CHAPTER 2

Climate Change

A look into the environmental consequences of CO2 and short-lived pollutants such as black carbon generated from fossil fuel production in the Himalayan Hindu Kush, and implications that this holds for human life and ecosystems in the densest pocket of extreme poverty on earth.

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CHAPTER 2

Climate Change

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

DOLMA FOUNDATION
E-mail: contact@dolmafund.org
Website: www.dolmafoundation.org/consulting

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.

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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).

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:

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

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

1. Sovereign credit rating
2. Cost-plus approach
3. Competitive bidding
4. Protection for seasonality
5. Benefit sharing
6. 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:

1. Valuation at exit
2. Taxation in change of ownership
3. Repatriation issues

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

1. A limited tenor and floating interest rates on long term loans.
2. Generally, a limited capacity for banks to lend.
3. 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.

ABBREBIATIONS

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ABBREVIATIONS

ADB	ASIAN DEVELOPMENT BANK
AEPC	ALTERNATIVE ENERGY PROMOTION CENTRE
BR	BLACK CARBON
CER	CERTIFIED EMISSIONS REDUCTION
CO2	CARBON DIOXIDE
EPA	ENVIRONMENTAL PROTECTION AGENCY
ETS	EMISSIONS TRADING SCHEME
GLOF	GLACIAL LAKE OUTBREAK FLOOD
GW	GIGAWATT
HKH	HINDU KUSH HIMALAYAS
ICIMOD	INTERNATIONAL CENTRE FOR INTEGRATED MOUNTAIN DEVELOPMENT
IBRD	INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
MW	MEGAWATT
NREL	NATIONAL RENEWABLE ENERGY LABORATORY
PM	PARTICULATE MATTER
SDG	SUSTAINABLE DEVELOPMENT GOALS
UMPP	ULTRA MEGA POWER PLATS
UNFCCC	UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE
USD	UNITED STATES DOLLAR

1.1 INTRODUCTION

The mountains and valleys of the Hindu Kush Himalayas are some of the most inaccessible, remote regions in the world today. Home to millions of ecosystems, the mountains also provide hospice to human settlements that rely on stable ecological systems to preserve their way of living.

Despite an abundance of natural resources, the Himalayas have recently been acknowledged as one of the most environmentally sensitive regions on earth. According to recent scientific publications, temperatures have risen by nearly 2 degrees since the start of the 20th century. With reports of glaciers retreating, permafrost melting and increasingly erratic weather patterns – water and food sources for the 600 million people living downstream are under significant strain. This chapter analyses this "silent environmental crisis" and the national, bilateral and multilateral efforts to date in reversing some of the damaging consequences of climate change in the region.

1.2 ECONOMIC AND SOCIAL REASONS FOR BLACK CARBON EMISSIONS, AND EFFECT ON GLACIAL MELT AND HYDROLOGY IN THE REGION

THE REGION AT A GLANCE

Figure 1 shows the build-up of black carbon in the Himalayas. Nepal is clearly a hotspot, with levels of well over 100 micrograms/m2/year.

While fossil fuel power generation increases global warming through global CO2 emissions, the emission of black carbon, particularly from coal and biomass (wood burning in particular), is causing a localised crisis in the Himalayas. As the world's seventh largest consumer of biomass, accounting for 0.8% of the global share of production, Nepal can play a critical role in mitigating further glacial melt caused by black carbon in the region. This can be achieved by deploying utility-scale hydro and solar generation, which will offset the use of carbon-emitting forms of energy while addressing United Nations Sustainable Development Goal (SDG) 7, which underlines "access to affordable, reliable, sustainable and modern energy" as being essential "for jobs, security, climate change, food production or increasing incomes".

The Himalayan Hindu Kush region has the highest level of solar radiation in the world. Less than 4% of the Himalayan region, if equipped with solar arrays, could generate 3.1 trillion kWh – equivalent to the total electricity consumption of China in 2007. The Himalayas – often called the "Third Pole" – hold the third-largest deposits of ice and snow in the world after the North and South Poles. Nepal alone has an estimated technically and economically feasible hydropower potential of at least 40,000 MW. If sufficient capital and a high level of corporate and environmental and social governance is attracted for large-scale development, there may be an opportunity to offset carbon emissions from proposed regional coal-fired plants in neighbouring countries. Nepal's hydro potential is roughly equivalent to the planned 48,000 to 50,000 MW of India's coal-fired Ultra Mega Power Projects (UMPPs).

The lifecycle greenhouse emission assessment, also known as "cradle-to-grave" analysis, is a useful metric to measure the actual CO2 emissions from individual energy sources. This approach measures all the stages of the product's life, from raw material extraction to materials processing, manufacture, distribution, use, repair, maintenance, and disposal/recycling. Figure 2 illustrates NREL's Lifecycle analysis for electricity generation technologies powered by both renewable and non-renewable resources.

The mix of coal-powered generation in India, and high levels of diesel generation and biomass burning (including wood and dung) in Nepal is due to a lack of access to electricity. This is contributing to increased glacial melt. Approximately half the population in Himalayan countries (excluding China but including Pakistan, Nepal, Bangladesh, and the Indian states of Bihar, UP, Sikkim, Himachal Pradhesh, and West Bengal) has no access to electricity. For these reasons, Nepal is an obvious target for mitigation and adaptation funding – a central objective after the 21st meeting of the United

Nations Framework Convention on Climate Change (UNFCCC) negotiations in Paris in November 2015, also known as COP21.

Table 1 below outlines how much 1 MW of renewable energy according to different capacities, or load factors, offsets the same amount of Indian coal-fired imported power, which accounts for 0.95 kg of CO2 per kWh.

IMPACTS OF CLIMATE CHANGE: CRYOSPHERE, HYRDOLOGICAL REGIMES

According to the International Centre for Integrated Mountain Development (ICIMOD), an intergovernmental research body, the Hindu Kush Himalayan glaciers are shrinking and retreating as a result of climate change, which is creating new glacial lakes and expanding old ones, and creating potentially hazardous moraine-dammed lakes that form below the terminus of glaciers as they recede. The increasing temperature is also leading to the disappearance of smaller lakes that are not glacier-fed, while supraglacial ponds are growing and merging, increasing lake area but reducing the number of lakes.

TABLE 1: ENERGY ASSET CLASS CO2 OFF SET PER 1 MW

MW	Energy Asset Class	Load Factor	CO2 Offset (tonnes)
1	Solar PV	18%	1.5
1	Hydro	40%	3.3
1	Solar CSP	20%	1.7
1	Onshore Wind	28%	2.6

TRENDS IN THE THIRD POLE

According to research conducted by Zhang et al. (2015) in coordination with ICIMOD, small lakes (<0.2 km2) were more sensitive to climate change; lakes closer to glaciers and at higher altitudes, particularly those connected to glacier termini, had undergone larger changes in area; and glacier□fed lakes showed faster expansion rates than non-glacier fed lakes.

TRENDS IN THE NEPAL HIMALAYAS

Both the number and area of glacial lakes decreased between 1960 to 2010, which can be partly attributed to the lower resolution of the second study and to the merging of supraglacial lakes.

REGIONAL IMPACTS OF CLIMATE CHANGE

The regional impacts of climate change have been well documented by ICIMOD. ICIMOD reports that between 2000 and 2015, 45,534 people were killed by flooding, 10,893 by extreme heat, and 191 by droughts in Himalayan countries alone. In 2015, ICIMOD outlined 10 key takeaways from their research, shown in Table 2.

PROJECTED TRENDS IN RENEWABLE ENERGY

Increases in peak flow are likely to pose a risk to hydropower plants, which can be damaged by floods and may also have reduced lifespans because of increased sedimentation. The total water availability in the Indus, Ganges, and Brahmaputra basins is expected to increase because of increased flows during the first

half of the 21st century. This will stimulate hydropower development. But climate change projections become more uncertain in the long term, as do hydrological projections.

PROJECTED TRENDS IN GLACIAL LAKE OUTBURST FLOODS

Glacial lake outburst floods (GLOFs) have proven to be a serious risk for hydropower sites. GLOFs are sudden, unpredictable outbursts that have earned the name “mountain tsunami”

TABLE 2: ICIMOD KEY MESSAGES CLIMATE CHANGE

1	Temperatures across the mountainous Hindu Kush Himalayan (HKH) region will increase by about 1–2 degrees Celsius (in some places by up to 4–5 degrees) by 2050
2	Precipitation across the HKH region will change by 5% on average and up to 25% by 2050
3	The monsoon is expected to become longer and more erratic
4	Extreme rainfall events are becoming less frequent but more intense and are likely to keep increasing in intensity
5	Glaciers will continue to suffer substantial mass loss, especially in the Indus basin
6	No decreases in annual volume of precipitation is expected through to 2050
7	More floods and droughts are expected
8	Communities living immediately downstream of glaciers are most vulnerable to glacial changes
9	The contribution of various water sources to river flow will change
10	Changes in temperature and precipitation will have serious and far-reaching consequences for climate-dependent sectors such as agriculture, water resources, and health

because of the catastrophic impact they have on communities living downstream. Though it is possible to assess conditions that make a GLOFs likely, it is impossible to predict when a dam or ice barrier will fail and whether the failure will be complete or partial.6

With climate change, glaciers are receding and the number and size of moraine-dammed lakes is increasing. Lakes in contact with a glacier are likely to grow particularly fast as glacier retreat accelerates.

PROJECTED TRENDS IN GLACIAL MELT

Most Himalayan glaciers have both retreated and lost mass since the mid-19th century; however, the pace of melting in the last three decades is unprecedented. The Indian Institute of Science states that roughly 95% of glaciers in the Himalayan region are retreating.

The greatest relative reductions have been experienced by the Salween (-44 to -67%) and Mekong (-39 to -68%), as their current glacial areas are the smallest. In the Indus basin, a change in glacier extent ranging from -20 to -28% is projected. Changes in glacier area in the Ganges and Brahmaputra basins follow similar trends (-35% to -45%).

According to Lutz, even glaciers in the highest mountains of the world will not escape the effects of climate change. Even if today’s level of emissions are greatly reduced, glaciers in the Everest region (Dudh Koshi basin, Nepal) are projected to lose, on average, 39% of their ice by 2050 and 83% by 2100.

While significant research needs to be done to better establish the relationship between black carbon and glacial melt in general, ICIMOD finds that around 30% of glacial retreat observed in the HKH can be attributed to to black carbon emissions.

RECENT REGIONAL CLIMATE-RELATED ANOMALIES AND DISASTERS

JUNE 2013: UTTARAKHAND, INDIA

In June 2013, the northern Indian state of Uttarakhand faced extreme rainfall. According to the Indian Meteorological Department, on 17 June 2013, the state received 240 mm of rain, more than four times the usual average rainfall during this period. This was attributed to the interplay between westerly and monsoonal circulations. This heavy precipitation resulted in the swelling of rivers in both upstream and downstream areas.

In addition to rain, a huge quantity of water was probably released from the melting of ice and glaciers due to high temperatures in May and June, as well as GLOFs. The subsequent damage from the flooding killed more than 5,500 people and around 1,000 went missing. Heavy damage to infrastructure, including highways and bridges, was recorded.

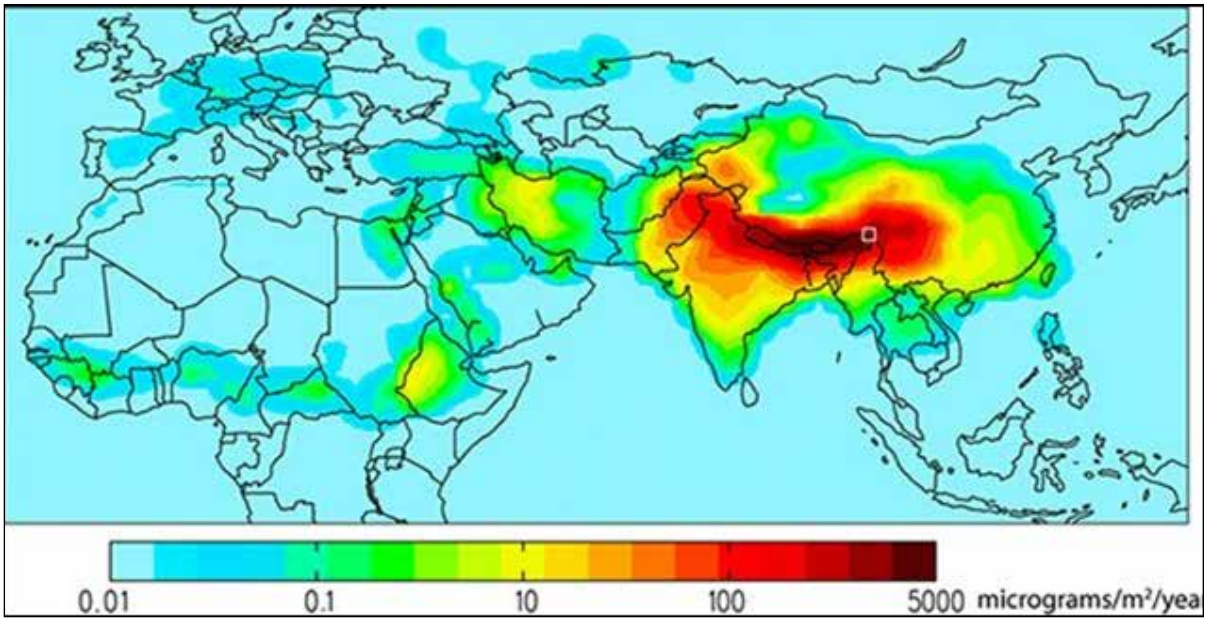
2010–2017: DOLAKHA, NEPAL

Access to sufficient amounts of water is crucial to agriculture. In Dolakha, a mountain district of Nepal, seasonal variations in rainfall are challenging cultivation patterns. Only 2% of annual precipitation occurs from December to February. Climate change is expected to increase average temperatures in Dolakha, especially night-time temperatures, which would improve the conditions for cultivation in the cold season. However, warmer weather needs to be accompanied by sufficient water for cultivation. Water harvesting, by means of tanks and pipes, would meet the dry season need for water for those who have access to a well. But the diverse geography of the Himalayas means no single solution is universally applicable.

AUGUST-SEPTEMBER 2017: NEPAL, INDIA AND BANGLADESH

The tail end of the monsoon in 2017 was one of the largest downpours in recent history, and it will be remembered for the death of over 1,200 people, with 100,000 affected.

FIGURE 1: GLOBAL CONCENTRATION OF BLACK CARBON



Source: UNEP/WMO Integrated Assessment of Black Carbon and Tropospheric Ozone, Summary for Decision Makers

FIGURE 2: RENEWABLE AND NON-RENEWABLE TECHNOLOGY LIFECYCLE ANALYSIS

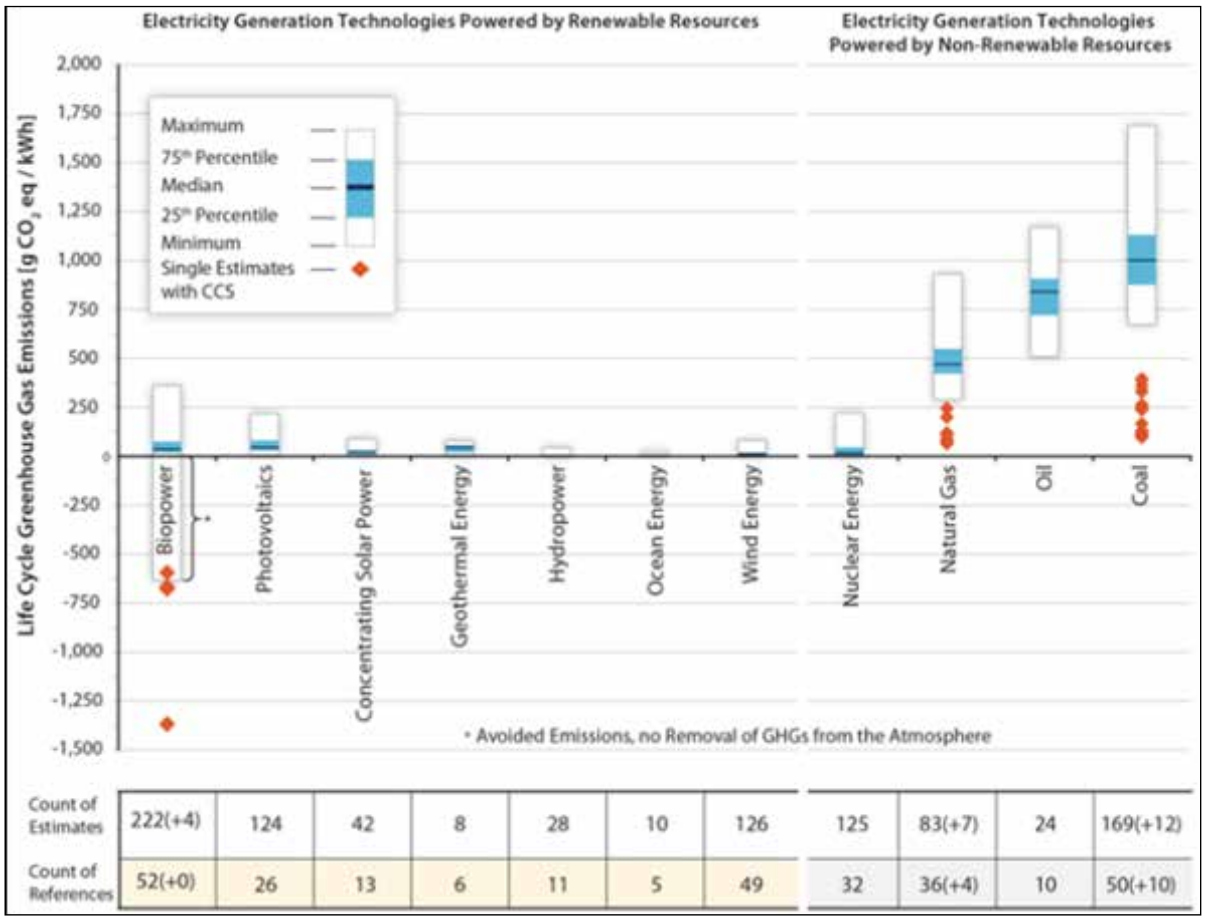
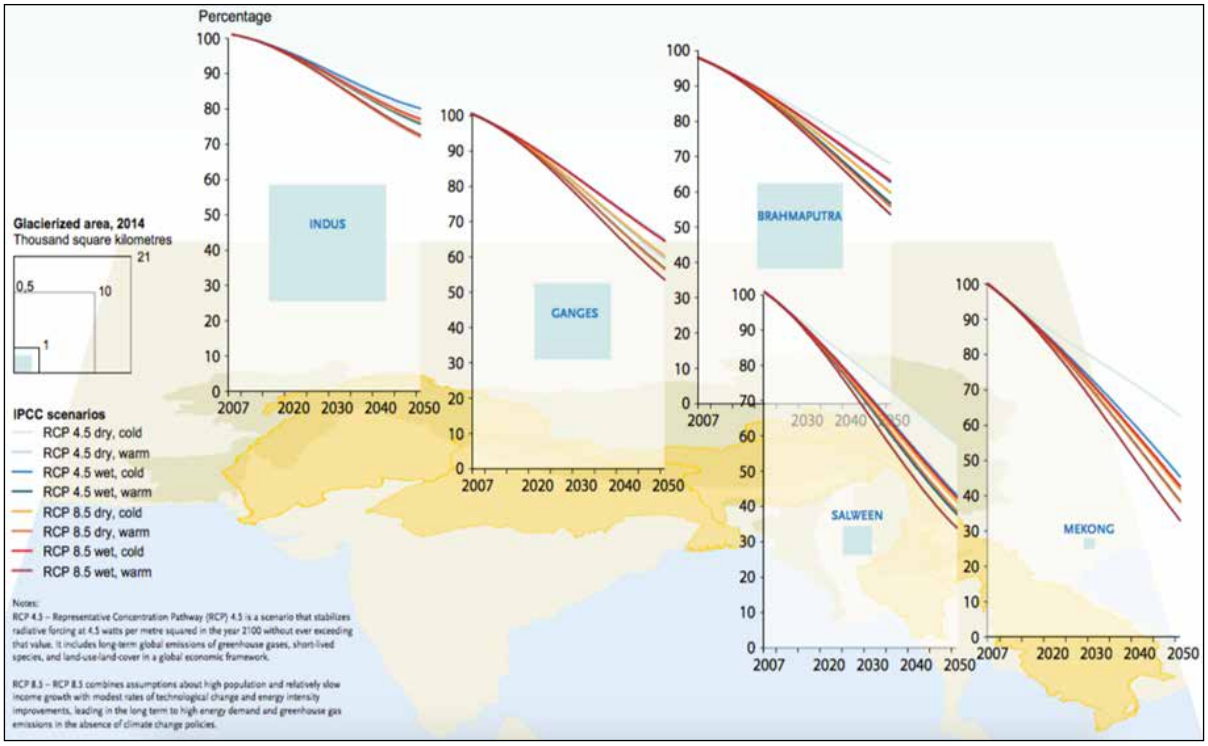


FIGURE 3: PROJECTED GLACIAL AREA CHANGE BY 2050



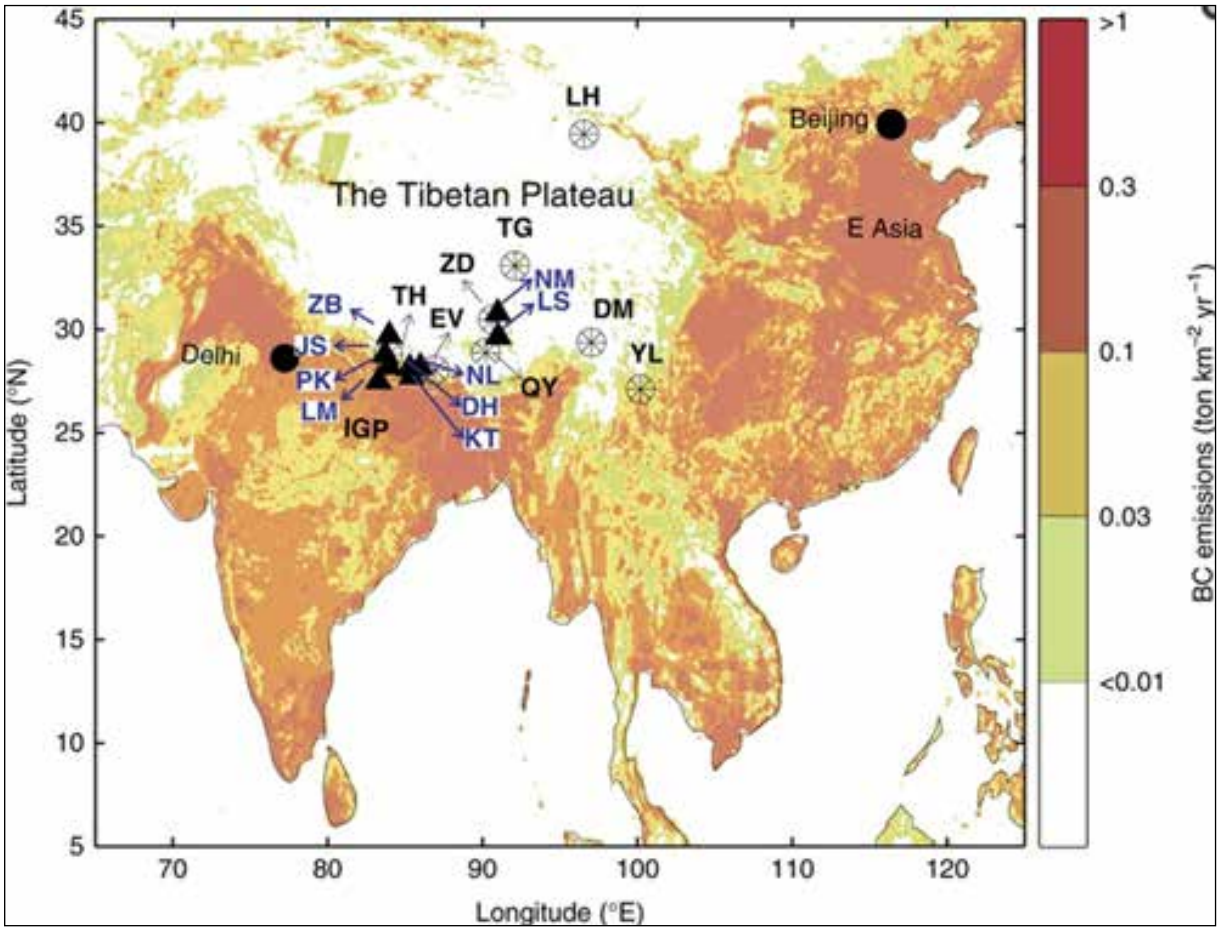
1.3 ANALYSIS OF BLACK CARBON IN THE REGION (COAL-FIRED GENERATION AND BIOMASS COMBUSTION)

Black carbon is the by-product of an unrivalled regional shortage of clean energy. This section details the scientific perspective on the effects of black carbon on the crysophere in the Himalayas and the contributing factors to its growing presence.

There are four key ways that dust can affect the cryosphere: (1) reflectivity decrease, (2) warming of the atmosphere, (3) altered precipitation patterns, (4) climate feedback. The sources of this type of emission come from two areas: fossil fuels and biomass. According to Li et al. (2016), for the Himalayas this is spread across contributions from fossil fuel (46%) and biomass (56%) combustion from the Indo-Gangetic Plain, whereas black carbon in the remote northern Tibetan Plateau is predominantly from fossil fuel combustion (66%), consistent with Chinese sources.

Li et al., also states that fossil fuel sourced black carbon appears to have approximately twice the particle-specific warming potential of biomass-sourced black carbon. Figure 4 details this.

FIGURE 4: REGIONAL CONCENTRATION OF BLACK CARBON



1.4 ONGOING REGIONAL INITIATIVES TACKLING CLIMATE CHANGE

Despite the pressing issues facing the region, there are several mitigation and adaptation funds as well as initiatives that are supported directly through specific initiatives in the field of finance for climate vulnerable regions of the world.

MULTILATERAL AND BILATERAL INITIATIVES

Table 3 is a list of projects that are active in the climate change space which could be used to draw funds for projects in Nepal.

REGIONAL INVESTMENT FUNDS

The progress of investment funds with a mandate for renewable energy in South Asia, let alone Nepal, has still got some way to go. However, strides have been made in India in the private equity space, which accounted for 60% of Foreign Direct Investments in 2016. The surge of investments in India's renewable energy space is a promising sign for Nepal.

TABLE 3: MULTILATERAL AND BILATERAL CLIMATE FUNDS WITH NEPAL AS A MANDATE

Fund/Type	Implementing Entity	Financing mechanism	Regions	Funding Level (USD)	Sectors	Target
ADB Climate Change Fund/ Multilateral	• Asian Development Bank (ADB)	• Co-financing • Grant • Technical assistance	• Asia	• 50 mn	• Energy • Agriculture • Energy Efficiency • Renewable Energy • Transport • Water	ADB Developing member countries
ASEAN Infrastructure Fund/Multilateral	• ADB	• Co-Financing • Loan • Technical assistance	• Asia	• 485.3 mn	• Energy • Environment • Rural Infra structure • Water	Sovereign guaranteed national and sub-regional projects of ASEAN developing member countries
Canada Climate Change/Multilateral	• International Finance Corporation (IFC)	• Loan, equity, Technical Assistance	• Global	• 276.55 mn	• All	UNFCCC Non-Annex; Parties to the Convention
Canada Climate Fund for the Private Sector in Asia/Multilateral (executed by ADB)	• Asian Development Bank (ADB)	• Concessional financing Grants	• Asia	• 63.22 mn	• All	Low, lower-middle income and small island developing countries
Climate and Development Knowledge Sector/ Multilateral	• Government of the Netherlands and Government of the United Kingdom	• Co-financing Grant Technical assistance	• Latin America • Asia • Africa	• •0.66 mn per project	• Adaptation • Capacity Building	Developing countries
Climate Insurance Fund/Bilateral	• KfW, Blue-Orchard	• Insurance	• Global	• 60 mn (seed investment)	• Adaptation • Disaster Risk Reduction	Qualified insurance/ reinsurance companies as well as other entities active in the value chain of insurance based in ODA recipient countries

Climate Public Private Partnership/ Bilateral	• Donor governments	• Equity Loan Grant	• Asia	• 283 mn	• Adaptation • Mitigation	Objective is to stimulate the development of climate funds and climate-friendly projects expected to play a key role in accelerating growth of investment in renewable energy and other low-carbon solutions
Danish Climate Investment Fund/ Bilateral	• Investment Fund for Developing Countries (IFU)	• Co-financing Loan Technical assistance Equity	• Developing Countries	• 200 mn	• Energy Efficiency • Renewable Energy	Must be commercially sustainable and employ known climate technology; a Danish company must participate in the project (or it must relate to a Danish economic interest)
GEF Trust Fund/ Multilateral	• GEF	• Grant	• Worldwide	• 3000 mn over 2015–2019	• Climate change • Energy Efficiency • Renewable energy	Countries eligible to receive World Bank financing or UNDP technical assistance through its target for resource assignments
Germany's International Climate Initiative/Bilateral	• Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), Germany		• Developing countries	• 1085 mn	• Mitigation • Adaptation	Projects in IKI's four areas of support: mitigation, adaptation, conservation of carbon sinks, and biodiversity
Green Climate Fund/Multilateral	• COP (UNFCCC) and Green Climate Fund Board	• Grant, Concessional loan, Guarantees, Equity	• Worldwide	• 100 (bn)	• Adaptation • Mitigation • REDD| • Technology transfer • Capacity Building	All developing country parties to the UNFCCC
IFC Partial Credit Guarantees/Multilateral	• IFC	• Loan Guarantee	• Worldwide	• N/A	• Adaptation • Mitigation	In accordance with IFC investment guidelines
IFC Risk Sharing Facility/Multilateral	• IFC	• RSF	• Worldwide	• N/A	• Adaptation • Mitigation	In accordance with IFC investment guidelinesrc
International Climate Initiative (Germany)/Bilateral	• BMUB, Germany	• Grant Loan	• Worldwide	• 138 mn p.a.	• Adaptation • Mitigation	Climate and biodiversity projects in developing countries and countries in transition
Japan's Fast Start Finance/Bilateral	• Japanese Ministry of Finance	• Grant Loan ODA Guarantees	• Worldwide. Approximately 50% of Japan's grant aid is focused on adaptation in LDCs	• 15 bn (11 bn public, 4 mn private)	• Agriculture • Energy Efficiency • Renewable Energy	Developing countries that have entered direct bilateral discussions with the Japanese government; some private sector actors may also be considered
KfW Development and Climate Finance/Bilateral	• KfW	• Grant Loan ODA Structured financing	• Worldwide	• Varying, dependent on project	• Energy • Agriculture • Water • Technology	Public and private entities

Korea Green Growth Trust Fund/Multilateral	• World Bank	• Grant Technical assistance	• Worldwide	• 40 mn (additional funding pending approval	• Energy • Environment • ICT • Water	IBRD/IDA country members
Least Developed Countries Fund/ Multilateral	• GEF	• Grant	• Worldwide	• 932 mn	• All	All LDC parties to UNFCCC
MDB Pilot Project for Climate Resilience/Multilateral	• MDB Climate Investment Funds (CIF)	• Grant • Loan • ODA	• MDB countries	• 1 bn	• Climate Resilience • Energy • Infrastructure • Low-Carbon • Sustainable Land Management • Water	MDB eligibility, in the following countries: Bangladesh; Bolivia; Cambodia; Mozambique; Nepal; Niger; Yemen; Zambia
Nordic Climate Facility/Multilateral	• NEFCO	• Co-financing	• Africa • Asia	• 289–578k	• Energy • Sanitation • Water	Applicant must be an active institution holding a registered place of operations in Scandinavia; average turnover of the applicant must be at least double the NFC funding requested
Nordic Environment Finance Corporation Carbon Finance and Funds/Multilateral	• NEFCO	• Grant • Technical Assistance	• Eastern Europe • China • South Asia • SE Asia	• 190 mn	• Energy Efficiency • Fuel Switching • Renewable Energy	Projects should be within the requirements of COP 21
Public-Private Infrastructure Advisory Facility/ Multilateral	• World Bank	• Grant Technical assistance	•Worldwide	• 15 mn	•Adaptation •Capacity Building	Developing or transitioning economies in the OECD
US Global Climate Change Initiative/ Bilateral	• USAID	• Grant • Loan • Guarantee	• Developing Countries	• 350 mn p.a.	• Clean Energy • Sustainable Landscape • Resilience	Developing Countries
World Bank Carbon Funds and Facilities	• World Bank	• Carbon finance	••Worldwide	• 2.5 mn	• Energy, Energy Efficiency, Agriculture	World Bank/IDA Countries

TABLE 4: MAJOR PE INVESTORS THAT HAVE INVESTED IN INDIA'S RENEWABLE ENERGY SECTOR

Investor	Invested in	Investment Total	Year
Helion Ventures, Mauritius			2008
IDFC Alternatives, India	Mytrah Energy		2010
JP Morgan Chase, US	Leap Green Energy	USD 200 mn	2010
IDFC Alternatives, India	Green Infra		2011
Morgan Stanley Infrastructure Partners, US	Continnum Energy	USD 212 mn	2012
Goldman Sachs, US	Renew Power	USD 135 mn	2013
Goldman Sachs, ADIA, Global Environment Fund, US	Amplus Energy	USD 150 mn	2015
GE Financial Services, US	Welspun Renewables	USD 570 mn	2015
Actis, UK	Ostro Energy	USD 30 mn	2015
I Squared Capital, US	Amplus Energy	USD 150 mn	2015
GIC, Singapore	Greenko Enegy Holdings	USD 256 mn	2016
GIC, Singpaore and Abu Dhabi Investment Authority	Greenko Energy Holdings	USD 230 mn	2016
IFC	Hero Energy	USD 125 mn	2016
Caisse de Depot et placement du Quebec	Azure Power	USD 180 mn	2016
Piramal Enterprise (India), APG Asset Management (Netherlands)	Essel Green Energy	USD 132 mn	2016
Asia Climate Partners and Olympus Capital Asia, Hong Kong	Suzlon	USD 200 mn	2017
Macquarie Group, Australia	Hindustan Power Projects	USD 600 mn	2017
Abu Dhabi Investment Authority (CDPQ), Canada	Renew Power	USD 265 mn	2017
Piramal Enterprise (India), APG Asset Management (Netherlands)	Essel Green Energy	USD 132 mn	2016
Asia Climate Partners and Olympus Capital Asia, Hong Kong	Suzlon	USD 200 mn	2017
Macquarie Group, Australia	Hindustan Power Projects	USD 600 mn	2017
Abu Dhabi Investment Authority	Renew Power	USD 265 mn	2017

1.5 REGIONAL RENEWABLE ENERGY TARGETS

Because of pressure to align renewable energy targets with the UNFCCC global targets and a general need for South Asian countries to improve their electricity supply, there has been a concerted push to target renewable energy development in the region. India has set a precedent by committing to 175 GW by 2022; neighbouring states have made a significant attempt to broaden the market for green developments (see Table 5). In this case, run-of-river hydropower was classified as a renewable energy asset class.

POTENTIAL MARKET

Although different countries in the region hold varying targets for renewable energy development, there appears to be an effort to scale up on grid supply from hydro, wind, and solar. This presents an opportunity for foreign direct investment into the renewables market in South Asia, which totals 196,785 MW.

Assuming a 60/25/15 regional percentage mix between solar PV, hydropower, and onshore wind respectively, the size of the potential market is reflected in Table 6. This mix is not based on scientific calculation but merely one of many estimated scenarios of how South Asia's 196,784 renewable target could be managed.

TABLE 5: REGIONAL INSTALLED CAPACITY AND RENEWABLES TARGET

Country	Installed Capacity (MW)	2030 Target (MW)	2030 Renewables Target (MW)
Bangladesh	13,179	34,000	3,400
Bhutan	1,615	10,000	8,385
India	282,023 (country wide) Bihar: 2,759 Uttar Pradesh: 15,721 Uttarakhand: 3,177 West Bengal: 9,563	500,000	175,000
Nepal	1046	10,000	9,030 (80% hydro and 20% solar)
Pakistan	24,850	40,000	2,000

TABLE 6: REGIONAL POTENTIAL RENEWABLE MARKET

Energy Asset Class	Cost per MW (USD)	Potential Market (MW)	Cost of Market Materialising (USD)
Solar PV	800,000	118,071	94,456,800,000
Hydropower	2,000,000	49,196	98,392,000,000
Onshore Wind	1,450,000	29,517	43,799,650,000

1.6 CARBON FINANCING

Certified emission reduction (CER) credits are emission units equivalent to a tonne of CO2. They are issued by the Clean Development Mechanism (CDM) of the United Nations Framework Convention on Climate Change (UNFCCC). Emission reducing projects generate CER credits and may be purchased to meet Kyoto targets.

CER prices have declined since 2012. The prices were around EUR 15/tonne of CO2 and have decreased significantly to EUR 0.23/tonne of CO2. In Nepal, AEPC facilitates the process of registering projects to the CDM. According to AEPC, carbon credits in Nepal are purchased by the World Bank, ADB, and KfW.

INCENTIVES FOR DEVELOPERS

Our conversations with stakeholders in Nepal suggested little confidence in the continued deployment of carbon permits. Projects eligible to subscribe for CERs in Nepal, including Arun 3 and Upper Karnali, have not applied for them, which suggests they do not provide significant incentives.

IS THERE POTENTIAL FOR A CARBON MARKET TO EMERGE IN NEPAL?

Given the ineffective role of CERs in stimulating private developers' confidence, the position of the UNFCCC in encouraging publically managed carbon credits is questionable. It may take a broader market for carbon credits to emerge as a palatable incentive for developers.

A market for carbon credits, also known as an emissions trading scheme (ETS) for carbon, operates by taxing carbon through quotas. While governments may differ on implementation policies, the underlying aim is clear: set a limit on the quantity of total emissions for industries included in the carbon market. Carbon markets are justified based on the theoretical notion

FIGURE 5: ICE ECX CER FUTURES FROM 2012–2017

Source: Marketwatch.com

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