans, Energy road map and action plan, SDG commitments, Government's priority in annual policy and programs.
- NEA's sound leadership to implement these policies.
- Dedicated Community and Rural Electrification Department under Nepal Electricity Authority (NEA).
- Partnership between NEA and Community Rural Electrification Enterprises(CREEs): CREEs share 10% of the community electrification cost, own the electrification scheme, buy electricity in bulk from NEA and sell to community at the same rate of NEA. They also take steps to control electricity theft and losses.
- Grid reinforcement expansion by NEA through regular joint budget of Government, NEA and the development partners.
- Off-grid electrification expansion (Micro/mini hydro, solar) by Alternate Energy Promotion Centre (AEPC) in coordination with NEA
- Electrification in the Project affected area as part of CSR by Licensed hydropower developers as per the mandatory provision of EIA.
- Subsidy policy in place for off-grid technology.
- Subsidy flow to Provincial and local government from federal government for electrification programs.
- Royalty form hydropower project distributed to federal, Provincial and local government in the ratio of 50:25:25 which needs to be given priority for expanding electrification.
- Strong Monitoring and Evaluation framework.
- Incentivized tariff for the customers, Cost reflective PPAs with private sectors.
- Development of economic end uses.

Thank you!

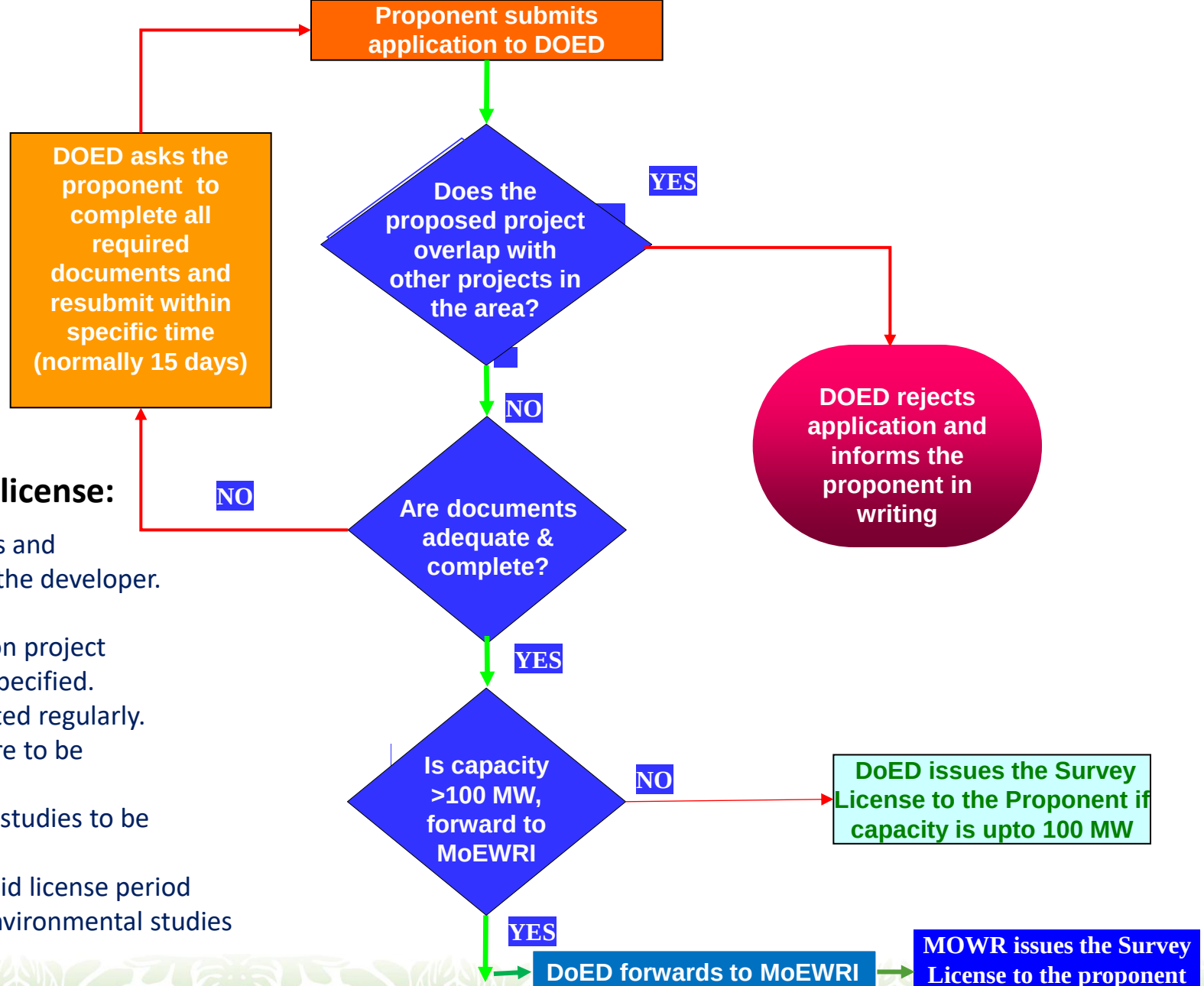
Current Structure of Power Sector



NEA: Nepal Electricity Authority, a single off taker of IPPs and its subsidiaries through PPA
VUCL: Vidyut Utpadan (Electricity Generation) Company Ltd..
RPGCL: Rashtriya Prasaran (National Transmission) Grid Company Ltd.

PTCN: Power Trading Corporation Nepal
HIDCL: Hydroelectricity Investment and Development company Ltd.

Survey License Application Process

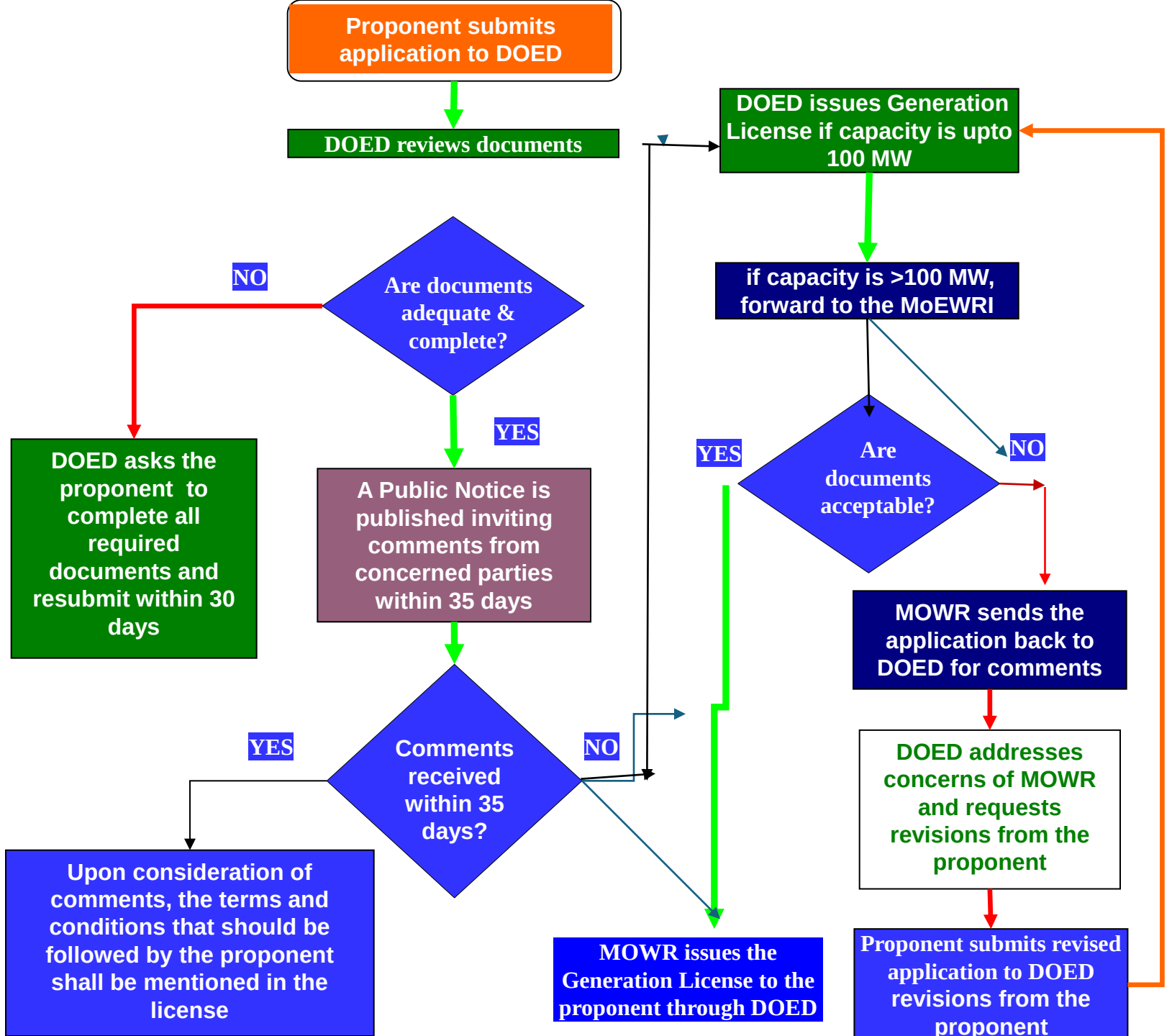


Legal framework for Survey license:

The Survey license specifies the terms and conditions required to be fulfilled by the developer.

1. Project details such as location project
2. features, study area etc are specified.
3. Progress report to be submitted regularly.
4. Change in ownership structure to be
5. informed.
6. Technical and Environmental studies to be
7. done following guidelines.
8. Developer to apply within valid license period
9. with completed technical, environmental studies
10. and other necessary things.
11. Industrial Certificate

Generation License Application Process



Legal framework:
Complete Power Purchase Agreement and financial closure within 2 years.

1.Progress report to be submitted regularly.

2.Change in ownership structure to be informed.

3.Construction works will start within one year after obtaining Generation License.

4.Get approval if structures are changed different than in Generation License due to different condition.

Take or Pay PPA rates for ROR (3% simple escalations for 8 years and base rate to be lowered for projects of any rated capacity with ROE higher than 17 %)

Options	Season	Rate Rs/KWh (up to 100 MW project)	Min. Dry Energy
Dry season: 6 months Wet season: 6 month	Wet: June-November Dry: October-May	4.80 8.40	30%
Dry season: 4 months Wet season: 8 month	Wet: June-September Dry: October-May	4.80 8.40	15%

Take or Pay PPA rates for PROR (3% simple escalations for 8 years and base rate to be lowered for projects of any rated capacity with ROE higher than 17 %)

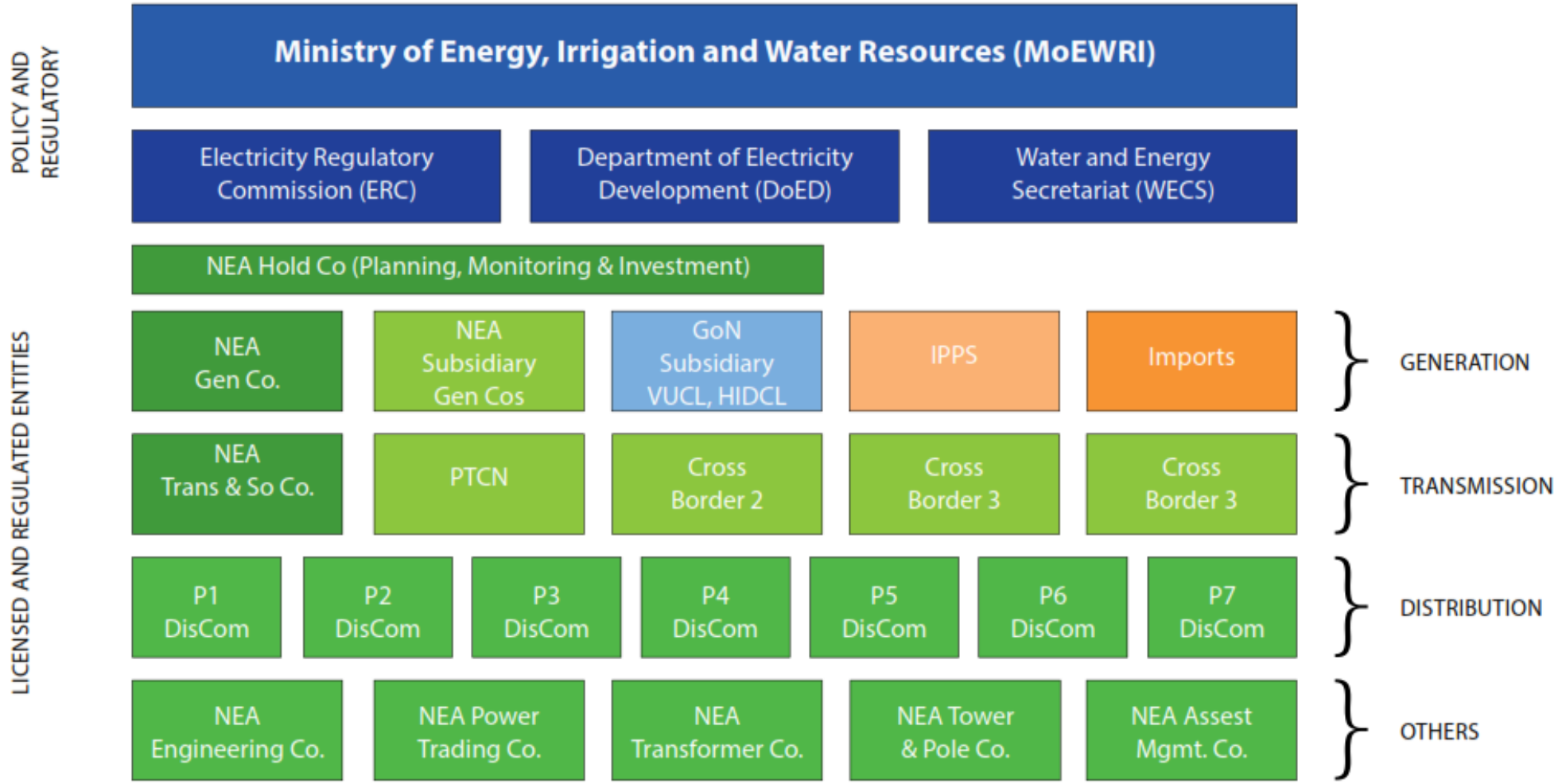
Season	Time of Day	Daily hours required to generate at rated capacity	Rate Rs./KWh	Min. Dry season Energy required
Dry (Mangsir 16-Jestha 15)	Peak Non peak	1 hr to less than 2 hrs 2 hrs to less than 3 hrs 3 hrs to less than 4 hrs 4 hrs to 6 hrs All hours	8.50 8.80 9.40 10.55 8.40	30%
Wet: June-Nov	All hours		4.80	

Competitive bidding:

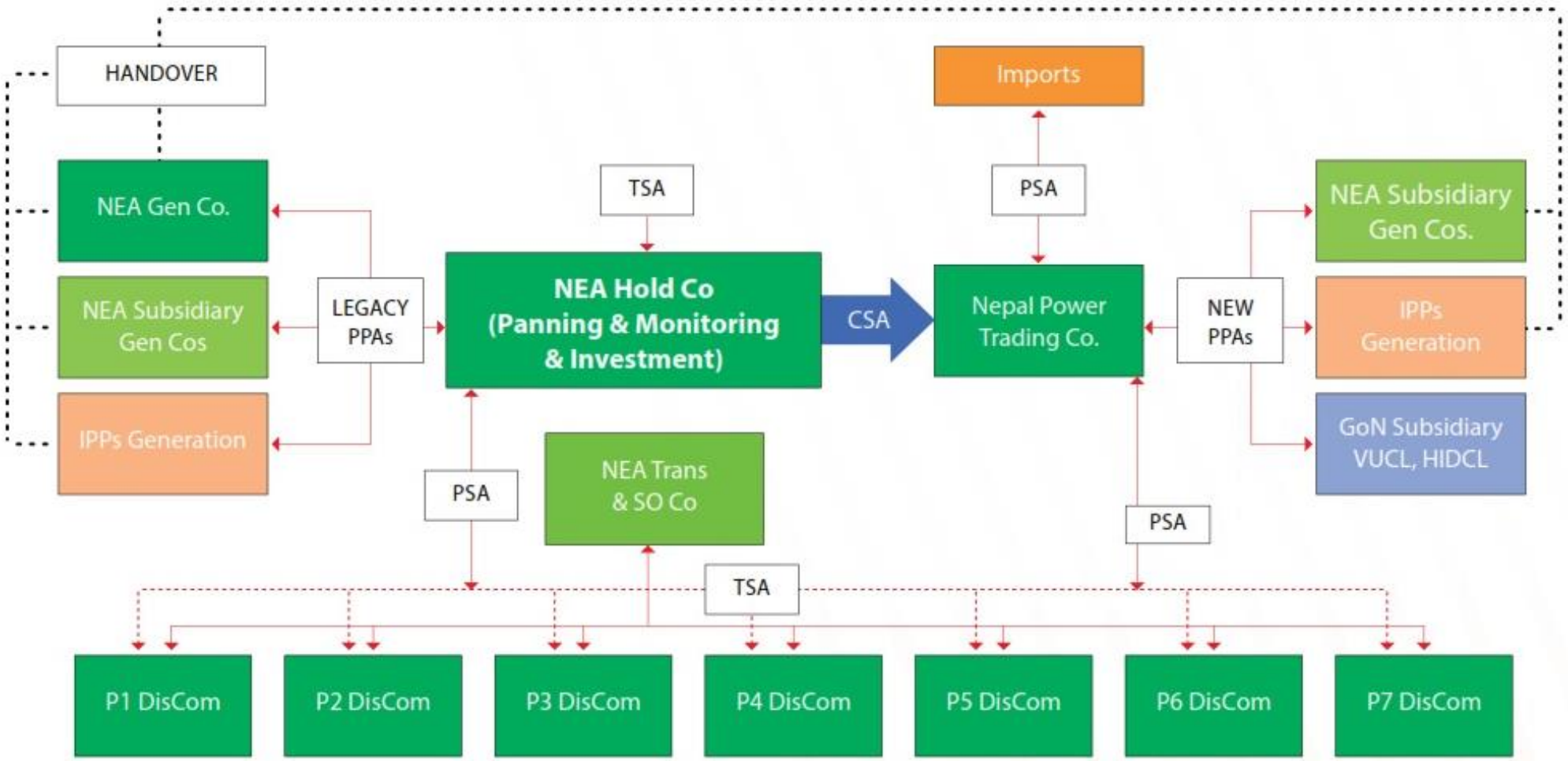
As per Existing Electricity Act, 1992, Government studied project can be floated (optional) for Competitive bidding. RfP is issued with upfront cost or free energy or PPA rates as the competition parameter and winning bidder is awarded survey license with PPA guaranteed as per the approved posted rate.

As per proposed Electricity bill, 2081, Competitive bidding is mandatory with competition parameter as mentioned above and the winning bidder will be awarded single stage generation license for 40 years with posted rate PPA guaranteed.

Proposed Restructuring of NEA in the federal context



Market Design after Re-structuring



CSA – Credit Support Agreement; PSA – Power Sales Agreement; TSA – Transmission Services Agreement

Annex-1: Distribution Line length developed, KM