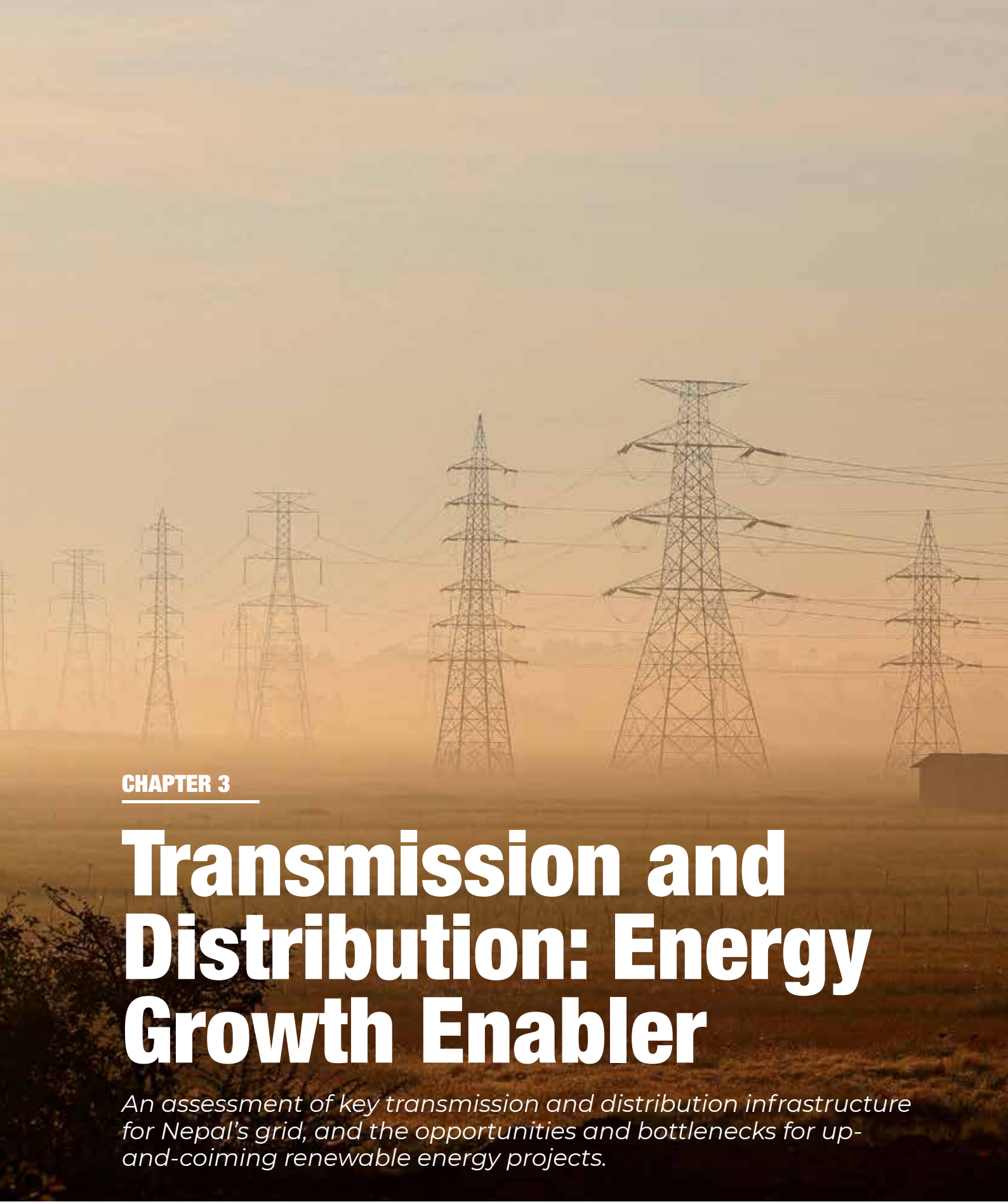

CHAPTER 3

Transmission and Distribution: Energy Growth Enabler

An assessment of key transmission and distribution infrastructure for Nepal's grid, and the opportunities and bottlenecks for up-and-coiming renewable energy projects.

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dolma foundation

CHAPTER 3

Transmission and Distribution: Energy Growth Enabler

This chapter is an excerpt from the publication: Lessons on how to promote and execute equity capital in the renewable energy sector of Nepal (Dolma Foundation, 2019).

The full publication can be accessed at: www.dolmaenergy.com/publication

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Dolma Foundation is a non-profit organisation, promoting prosperity by investing in education and sustainable business in Nepal that are risky for the private sector.

This report series was produced and authored by Matthew Ribeiro-Norley and Vishal Bista. The team is grateful for collaboration and data within Dolma and from various agencies in Nepal. The cut-off date for data in this report was January 2019.

SUGGESTED CITATION

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DISCLAIMER

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EXECUTIVE SUMMARY

CHAPTER 1: ENERGY MARKET ANALYSIS

Chapter 1 sets the tone for the series in highlighting that commercial institutional investors are the only sector with the capacity to finance this gap.

Nepal currently sits on a USD 17.8 bn infrastructure gap (excluding transmission and distribution) which needs to be addressed.

A prime solar belt region with 300 days of sunshine, and holding an economically feasible potential of ~43,000 MW of hydropower, Nepal boasts impressive renewable energy potential.

Despite this, Nepal's total installed capacity (March 2018) stands at 1,017 MW – 968 MW from hydro resources and 49 MW from thermal alternatives. Solar capacity is limited to 1.2 MW.

Electricity imports remain high in the dry season (Oct-Mar) for both peak load and base load energy, and as of March 2019 stood at 650 MW.

The Nepalese Rupee has remained pegged to the Indian rupee since 1993, primarily in the interest of price stability.

Based on Dolma's findings, the Project Internal Rate of Return for hydropower projects in Nepal range from 15-20%.

The main barriers to entry in Nepal include political stability, policy stability, currency, weak governance, climate change and bureaucracy.

Barriers to exit include the process of repatriating funds (whereby multiple authorities are required to sign-off after taxes are paid); as well as the lock-in period of up to three years after IPO on the Nepal Stock Exchange.

While there is a clear opportunity to export electricity to India in future, a clear framework agreed by both parties has not yet been enforced.

CHAPTER 2: CLIMATE CHANGE

Chapter 2 reflects on the environmental and social implications of a changing climate. Known for its pristine glaciers and abundant flora, the Himalayan region has witnessed an alarming number of climate-related tragedies in the last two decades. Between 2000 and 2015, ICIMOD estimates that 45,534 people died due to flooding, 10,893 to extreme heat, and 191 by drought, in Himalayan countries alone.

Higher temperatures have resulted in glaciers receding at alarming rates, adding volume to Glacial Lakes which pose a threat to those living downstream in the event of a burst. Moreover, unpredictable river flow can be a threat to farmers.

This chapter also puts into perspective that while CO2 rates remain high, the most immediate threat to the region – as identified in a series of recent reports from the Intergovernmental Panel on Climate Change (IPCC) and International Centre for Integrated Mountain Development (ICIMOD) – are short-lived climate pollutants, such as black carbon.

Despite its shorter life-span (approximately 50 years), black carbon is a warming agent with 1,500 times the warming effect of CO2. According to research, fossil fuel sourced black carbon appears to have twice the particle-specific warming potential of biomass sourced black carbon.

Based on conversations Dolma has had with regional climate scientists, prioritising the mitigation of short term climate pollutants is paramount to reversing Himalayan glacial melt – of which one third is expected to disappear by 2100 in a business-as-usual environment.

CHAPTER 3: TRANSMISSION AND DISTRIBUTION

Chapter 3 traces Nepal's energy infrastructure development and progress. Unlike energy generation, Nepal's transmission network grew at an annual rate of 8% from 2008 to 2012.

Electricity markets in Nepal are gradually un-bundling. Until 1990 all production, transmission and distribution were vertically controlled by the Nepal Electricity Authority.

Since 1990, Independent Power Producers have added ~500 MW to the grid.

Despite plans to un-bundle the NEA's transmission and distribution business following The Hydropower Development Policy 1992, it was only with assistance from the Asian Development Bank in 2015 that the National Transmission Grid Company was set up.

As this publication went to print, the newly-found distribution company had still not made any significant progress.

There are some USD 817 mn allocated to the enhancement of Nepal's transmission and distribution, mainly led by key donors such as ADB, Government of Norway, MCC and JICA.

A further USD 471.5 mn is being spent on policy and institutional reforms led mainly by the World Bank, ADB, and Canadian Government.

CHAPTER 4: REGULATORY ADVOCACY

Chapter 4 puts forward a number of recommendations to government that would facilitate the enabling environment for international investors.

Nepal has over the last five years (2013-2018) amended and introduced several regulations to facilitate public-private partnership and encourage further private sector investment.

Despite the government's best intentions to prioritise infrastructure, some have labelled the planning "erratic": since 2001 there have been five strategic documents on energy capacity targets, one every three years on average.

The most recent government plan, from 2016, calls for the construction of 10,000 MW by 2030.

The World Bank and others have argued that to attract and retain investment to the tune of tens of billions of dollars, an enabling environment is required.

"Quick-Win" regulatory reforms that would have a disproportionately positive impact on the infrastructure investment environment in Nepal:

Automatic route for foreign investment
Foreign currency power purchase agreements
Return on equity (ROE) clarifications
Alternative and auxiliary energy tariffs (new technologies such as batteries)

Long-term reform opportunities beyond the scope of this project:

Sovereign credit rating
Cost-plus approach
Competitive bidding
Protection for seasonality
Benefit sharing
Cooperation with regional partners

CHAPTER 5: INSTITUTIONAL INVESTOR INVESTMENT LANDSCAPE

Chapter 5 identifies three key catalysts for driving institutional investors into frontier markets like Nepal: low global interest rates; the commercial viability of renewable technologies; and heightened public, shareholder and regulatory opinion in relation to carbon emissions.

The need to attract large amounts of FDI to finance Nepal's power needs is well documented, both the Investment Board of Nepal and National Planning Commission agree that to meet just domestic demand, approximately USD 18 bn is required in capital investment (both debt and equity), or USD 1.5 bn annually.

The Dolma team interviewed some of the world's largest institutional investors, testing the risk and return mandate for Nepal against their current and emerging risk strategies. Interviewees included funds with

assets under management from USD 1 bn to 6 tn.

These were our findings:

Some investors suggested that the required return on equity for construction risk could be up to 20%, provided a Nepal project vehicle can demonstrate equivalency to investment grade status after successfully mitigating risks.

Among institutional investors there is a clear negative bias against credit and currency risk, suggesting that FX risk, real or perceived, prevents perhaps trillions of dollars from flowing to the poorest economies.

Dolma's findings also suggested that a country's credit rating is fundamental to getting an investment proposal through the first step of the investment procedure. In some cases, the lack of a sovereign credit rating and international sovereign bonds for Nepal has been too large a barrier to overcome in our discussions with some investors who are often restricted to considering countries that are at least investment grade (BBB-).

Some solutions to perceived risks included adopting Political Risk Insurance (PRI); Currency Hedging Mechanisms; and Bank Guarantees, amongst others.

Investors interviewed fell into two groups –leaders and followers – the former willing to take higher risk in search of greater yield and the latter less so; 2) there is no clear connection between Assets Under Management (AUM) and risk profile when it comes to investing in frontier markets like Nepal.

CHAPTER 6: COMPLEMENTARY INVESTORS

Chapter 6 discusses complementary investors (or blended concessional finance) which provide a new wind of opportunity for institutional investors – previously unable to invest in frontier market because of perceived risk. Blended capital works to de-risk perceived obstacles.

Investment instruments typically involve the deployment of grants, concessional lending, guarantees, and equity. These are deployed using adaptable programme, policy and sector investment loans, debt swaps, PPPs, advanced market commitments, and first loss reserve tranches.

Green bonds have recently also proven to be a potential solution by providing debt financing to eligible climate change projects. As of 2018, green bond issuance reached some USD 250 bn.

Complementary investors have played a key role in attracting investment to Nepal's renewable sector – these include Development Finance Institutions such as FMO, OEEB, DGGF and FINNFUND, as well as Multilateral platforms like IFC and ADB.

As stated in chapter 5, Dolma finds that at least two blended finance instruments are required for institutional investors to consider a renewable energy project in Nepal: political risk insurance and a currency hedge.

Dolma's research finds that countries successful in solving these risks for investors were able to make bold moves within their own domestic economies.

Nepal could follow the path of successful governments in doing so by creating its own government backed instruments and enacting reform.

CHAPTER 7: LEGAL STRUCTURING

Chapter 7 explains the legal structuring backdrop which is an essential component for foreign investors considering large infrastructure in Nepal.

To invest in Nepal through the FDI route, it is important to analyse and decide upon which country to invest from. To date there are 15 jurisdictions which hold a Dual Taxation Agreement (DTA) with Nepal which mitigates the risk of paying double taxation.

Dolma finds that Mauritius is generally viewed as the "gateway" to Nepal because both countries hold a DTA – Mauritius is

also known as a transparent jurisdiction that ranks well according to the financial services index. It also has experience fund management and administrative services which manage approximately USD 670 bn in assets.

Despite Mauritius' favourable positioning, the choice of domicile is based on the circumstances and preferences of individual investors.

Dolma views the UK as one of many strong locations to set up a fund manager, and has based the examples in chapter 7 on an English limited partnership or UK company as the fund vehicle.

CHAPTER 8: FINANCIAL STRUCTURING

Chapter 8 explores key regulated and non-regulated institutions that could act as potential sources of financing for energy projects in-country.

Nepal is yet to formulate specific regulatory provisions for private equity funds that invest in private companies.

There are a number of private equity players investing in renewable energy in Nepal, which include IFC, Dolma Impact Fund I and Equicap.

Dolma found that key exit issues for international investors include, but are not limited to the following:
Valuation at exit
Taxation in change of ownership
Repatriation issues

Dolma found that there could be some challenges for investors keen to invest through a project finance model, particularly for debt financing:

A limited tenor and floating interest rates on long term loans.
Generally, a limited capacity for banks to lend.
A limited scope for corporate bonds, which is still a nascent market.

The chapter also explores key financial issues for investors and how to integrate these solutions at the fund level: these include suggestions for currency risk, political risk, and debt risk.

CHAPTER 9: PROJECT DESIGN AND ENGINEERING

Chapter 9 focuses on the practical realities of executing renewables projects in Nepal, acknowledging that besides hydropower – Nepal's most mature energy asset class – other newer technologies such as solar and batteries could play a significant role in servicing growing supply, and providing auxiliary services.

Despite Nepal's installed generation capacity standing at 1,100 MW, there are some 7,000 MW in licenses that have been issued by the government to IPPs. The vast majority of these are for hydro-run-of-river (RoR) projects.

Dolma has identified a priority pipeline of hydro and solar projects that are optimal from a project execution perspective.

The chapter also includes a summary of leading battery technologies and which would be most suited in Nepal's context.

While there are no Nepali contractors that offer Engineer Procurement Construction (EPC) contracts this chapter analyses local firms that have a track record for hydro and solar projects in-country.

As financiers are increasingly aligning their investment mandates to the UN's Sustainable Development Goals, the chapter also outlines high level strategies for climate adaptation and resilience.

ABBREVIATIONS

FIGURES

ABBREVIATIONS

ADB	**ASIAN DEVELOPMENT BANK**
AEPC	**ALTERNATIVE ENERGY PROMOTION CENTRE**
DFI	**DEVELOPMENT FINANCIAL INSTITUTION**
DOED	**DEPARTMENT OF ELECTRICITY DEVELOPMENT**
EIB	**EUROPEAN INVESTMENT BANK**
ESIA	**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT**
ETFC	**ELECTRICITY TARIFF FIXATION COMMISSION**
GESI	**GENDER EQUALITY AND SOCIAL INCLUSION**
IBN	**INVESTMENT BOARD OF NEPAL**
IDA	**INTERNATIONAL DEVELOPMENT ASSOCIATION**
IFC	**INTERNATIONAL FINANCE CORPORATION**
IWRM	**INTEGRATED WATER RESOURCE MANAGEMENT**
JICA	**JAPAN INTERNATIONAL COOPERATION AGENCY**
KM	**KILOMETRES**
KV	**KILO VOLTS**
KW	**KILO WATTS**
MN	**MILLION**
MOE	**MINISTRY OF ENERGY**
MVA	**MEGA VOLT AMP**
MW	**MEGA WATTS**
NEA	**NEPAL ELECTRICITY AUTHORITY**
USD	**UNITED STATES DOLLARS**
WECS	**WATER AND ENERGY COMMISSION SECRETARIAT**

1.1 INTRODUCTION

A reliable power network requires a mix of generating sources and a robust transmission and distribution network. Increasing generation capacity has been a pressing need in the Nepalese energy system, mainly due to a history of chronic load shedding (up to 16 hours per day) over the last few years. But equally important is transmission and distribution infrastructure, without which the new generated electricity would go to waste.

SCOPE

In Section 1.2, this document explores the status of transmission structure of the Nepalese electricity grid. The enhancements of the grid and transmission infrastructure is supported by the Development Financial Institutions (DFI), so Section 1.3 lists work currently underway in this space undertaken by regulators, utility, and DFIs. Finally, in section 1.4, the report graphically presents the capacity additions in generation, transmission lines, and substations.


YOUNG

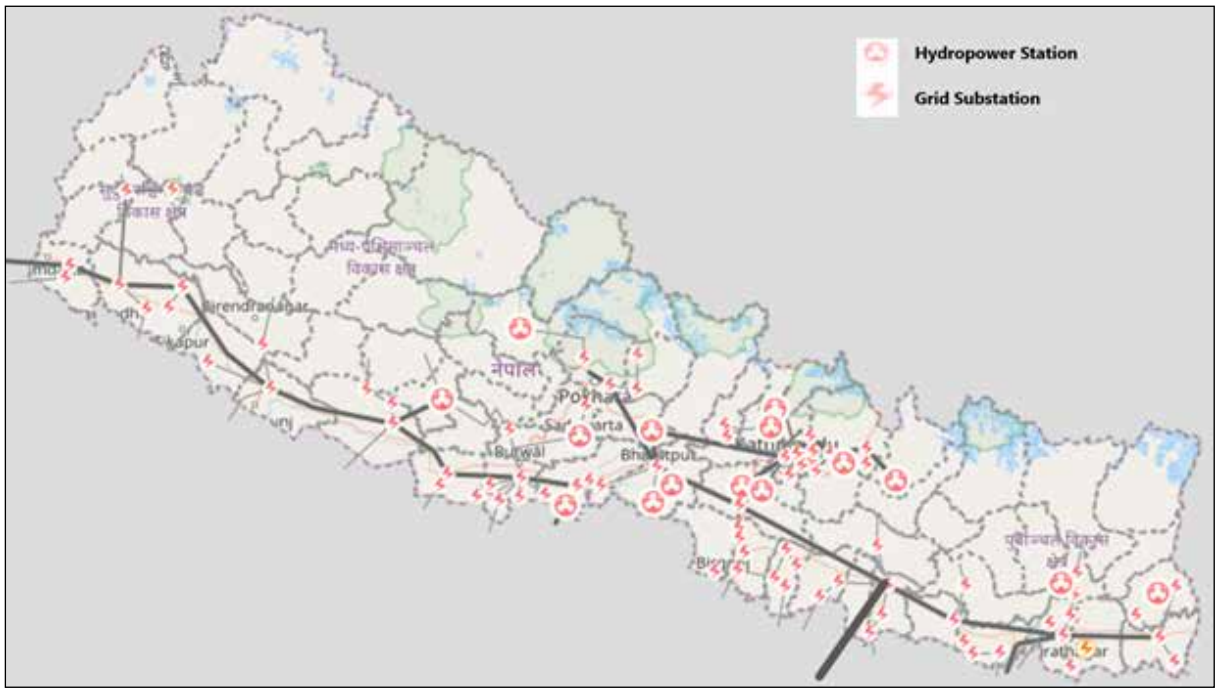
1.2 NEPALESE MARKET SIZE UNDER CURRENT REGULATIONS AND INFRASTRUCTURE CAPACITY

CURRENT TRANSMISSION INFRASTRUCTURE

Nepal uses up to 220 kV voltage lines to evacuate and distribute power internally. A 400 kV (currently charged at 220 kV) cross-border line from Dhalkebar, Nepal, to Muzzafapur, India, was recently commissioned. Figure 1 shows transmission lines in Nepal along with substations and hydropower plants. The transmission lines mainly run east to west along the southern part of the country. Since most hydropower development is in the central region, and Kathmandu is the main load centre, transmission lines and substations are concentrated in and around Kathmandu.

Nepal's existing high voltage transmission network comprises 2,130 circuit km of 132 kV lines and 1,376 MVA of substation capacity at the 132 kV level. Unlike the generation segment of the country, the transmission segment showed significant growth between 2008 and 2012. The 132 kV transmission line network has grown at a rate of 8% over this period. The country also has a 66 kV transmission network comprising 511 circuit km of lines and a transformer capacity of 464 MVA. Nepal's transmission grid is linked with India's via 22 links at the 132 kV, 33 kV, and 11 kV levels. About 80–100 MW of power is exchanged between the two countries in radial mode via these links. Nepal imports up to 500 MW of energy out of which up to 400 MW can be imported through the Dhalkebar–Muzzafapur line.

FIGURE 1: NEPAL TRANSMISSION LINES, SUBSTATIONS, AND HYDROPOWER PLANTS



1.3 REGULATORY REFORMS AND TRANSMISSION AND DISTRIBUTION PROJECTS CURRENTLY UNDERWAY

In February 2016, the Government of Nepal endorsed a National Crisis Reduction and Electricity Development Decade plan, which aims to develop 10,000 MW of electricity in 10 years. There are several regulatory reforms, transmission projects, and distribution projects currently underway to achieve those targets.

Until 1990, the NEA was the sole body for power generation, transmission, and distribution. The Hydropower Development Policy 1992 first envisaged a need to open generation to the private sector.

The Hydropower Development Policy 2001 took a step further to unbundle the NEA into different institutions. It planned to unbundle the NEA into three different bodies handling generation, transmission, and distribution. The ADB helped the Government of Nepal launch the reform process by establishing the National Transmission Grid Company Ltd. The company was finally set up in July 2015. However, the company has not made any significant progress hence and we are yet to see the impact of unbundling.

GOVERNMENT ENERGY INFRASTRUCTURE PLANS UNTIL 2030

Description	Impact	Project name / Institutions involved	Amount
Physical Infrastructure			
Kohalpur–Mahendranagar 132 kV transmission line	Increase transmission capacity in Western Nepal.	Electricity Transmission Expansion and Supply Improvement Project / Asian Development Bank (ADB), Nepal Electricity Authority (NEA), Government of Norway	USD 128.05 mn
Construction of the 220 kV/400 kV Tamakoshi–Kathmandu transmission line	Electricity evacuation from Tamakoshi Hydro project to Kathmandu and other parts of mid-Nepal.		
Expansion of the Chapali grid substation	Increase transmission capability within the Kathmandu valley and increase reliability of national grid.		
Rehabilitation of 12 distribution substations	Increase reliability of supply due to rehabilitation of substations and associated facilities in Gaur, Nijgarh, Chandragadhi, Jare, Belbari, Gorkha, Parasi, Krishnanagar, Taulihawa, Amuwa, Mirmi and new distribution systems along the Khimti–Kathmandu transmission line.		
Rehabilitation of Tinau (1 MW) and Sundarijal (640 kW) hydropower plants	Renovation and modernisation of two old hydroelectric projects – Sundarijal, over 70 years old, and Tinau, over 40 years old.		
Construction of substations at Barhabise, Lapshiphedi, Changunarayan, Chapagaun, Mulpani, and Phutung	A 220/132 kV 160 MVA substation at Barhabise and Laphsiphedi and a 132/11kV 45 MVA substation at Changunarayan are being constructed to complete the Tamakoshi–Kathmandu 220/400 kV Transmission Line Project. This line will provide vital power to Kathmandu from the power-generating stations that are being constructed at Khimti (Tamakoshi) and Barhabise. Another three 132/11 kV 45 MVA substations in Chapagaun, Mulpani, and Phutung will provide the necessary power to Kathmandu Valley.	Power Transmission and Distribution Efficiency Enhancement Project / ADB, NEA	USD 189 mn

Feasibility and detailed engineering studies of key hydropower projects and key transmission lines	Provision of high quality due diligence to support investment to transform the power sector. Studies of the following mega projects: • Sunkoshi 2 (1,110 MW) • Sunkoshi 3 (536 MW) • Dudhkoshi (300 MW) • Second Nepal–India Cross Border Transmission Lines	Project Preparatory Facility for Energy / ADB, NEA, Department of Electricity Development (DoED)	USD 26.25 mn
Construction and augmentation of transmission lines (400kV and 220kV) along Gandaki corridor and Marsyangdi–Kathmandu route	Increased capacity of national power grid by construction/augmentation of 236.5 km of transmission lines and substations along the Kali Gandaki corridor and Marsyangdi–Kathmandu route.	South Asia Sub-regional Economic Cooperation Power System Expansion Project / ADB, European Investment Bank (EIB), Government of Norway, NEA, Alternative Energy Promotion Centre (AEPC)	USD 440 mn
Construction and augmentation of transmission lines (up to 33kV) across the country	Power distribution network improved through construction of 1,135 km of distribution lines and substations across the country.		
Mini-grid based renewable energy system	Increased access to electricity in off-grid areas by installing in selected rural communities up to a total of 4.3 MW of mini hydro-electric power plants and up to a total of 0.5 MW of mini-grid based solar or solar/wind hybrid systems.		
Middle Marsyangdi–Marsyangdi, Dumre–Damauli 132 kV transmission line and related substation work	Construction of a new double circuit transmission line from Dumre to Damauli; string the second circuit of the existing transmission line from Middle-Marshyangdi to Dumre to Marshyangdi.	Energy Access and Efficiency Improvement Project / ADB, NEA	USD 12.72 mn
Tanahun Hydropower project	Access to clean and sustainable energy, increased efficiency, and reliable supply of energy by constructing 140 MW of hydropower plants and 37 km of 220 kV transmission line. Includes rural electrification that covers 17,636 households.	Tanahun Hydropower Projec / ADB; Abu Dhabi Fund for Development; EIB; Japan International Cooperation Agency (JICA); NEA	USD 505 mn
Grid Connected Solar PV Farm	Design, supply, construction, commissioning, O&M of first grid connected solar farms of 25 MWp capacity.	Grid Solar and Energy Efficiency Project – World Bank; NEA	USD 54 mn
Kabeli-A Hydroelectric Project	Construction of a 37.6 MW peaking hydroelectric project.	Kabeli-A, Hydroelectric Project – World Bank, International Finance Corporation (IFC), Canada Climate Change Program	USD 102. 6 mn
Preparation of Hydropower and Transmission Line Investment Projects	The project will prepare two hydropower projects (365 MW) and a priority cross-border high voltage transmission line project. It will finance detailed engineering designs and bid documents, ESIA including a Cumulative Impact Assessment and mitigation studies, and the hiring of a dam safety panel of experts and an environmental and social panel of experts for Upper Arun (335 MW) and Ikhuwa khola (30MW). It will also include a feasibility study and the preparation of a basic design, route survey, ESIA, and bid documents for transmission line projects to be identified	Power Sector Reform and Sustainable Hydropower Development- World Bank (IDA), South Asia Water Initiative; NEA	USD 18 mn
Hetauda–Dhalkebar–Duhabi (H–D–D) Transmission Line and Grid Synchronisation	Design, construction, and operation of approximately 285 km of 400 kV 42 double circuit transmission line and substations for the Hetauda–Dhalkebar–Duhabi segment.	Nepal–India Electricity Transmission And Trade Project, World Bank (IDA)	USD 118.6 mn
Synchronization of Operation of the Nepal and Indian Grids	Installation of properly tuned power system stabilisers in the major power generating stations and other measures in Nepal in order to synchronise its power system with India's	Nepal-India Electricity Transmission And Trade Project, World Bank (IDA)	USD 118.6 mn

Electricity Transmission Project: Construction of 300 km of 400 kV transmission lines and three sub-stations	Increased transmission capacity in central Nepal and construction of cross-border transmission line with India from New Butwal.	Millennium Challenge Corporation	USD 500 mn
Study of 15 hydropower projects in Nepal	Data collection and preliminary study of these projects.	JICA	)

POLICY REFORMS

Policy reforms			
Economic reform and development programs initiated to achieve the government's vision of double-digit and more inclusive economic growth by 2022	Introduction of institutional and policy reforms in key public entities, such as the NEA, that are critical to improve the investment climate.	Support for formulating an Economic Development Vision – ADB	USD 5.6 mn
Studies and preparation for policy recommendations and sector reform	Support MoE, IBN, DoED, WECS, ETFC, NEA, and AEPC on: • River basin planning with an IWRM approach for selected river basins • Recommendations to improve water resources management and regulations, such as updating the Water Resource Act and capacity building of the WECS • Power System Expansion Plan, including preparation of a Hydropower Generation Master Plan • Establishment and operationalisation of a power trading company • NEA business restructuring to improve management and efficiency, including provision of computerised management tools, installation of smart meters to enhance the distribution business management, and asset evaluations.	Power Sector Reform and Sustainable Hydropower Development – World Bank (IDA), South Asia Water Initiative; NEA	

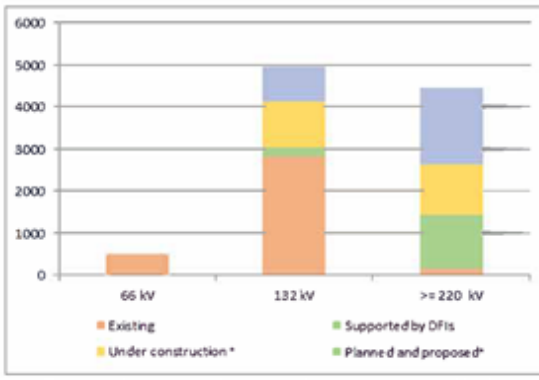
INSTITUTIONAL REFORMS

Institutional Reforms			
Enhance operational and financial performance of NEA distribution centres	Single-phase and three-phase smart meters with associated communication facilities that are aligned with modern international practices will be introduced to automate customer metering and reduce nontechnical losses.	Power Transmission and Distribution Efficiency Enhancement Project, ADB; NEA	USD 189 mn
Develop the NEA's capacity to operate and manage advanced distribution system, intelligent network (smart grid) technology with Gender Equality and Social Inclusion (GESI) aspects in electricity access, and end-user awareness	Training and other capacity building activities will be conducted to help NEA staff to plan and execute advanced distribution efficiency projects with special emphasis on gender.	Power Transmission and Distribution Efficiency Enhancement Project, ADB; NEA	USD 189 mn
Distribution System Planning and Loss Reduction	Aid NEA to redress high system losses in the country and enhance the NEA's capacity in distribution system planning and management.	Grid Solar And Energy Efficiency Project - World Bank (IDA)	USD 84 mn
Kabeli Hydroelectric Project	Help IBN (a) conduct additional due diligence and PDA negotiations of large hydropower projects (four projects, totalling 3050 MW) proposed by private investors; (b) supervise the construction of abovementioned projects to ensure compliance with the terms and conditions of the PDAs and sustainability of such projects; (c) build its procurement, financial management, environmental, and social safeguards and technical capacities; and (d) cover incremental operating costs for project implementation.	Kabeli-A, Hydroelectric Project – World Bank, IFC, Canada Climate Change Program	USD 4 mn

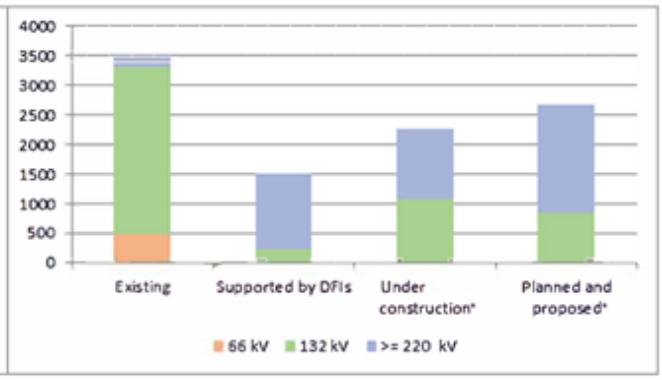
1.4 IMPACT ON MARKET SIZE

Transmission Grid

Transmission grid length (km)	Existing	Supported by DFIs	Under construction*	Planned and proposed*	Total
66 kV	494	-			494
132 kV	2,819	229	1,068	846	4,962
>= 220 kV	153	1,292	1,187	1,820	4,452
Total	3,466	1,521	2,255	2,666	9,908



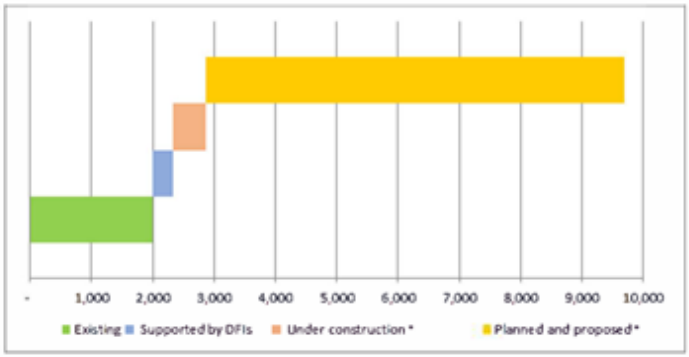
Transmission grid based on capacity (kV)



Existing and planned transmission grids

Substation

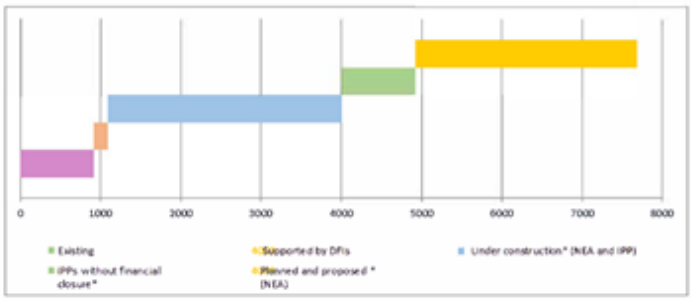
Substation capacity in MVA	66kV	>132kV
Existing	622	1,996
Supported by DFIs		340
Under construction*		533
Planned and proposed*		6,818
Total	622	9,687



Sub station capacity in MVA - Existing and planned

Hydropower Capacity

Total installed capacity on grid in MWs	Hydro
Existing	918
Supported by DFIs	178
Under construction* (NEA and IPP)	2,913
IPPs without financial closure *	910
Planned and proposed* (NEA)	2,770
Total	7,689



Hydropower Installed Capacity in MW - Existing and Planned

Solar Energy
200 MW
(Planned)

Thermal Energy
53 MW
(Existing)

* Without DFI support

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