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**GREEN ENERGY FINANCE IN INDIA:  
CHALLENGES AND SOLUTIONS**

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**Abstract**

India's energy sector is experiencing a transition with increasing penetration of renewable energy in the energy mix. One of the major impediments in the process of such a transition is to secure the necessary finance to achieve the transformative goal of producing 175 gigawatts of renewables by 2022. The problem gets compounded with limited budgetary resources available, conjugated with difficulties associated with mobilizing private capital for the sector. With this backdrop, the present paper offers a granular understanding of the associated challenges of mobilizing such finances, drawing from the Indian perspective. It contributes to the present understanding by identifying the emerging pathways of financing renewables and the inherent challenges. The findings are quite revealing. Financing of renewable energy in India continues to face multiple conundrums, largely entrenched with the nature of current financial market in India in general, such as short tenure of loans, high capital costs, and lack of adequate debt financing etc., as well as with the sector specific issues of the renewable energy sector. The success of introducing innovative financing mechanisms and instruments requires necessary conditions to prevail.

**JEL Classification:** N55, O13, O38, Q42, Q48, Q58, G20

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# 1. INTRODUCTION

The energy sector of any economy holds critical importance for realizing its developmental goals (IEA 2015). The primacy of energy, however, has received a renewed thrust in an era where the nexus between energy and climate change has occupied the central position in the policy agenda and requires strategic energy sector interventions to arrest the imminent threats of climate change. India, being one of the fastest growing economies across the globe,<sup>1</sup> has, of late, witnessed major transformations in its energy systems and structures with strategic policy thrust on promoting renewable energy. This is also in line with India's growing strategic global importance as a country that increasingly assumes center stage in global renewable energy order. A glaring example of such strategic importance is evident from the lead taken by India in forming the International Solar Alliance (ISA) on 1 December 2015, with a goal to mobilize joint global efforts to address the climate change concerns. This conscious policy decision to promote renewables has become imperative with burgeoning domestic energy demand spurred by high economic growth, rapid urbanization through initiatives like Smart City projects, and recent industrialization measures such as 'Make in India'. Not only is this the policy priority of the Government of India to provide 24X7 electricity to all the households by 2019, but it is expected to add about 600 million new electricity consumers by 2040, leading to a significant increase in demand (IEA 2015). Studies have asserted that there would be a dramatic rise in the electricity demand in the country, leapfrogging from the present capacity of 300 GW to more than 1,000 gigawatts (GW) by 2040 (IEA 2015).

Hence, charting the future energy trajectory of the country that is more secure, sustainable, and technologically advanced looks challenging. Challenges loom large as the Indian electricity sector continues to suffer from multiple distortions. Operational constraints, such as declining capacity factors (Buckley and Shah 2017), poor financial health of power distribution utilities, and infrastructural-related constraints continue to disrupt the electricity sector of the country. On the top of this, India is infamously known as one of the energy deprivation hotspots globally, with per capita availability of electricity close to one-third of the global average and about 239 million people are still deprived of basic minimum access to electricity (IEA 2017). However, despite the presence of such anomalies, a transition to a low-carbon regime with a specific thrust on renewable energy looks promising. The early signs of such transitions are already visible. For instance, the year 2017 has been recorded as a landmark year in the history of renewable energy development in the country primarily because of two important considerations; one is that for the first time, the renewable energy capacity addition has outpaced the conventional capacity addition for the first time in the history of India (BNEF 2017); second, the year 2017 also witnessed an unprecedented fall in the renewable energy price, in particular the price of solar and wind energy, falling below INR 3 per kWh, which is roughly less than \$0.5 per kWh (Buckley and Shah 2017). However, the process of this transition to a low-carbon energy regime is not smooth. Though the promise looks worth strategizing, renewable energy development confronts a host of structural, governance, and institutional hurdles. Despite clear strategic policy thrust on promoting renewable energy in the country, the vision continues to be blurred by the country's complex political system and the multiplicity of institutional settings governing the energy sector. The ownership structure of the renewable energy sector in India also causes some form of hardships for the sector. Renewable energy, unlike the conventional forms

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<sup>1</sup> India grew at a rate of 7.7 % in quarter 4 (i.e., January–March) of 2018, making India the fastest growing economy in the world.

of energy, is primarily driven by private sector. This is evident from the fact that while two-thirds of conventional power generation capacity is with the direct ownership of Central and State governments, in the case of renewable energy, the entire responsibility of developing the sector rests with the private sector (Gol 2015a). Given the emphasis on private-sector-driven and commercially focused renewable energy development in the country, one of the major concerns for the sector revolves around mobilizing the required finance (IEA 2015). More specifically, mobilizing cheap and adequate finance to achieve the ambitious target of 175 GW of installed renewable energy capacity by 2022 appears to be a major stumbling block (Shakti Foundation and Crisil India 2015). One of the key questions related to the financing of renewable energy is “where would all these finances come from?” Given that the onus of renewable energy development in India rests on the private sector, which is more sensitive to associated risks and uncertainties, it looks more challenging.

In this context, the present paper carries out a critical analysis of renewable energy financing in India. The purpose of this paper is to have a granular understanding of the structure and pattern of renewable energy financing in India and to identify key hindrances that act as barrier to mobilize the necessary finance for the sector. It contributes to the present understanding of the financing of renewables by identifying the modalities of renewable energy financing and the associated challenges drawing from the Indian context.

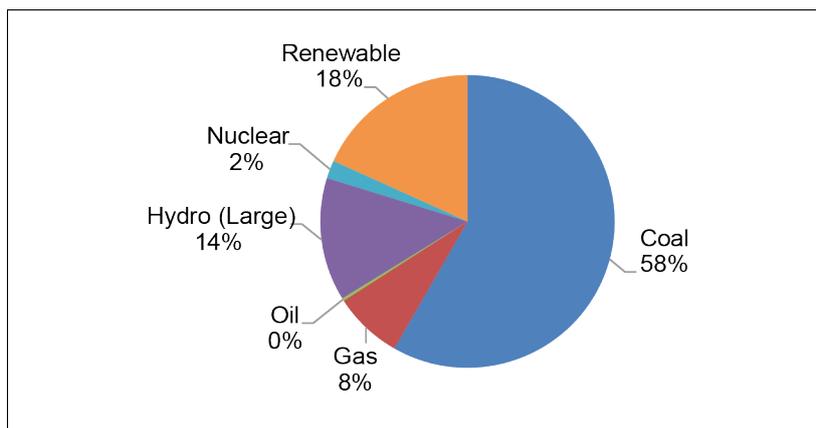
The paper is organized as follows. Section II offers a brief outlook of renewable energy in India by highlighting the current energy mix and the transition in terms of future projections. The third section details out the structure and pattern of renewable energy financing in India. Section IV briefly highlights the key instruments and incentive structures for the financing of green energy in India. Finance-related challenges and possible solutions are discussed in Section V. The final section offers concluding remarks.

## **2. RENEWABLE ENERGY IN INDIA: A BRIEF OUTLOOK**

The genesis of renewable energy development in India could be traced back to the global oil crisis in late eighties. The Government of India has been, since then, striving consistently to develop renewable energy sector with a set of strategic policy and regulatory measures. Given the constitutional status of energy as a concurrent item—entry 38 in the concurrent list—strategic policy initiatives are framed from time to time both by the federal government as well as provincial governments to expand the renewable energy sector. However, the most recent policy thrust to transit to a greener energy regime is manifested in the Government of India’s transformative energy vision to produce 175 GW of renewable energy by 2022. Solar power has been given a place of pride in the renewable basket with the specific policy pronouncement of the Jawaharlal Nehru National Solar Mission (JNNSM). Similar policy-level initiatives, such as provision of 24 X 7 power availability across the country by 2019, are clear reflections of the thrust laid on renewable energy. This emphasis also further reiterated by India’s global climate pledges made to UNFCCC through Intended Nationally Determined Contributions (INDCs). The global climate commitment to sourcing 40% of its energy from renewable energy by 2040 is a clear indication of policy-level priorities on renewable energy (Gol 2015b).

Not only this, but the current energy mix also indicates such changing policy focus on energy generation with increasingly larger share of renewables in the country’s energy basket. Figure 1 captures the installed capacity of the country by source.

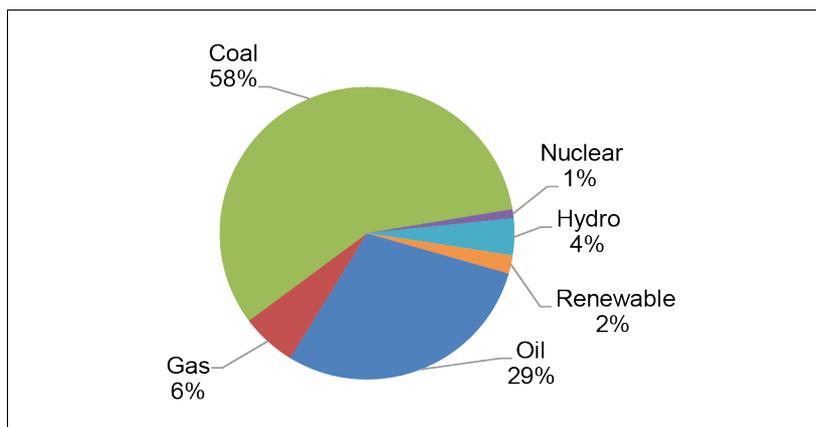
**Figure 1: Energy Mix by Installed Capacity in India in 2017**



Source: CEA (2017).

It is clear from the above figure that renewable energy generation capacity in the country has touched a new height with about 18% of the share constituting about 57,245 MW of the total capacity of the country. A further decomposition of this installed capacity shows that about more than 50% of this installed capacity is wind energy capacity, about 20% capacity is solar energy capacity, and rest are small hydro, biomass, and waste-to-energy sources. However, the most recent trend suggests that solar power is occupying an increasingly larger space in the renewable energy basket.

**Figure 2: Primary Energy Consumption in India in 2016**



Note: Renewables (including biofuels).

Source: BP (2018).

However, mapping of primary energy consumption does not really point to such a transition, primarily due to over reliance on biofuels and oil products (Figure 2). This clearly reflects that rural India continues to depend on fossil fuels for its primary energy consumption. This also reveals that India has a long way to travel in terms of complete energy transformation.

On other hand, renewable energy as a source of electricity has been fast replacing other sources of energy in the country. It can be gauged from the various growth projections of renewable energy made for the country. For instance, the National Action Plan on Climate Change (NAPCC) targets aim to have 15% renewable energy consumption by

2020. Estimates by the NITI Ayogo's "heroic scenario" presents a very ambitious future target of 410 GW of wind and 420 GW of solar by 2047 (Gol 2014). The most important projections are made by IEA in its New Policy Scenario (IEA 2015). It suggests that electricity generation capacity in the country will increase more than three times by 2040, with compound annual average growth rate of about 7% per annum. The detailed projections by IEA under the New Policies Scenario are presented below in Table 1.

**Table 1: Power Generation Capacity by Type in India  
in the New Policies Scenario  
(GW)**

	2014	2020	2030	2040	Shares (%)		CAAGR*
					2014	2040	2014–2040
Fossil fuels	204	280	419	576	71	53	4.1
Coal	174	230	329	438	60	41	3.6
Gas	23	41	76	122	8	11	6.6
oil	7	9	13	15	3	1	2.9
Nuclear	6	10	24	39	2	4	7.6
Renewables	79	147	304	462	27	43	7
Hydro	45	58	83	108	15	10	3.5
Wind	23	50	102	142	8	13	7.2
Solar PV	3	28	100	182	1	17	16.4
Other	7	11	18	30	3	3	5.5
Total	289	436	746	1076	100	100	5.2

\* Compound average annual growth rate.

Source: IEA (2015).

### 3. STRUCTURE AND PATTERN OF RENEWABLE ENERGY FINANCING IN INDIA

Technological artifacts of renewable energy systems are significantly different from the conventional power system. Hence, the cost elements also differ for both the sectors. The cost characteristics are such that renewable energy projects are highly capital-intensive in nature, with zero fuel cost (Bhattacharyya and Maheswari 2010; Hirth and Steckel 2016), in contrast to conventional energy systems. These zero recurring costs do have positive implications on the average electricity prices, which are less volatile in nature. Considering the technological characteristics of the sector, it has been projected that an investment requirement to meet the ambitious target set by the Government of India of setting up 175 GW would be around \$189 billion (CPI 2016).

It is interesting to dwell more on the market structure of renewable energy in India. Unlike the conventional energy sector, the onus of developing the renewable energy sector is with the private sector. The challenge for the sector is then to mobilize private capital at a pace and rate in tune with the policy targets and goals. This is imperative due to the limited availability of public budget. Whatever limited public financing is available, it is primarily used as support funding to incentivize private capital to flow into the sector. It is built on the premise that private sector has the potential to fund the sector; however, it requires an enabling framework to be created by the government.

A deconstructed financial mapping for the sector reveals that the renewable energy sector is being driven by private investors and there is reliance on banking institutions to mobilize the necessary finance (Yoshino and Taghizadeh-Hesary 2015). However, there has been a reluctant attitude among the banking communities to finance renewable energy projects primarily due to associated risks and uncertainties with these projects (Yoshino and Taghizadeh-Hesary 2017). This is evident in a recent study that clearly brings out that a substantial amount of finances from government-owned banks and other financial institutions have been flown into coal projects, rather than renewables (CFA 2018). This financing pattern is also very much in alignment with the debt-equity type of financing, where 70% of funds are sourced from debt and 30% are mobilized as equity funding. It is also contended that the debt costs of renewable energy projects in India is 24% to 32% higher than what it is in the United States and Europe, calculated on the basis of the levelized cost of energy (CPI 2012). On the other hand, the equity component of financing, traditionally, provided by the project developers, has experienced a metamorphosis. Recent financing patterns reveal that equity funding is provided by third parties, such as private equity (PE) investors. This is evident as equity investment in renewable energy in India is gradually moving from balance-sheet financing to project-based financing (Bhattacharyya and Maheswari 2009; CEEW and NRDC 2014).

Though the financing structure of renewable energy in India is dominated by bank finances, of late, a variety of investors are found in the renewable energy space in Indian market. They range from commercial banks to private equity investors, institutional investors, and to development banks. The table below (Table 2) maps the presence of various types of investors in the renewable energy market. It can be observed from the table that the most recent type of investors in the space is the venture capital type of investors to support the equity component under the project-based financing mode. However, the presence of foreign banks is conspicuous by their absence.

**Table 2: Mapping of renewable energy investors in India**

Types of investors in renewable energy space in India			
Type of Investors	Category	Total Registered in India	Active in Renewable Sector
Commercial Banks	Public Sector Banks	26	9
	Private Sector Banks	30	6
	Foreign Banks	37	0
Equity Investors	Private Equity	51	16
	Venture Capital	180	21
Institutional Investors	e.g., Insurance Funds, State-owned, and bilateral and multilateral institutions	24	11
Development Banks	Development financial institutions such as IREDA, IFCI, SIDBI	3	3

Source: CPI (2012).

A detailed bank and non-banking financing of renewable energy projects reveals that about \$2,570 million have been committed by several banks (Please refer to Table 3). Of this, about 20% of the amount has been committed by IDFC. The table also clearly reflects the fact that the commitments are largely made by non-banking financial institutions.

**Table 3: Commitments Made by Different Financial Institutions for Renewable Energy**

Bank	Share of Total Committed Amount (%)
SBI	12.6
IREDA	10.9
Yes Bank	10.2
Indus bank	9.3
India Infradebt	8.2
PTC India Financial Services	5.4
Union Bank of India	5.3
Bank of Baroda	4.2
IDFC	20.2
L & T Finance Holdings	13.7

Source: CFA (2018).

#### **4. RENEWABLE ENERGY FINANCING IN INDIA: INCENTIVES AND INSTRUMENTS**

Renewable energy financing in India reveals some interesting evolution and patterns. A variety of incentives and instruments are present in the Indian market to support renewable energy financing. The present section attempts to briefly highlight the most important incentive schemes and instruments of renewable energy financing in India. Historical analysis of the incentive structures for the renewable energy could be traced back to the year 1992 with the creation of a separate Ministry at the center, rechristened later as the Ministry of New and Renewable Energy (MNRE) in 2006. Since the very beginning, various incentives have been provided from time to time to accelerate the growth of the renewable energy sector in India. It is observed that there has been a transition from publicly supported incentive mechanisms for renewable energy development in the country to more of a competitively based incentive regime. Most relevant incentive schemes prevalent in the renewable energy space in India and which have bearings on the financing of the sector are of three important types i.e. accelerated depreciation (AD), generation-based incentive (GBI) schemes, and viability gap funding (VGF). AD is essentially a tax-based incentive on the tax returns of the project developers. AD provides financial incentives to investors by relaxing its tax liability on the investment. It was introduced in 2009 and continues as a mainstream incentive scheme for wind projects until 2012. This was again reinstated in 2014 and continues to date with some modifications. For instance, the latest information shows that solar projects are eligible to avail depreciation of about 40% of their investment (Bridge to India 2017). Generation-based incentive mechanisms (GBI) offer an incentive per kWh of grid interactive solar and wind energy generation. One of the prime goals of this incentive mechanism was to mobilize a variety of independent power producers with a focus on promoting generation rather than only setting up projects (Chaudhary et al. 2014). This

incentive is over and above other incentives such as feed-in-tariffs, which are provided by state utilities. However, these incentive schemes are largely withdrawn for utility scale projects, primarily due to the rapid growth of the renewable energy market, leading to a dramatic fall in tariffs, which have almost achieved parity with thermal power tariffs. As a consequence, there have been new forms of smart incentive schemes introduced, such as viability gap funding (VGF), a mechanism to finance economically justifiable infrastructural projects that are not financially viable. This is usually a one-time grant provided by government to make projects commercially viable. The VGF scheme has been used by the Solar Energy Corporation of India (SECI) to promote solar energy generation in the country. The latest available statistics show that about 785 MW of tenders are considered to avail the VGF incentive. Apart from the above, solar projects used to receive a 10-year income tax holiday, which has been scrapped from April 2017. However, these incentive schemes are either redesigned or downscaled with a dramatic fall in renewable prices in the country. In addition, there exist a gamut of policy instruments, such as renewable portfolio obligations (RPO), renewable energy certificates (REC), and feed-in-tariff (FiT) schemes to drive the renewable energy sector in the country. RPO essentially mandates power distribution utilities and other obligated entities to procure a certain percentage of electricity from renewable energy sources. These schemes are part of regulatory requirements to transition to a green regime in India. However, issues exist related to the compliance of such obligations, primarily due to concerns related to the financial health of electricity distribution utilities at the provincial level. This happened despite interventions by the Supreme Court of India. This compliance problem also has led to the piling up and oversupply of renewable energy certificates (RECs). The current RPO statistics indicate that percentages vary significantly across states, such as 0.6% in Meghalaya to 10% in Karnataka for non-solar RPO. These regulatory requirements have also gradually become irrelevant with the introduction of competitive-bidding mechanisms as a procurement mode of renewable energy.

The discussion of renewable energy financing in India is incomplete without a discussion of the key organizational structure devised for the sector. Given that technical contours of the renewable energy sector are different from other economic sectors, attempts have been made by the Government of India long ago, in 1987, to create a non-banking, dedicated financial institution, called the Indian Renewable Energy Development Agency Limited (IREDA), as a Government of India enterprise to promote renewable energy projects through financial assistance. This institution works under the aegis of the Ministry of New and Renewable Energy (MNRE) of the Government of India and offers financial support to renewable energy projects by offering soft loans, counter guarantees, securitization of future cash flows, etc. Beyond, IREDA, organizations such as the Power Finance Corporation (PFC), Rural Electrification Corporation (REC), and National Bank for Agricultural and Rural Development (NABARD), are the key government agencies providing required finance for the renewable energy sector. Apart from the above, there exist a host of banking and non-banking institutions offering various financial services to accelerate renewable energy growth in India. Apart from that, there have been efforts made to create new institutions, mechanisms, and instruments to drive renewable energy development by providing alternative funding avenues. This section briefly highlights all of them.

## 4.1 National Clean Energy and Environment Fund (NCEEF)

NCEEF is one such funding mechanism available to support, *inter alia*, renewable energy financing in India. The fund was created to support entrepreneurial ventures and research in the clean energy technologies by mobilizing funds through a cess on coal of INR 400 per ton known as Clean Environment Cess. The fund has been operational since 2011–12 and is primarily aimed at mobilizing additional resources to support clean energy development. Part of the fund gathered from the NCEEF is utilized by IREDA to lend to banks at a 2% rate so that this money can be lent to various renewable energy projects at a concessional rate of interest not exceeding a 5% rate. The budgeted estimates for the year 2017–18 shows that about 53,410 million INR has been allocated to the Ministry of New and Renewable Energy (MNRE) under various heads to support renewable energy development in the country.

However, there exist several concerns with the fund. First, the renaming of the fund from 'Clean Energy Cess' to 'Clean Environment Cess' is a clear reflection of broad-basing the use of the fund for multiple purposes—essentially diverting the money for purposes not meant for. For instance, a recent assessment carried out on NCEEF shows that an increasing amount of the fund is diverted toward projects other than renewables (CSE 2017). The fund lacks appropriate monitoring mechanisms to oversee whether the financed projects have achieved their goals or not. There have been concerns with the allocation of resources for different projects as well as operationalization of the fund. It is argued that the cess has created a mess in utilizing the fund and diverting to areas that were not prioritized during the design of this funding scheme. A clear reflection of such mess is reflected in the Government of India's recent policy to use the fund to finance the Goods and Services Tax (GST) compensation fund and on *Namame Ganga*—the project to rejuvenate the river Ganges.

## 4.2 Recognition of Priority Sector Lending

Considering the importance of the sector and the need for mobilizing capital by the private sector, RBI has categorized the renewable energy sector as a priority sector lending in April 2015. The primary purpose of such categorization, *inter alia*, is to enhance employability, build basic infrastructure, and strengthen the competitiveness of the economy. The RBI guidelines suggest that 40% of the net credit of banks should be lent out to the priority sectors. However, there is cap put on the bank loans for renewable energy projects. The loan ceiling has been kept at \$2.3 million per borrower (INR 15 Crore) for renewable energy projects such as solar power generators, biomass-based power generators, wind mills, micro-hydel plants, and for non-conventional-energy-based public utilities viz. street lighting systems, and remote village electrification (RBI 2015).

Though the effort to list the sector in the priority lending sector is praiseworthy and can enhance the ease of doing business. However, the current trend shows that it has not resulted in flowing in the required finance from bank to the sector. One of the reasons is due to the clubbing of renewable energy within the larger umbrella of 'energy,' resulting in a larger chunk of money flowing into the non-renewable energy sector. Given the magnitude of the exposure of the power sector to bank loans, it becomes a cumbersome affair to mobilize additional loans through the priority sector lending route.

### 4.3 Soft Loans from IREDA

IREDA extends loans to the renewable energy project developers that bear low interest rates. The funding is routed through various modes, such as direct lending and lending through various financial intermediaries such as providing various lines of credits to NBFCs, and underwriting of debts etc. IREDA also uses the NCEEF to provide subsidized debt at a 5% rate of interest to renewable energy projects through select banks. IREDA often sources funds from international agencies and banks to provide such loans for renewable energy projects. For instance, European Investment Banks (EIB) has provided a long-term loan of Euro 150 million to fund clean energy projects recently. Similarly, the World Bank has provided \$100 million to IREDA to promote and develop solar parks. Along with the soft loans, IREDA also offers other services, such as providing a letter of comfort, discounting of energy bills, and providing credit enhancement facilities.

However, it has been reported that IREDA as an organization has not been able to continue as a leader in financing the renewable energy. There have been regulatory concerns with the financing of projects in terms of delay in sanctioning of loans. A recent study highlights that on average, sanctioning of projects is delayed by about 66 days beyond the prescribed norm of 90 days (CoPU 2017).

### 4.4 Green Banks

Green banks have emerged as an innovative tool for accelerating clean energy financing globally. Such dedicated financial institutions are proved to be a successful mechanism for leveraging the limited public finance to mobilize the required private capital into the sector. The first such effort in India can be traced back to the Indian Renewable Energy Development Agency (IREDA)'s plan in May 2016 to explore becoming the first green bank in the country. This idea was conceptualized with an understanding that it would utilize limited public funds to mobilize private funds in order to meet the overarching clean energy goals of India. This was the result of a two-year discussion among various government agencies such as MNRE and IREDA and other stakeholders. Several other commercial banks in India have also taken initiatives toward converting to green banks. For instance, the State Bank of India (SBI) offers long-term loans at concessionary rates of interest to renewable energy projects. Green banks have the potential to reduce the lending rates and offer flexible finance to match the needs of renewable energy financing. It is posited that a green bank system in India could address the persisting finance-related challenges, such as minimizing foreign-exchange risks, setting up an escrow facility, providing blended lines of credit, etc.

There have been a host of concerns associated with the green banking initiative in India. One of the basic concerns is about the legal sanctioning of such initiatives. While the need for such banks is felt in every nook and corner, regulatory mechanism in terms of recognition of these new form of institutions by the Reserve Bank of India (RBI) is very much imperative. The goal that green banks will mobilize the necessary finances at a cheaper rate has not been successful in India. This is primarily because of a lack of mainstreaming of such kind of financial institutions in the larger financial settings in the country.

## 4.5 Green Bonds

Green bonds are innovative market-based financing instruments (GIZ 2015). They are fixed-income financial instruments for raising funds for projects that are environmentally beneficial in nature. The risk holdings in the case of green bonds are similar to those of other bonds. Green bonds do have to also acquire the desired credit rating to attract institutional financing. Although the Indian experience of this type of financial instrument is nascent, they are increasingly being used in the Indian financial market of late. Another unique type of green bonds issued by IREDA is called Green Masala Bonds. India, being one of the top 10 global green bond issuers globally, has issued \$3.2 billion worth of bonds as of April 2017. Out of the total bonds issued during 2015–17, close to 70% of the proceeds were directed to finance renewable energy in the country (Climate Bonds 2017). Given the poor creditworthiness of the renewable energy sector, renewable energy project developers seek finance on preferential terms through sources like green bonds, which are usually issued by a bank or by an NBFC. These green bonds are then disbursed to the renewable energy projects in the form of loans. A step forward in this space was taken by the Security and Exchange Board of India (SEBI) in May 2017 with issuance of green bond regulations. Because of this, the issuance of green bonds in India has experienced a shift to \$6.5 billion.

It has been often argued that the given the Indian financial market and the schema<sup>2</sup> of green bonds, it may be doubted by investors whether funds gathered through green bonds will be utilized for the purpose for which the bond is issued. This also depends on the credibility of the bond issuer. Although the Indian banking system has created the necessary regulation to drive up the green bond market, the success of the green bond market largely depends on the risk perception of such instruments by the investors. The acceptability of these kinds of new instruments among investors requires generation of awareness among investors of such instruments, making the process standardized, and devising incentive mechanisms for both the issuer as well as the investors.

## 4.6 Infrastructure Debt Fund

This is again an innovative financing instrument for renewable energy financing in India. These funds can be created to accelerate and further the long-term debt in infrastructure projects. The current regulatory regime allows such funds to be lent to PPP projects. Such funds have been floated in the market by L & T IDF, Indiainfra debt, and IDFC IDF. Infrastructure debt funds can start investing in projects after one year of their operation. IDF is currently primarily used to refinance debt of infrastructure companies to mobilize up to 10% of their total outstanding borrowings through shorter tenure bonds and commercial papers (Centrum and FICCI 2016).

It has been reported that IDFs have yet make any impact in the country. One of the key reasons for such low growth of IDFs is the problem of availability of well-performing projects, resulting in much less use of this instrument in the renewable energy space in India.

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<sup>2</sup> Where the repayment is very much dependent on the issuer and not based on the success of the project.

## 4.7 Crowd Funding

Crowd funding has emerged as a new source of green financing in countries like North America and Western Europe and has experienced tremendous popularity. This kind of funding mobilizes funds from large number of small private investors to reach the desired scale. Hence, it is more of a decentralized funding mechanism to gather funds for renewable energy projects. This has become possible due to widespread use of information and communication technology (ICT). One recent example of such funding is by Sun funders. Crowd funding also has been employed in India in the rural electrification space. Bettervest—a German crowdfunding platform has been investing in ‘MeraGao Power’ and ‘Boond Engineering’—initiatives to energize rural India through renewables.

However, it appears that a proper regulatory framework for such innovative fund-raising mechanism has to yet to evolve in the country. It is also imperative to develop an understanding that such finances are necessary to drive renewable energy in the country.

Despite efforts taken to mobilize the required finance for the sector through a portfolio of sources, financing of renewable energy continues to be challenging for the sector. The assessment of current investment flows and patterns reveal that the investment flows fall short of the requirement to sustain the development needs of the sector. The next section identifies such key challenges and offers some plausible solutions.

## 5. CHALLENGES AND POSSIBLE SOLUTIONS

The challenges of financing renewable energy in India are intricately associated with the structure of the industry and investment character for the industry, which are largely shaped by the instrument types and sentiments of the investor. Given the capital-intensive nature of the sector and private sector led sectoral development, attracting the required type and size of investment continues to be a major roadblock for the sector. Over the years an array of innovative financing instruments and tools have been devised and employed; however, mobilizing adequate finance on cheap terms is very challenging (CPI 2012). In particular, labor and construction costs are significantly lower in India and more importantly, recently there has been a dramatic fall in the renewable energy prices<sup>3</sup> (Taghizadeh-Hesary et. al, 2018)—in particular prices of solar and wind energies. The attempt is made here to highlight some of the key challenges and offer possible solutions to minimize such challenges.

### 5.1 Institutional and Policy-level Complicacies and Uncertainties

Part of the problem is entangled with constitutional status of energy as a concurrent subject. The political setting of the country construes that the idea of cooperative federalism necessitates effective and continuous coordination between different political entities, such as federal government as well as provincial governments, to mobilize the required finance. This gets manifested in various policy pronouncements carried out by provincial agencies. For instance, the fixation of renewable purchase obligations (RPOs) by state electricity regulatory commissions (SERCs) appears to be devoid of logic

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<sup>3</sup> It has been reported that the dramatic fall in solar module prices is primarily due to low-interest, financed capital costs (Taghizadeh-Hesary et al. 2018).

(Chatterjee 2017). This somehow creates a degree of uncertainty, as the decision making for energy investments does not lie with the center alone, but also with provincial governments. This also creates market segmentation within the country, and India is not often considered as a single market by investors—including both domestic and foreign investors (GoI 2015a). The distributed nature of renewable energy resources unevenly spread across various regions of the country further intensifies this market segmentation. Given the size of the country and its administrative division into provinces, it can be envisaged that varied forms of markets exist in India with peculiar and different sets of risks and barriers. This market segmentation makes the renewable energy investment market volatile and short-term, resulting in opportunistic behavior on the part of investors (GoI 2015a). Along with the above, policy-level uncertainties also generate skepticism in the minds of the investors and hence banks are reluctant to provide the necessary finance for the sector. As renewable energy comes under the ambit of the larger power market, the problem of market segmentation also gets accentuated by the existing anomalies of the power sector in general. For instance, the balance sheets of distribution companies differ significantly depending on a multitude of factors. This aggravates this market segmentation problem and further hinders the inflow of private capital into the sector.

Some of these risks have been addressed by creating single window clearance facilities in some states like Tamil Nadu and Andhra Pradesh to expedite the process of clearance. For instance, these states have identified solar energy zones and solar energy parks to attract investors into the sector. This can be replicated in other states as well to streamline the process of investment into the sector.

## **5.2 Juxtaposing Renewable Energy within the Umbrella of the Power Sector**

Financing problems emerge partly due to the tagging of renewable energy as a component of the power sector. First, funding for the renewable energy sector is crowded out by the loans disbursed to conventional power projects (GoI 2015a). It is posited that investments in fossil fuel resources continue to dwarf green energy investments. Conventional energy projects attract a substantial amount of loan finance due to investors' confidence, whereas building confidence in the renewable energy projects will take some time.

Second, the Indian banking system, given its exposure to conventional sources of energy, is also on the verge of reaching the loan ceiling of 15% set by Reserve Bank of India (RBI 2015). Hence, every additional unit of bank finance becomes increasingly difficult to realize.

Third, the structural issues of power sector in general contaminate the financing of renewable energy in the country. Given the poor balance sheet of power distribution and utilities' and commercial banks' overexposure to power sector, banks are usually reluctant to lend further to the renewable energy. The latest statistics reveal that power sector exposure to bank loans constitutes about INR 2.3 lakh Crore. The fact that the Indian power sector is riddled with multiple infirmities, such as lack of compliance of power purchase agreements, and payment defaults resulting in payment risks, negatively impacts the financing of renewables and also influences the renewable energy sector development.

Fourth, the institutional and organizational architecture that has been built over years has been more susceptible to not performing well for renewable energy. For instance, unlike the conventional power sector, renewable energy is primarily being driven by the private sector. Hence, it is crucial to create credible intermediaries that would act as a facilitator for the sector.

Although the Government of India is striving hard to arrest such distortions of the power sector with innovative policy pushes, such as the UjwalDiscom Assurance Yojana (UDAY) scheme, to turn around the financial health of the sector, the sector continues to be mired by several infirmities. It is crucial to enhance the creditworthiness of power distribution companies through continuous reforms. Further, renewable energy should be reckoned as a separate sector within the banking industry.

### **5.3 Short Tenures and High Costs of Debt Financing**

Existing financial structures reveal that India continues to be the most expensive destination for investment in renewable energy, largely due to the high cost of debt. It has been reported that sharp distinctions exist between the costs for India and other countries largely due to high interest rates, short debt tenures, and lack of non-recourse debt (CPI 2012; Bridge to India 2013; CEEW 2016). Studies point that solar projects financed by banks and non-bank financing companies end up paying an exorbitant interest rate of about 13% (Bridge to India, 2013). Not only this, the nature of interest rates (i.e., variable interest rate) goes against the investors' interest. Usually, investors would prefer to secure debt at fixed interest rate. Short debt tenures also further aggravate the debt financing for the renewable energy sector in the country. Debts are available for a short tenure typically for a period up to eight years, whereas given the life span of most of renewable energy projects, a debt tenure of 12 to 15 years looks more promising (CPI 2012; Mytrah and PwC 2015). This conundrum is due to an asset-liability mismatch within the domestic banking system—a legacy issue with the Indian banking system. This asset-liability mismatch emerges from the very nature of the bank deposits, which are short-maturity in nature. Given that the Indian banking system has already experienced such anomalies with other infrastructure projects, they are very cautious and calculative when lending to renewable projects. The ideal financial market would be long-term financial markets such as insurance and pension funds. However, the long-term finance available through insurance and pension funds constitute only a small fraction of the household financial savings in India (CEEW 2016). Other non-banking financing companies also have limited ability to provide the required finance. For instance, in India, corporate bond markets have not been evolved as long-term investors (Mytrah and PwC 2015).

Above all, limited availability of non-recourse financing served as a major deterrent for new entrants into the renewable energy space (Mytrah and PwC 2015). A few renewable energy projects have availed this type of financing (Bridge to India 2013). There are also constraints on the supply side of the debt. One such constraint is in terms of sectoral limits set by internal investment committees. Debt financing also depends on how the equity is financed. If equity investment is not provided by the developer, but rather is mobilized through third-party investors, such as private investors and foreign investors, banks are often found to be hesitant to provide the required debt finance.

## 5.4 Risks and Uncertainties

A host of risks, such as policy and regulatory risks, perceived risks, technology-related risks, off-taker risks, and foreign-exchange risks are associated with renewable energy sector financing in India, given the nascent phase of renewable energy development in the country. Risks generate lot of uncertainties and hence further compound the availability of required finance.

Political setting and pattern of resource endowment holding generates a lot of risks. Regulatory and policy-level risks emanate largely from the nexus between renewable energy and power sector in general. The presence of policy and regulatory-level uncertainties, such as non-compliance of RPOs and uncertainties associated with the REC market, policy-level uncertainties about the future of various incentive schemes, pose major risks for the investors. Not only this, but there also exist project-development risks that emerge at various phases of project development. It has also been a concern that standard processes of project development, such as demarcating a location, process of land acquisition, getting the necessary permits, issues related to interconnections, etc. have not been developed for renewable energy projects in India in a systematic manner. There have been heterogeneous approaches followed across states, making it cumbersome for investors. It appears that the efforts are inadequate to further standardize the existing approaches for renewable energy project development. This can enhance the credibility of investors and can contribute to the cost-minimization efforts of the project developer.

Given that the renewable energy sector is new, the sector is vulnerable to perceived high risks (Umamaheswaran and Seth 2015). This emanates largely due to the presence of information asymmetry within the domestic banking sector about clean energy technological transformation and risks associated with policy and regulatory level (CPI 2012). Renewable energy investment is an unfamiliar type of investment among the investors. Given the limited history of renewable energy development in the country, investors do not always have past records to show the performance data/indicators. The required data or performance indicators are either not available or partly available. This enhances the perceived risks of the banking system, which eventually enhances the cost of capital (Diacore 2016). Not only this, even the success of the new instruments, such as green bonds, is based on the premise that the investors are well convinced of the purpose of such bonds. Often in developing country settings, investors are skeptical about the purpose and use of such instruments, further compounding the problem of mobilizing the necessary finance.

Technological risks emerge from the technological contours of the sector and its dynamic character. Renewable energy technologies, such as solar and wind, are fast-evolving technologies. The most recent advancement in this space is the battery and storage technology. Given the dynamic nature of renewable energy technology, skepticism always prevails among the minds of investors about the assets being stranded in future. Banks are not well-equipped to appreciate this transition of technological leapfrogging, and hence are reluctant to take risks by providing the required finance. Technological risks are also associated with the quality of renewable energy equipment and products, availability of resource data, error margin in the data, and availability of data in plant load factors or plant efficiency. These factors limit the comfort of investors, especially the debt investors in India. This can be minimized by gradually improving the standardization and certification process for the sector. Technological risks are also associated with a lack of adequate support infrastructure required for renewable energy generation and transmission. Inadequate and insufficient power evacuation infrastructure and risks associated with the stability of the grid to

integrate the evacuated solar power continues to deter the investments in the sector. Associated technological risks also can deter foreign equity investments into the sector. Sustained and continuous efforts to reform the electricity sector can minimize such risks.

There also exist a set of other risks for the sector largely around infrastructure. One such risk factor is associated with the acquiring of land for renewable energy projects. The estimated land requirement comes out to 9MW/km<sup>2</sup> for wind farms in India and, 35 MW/km<sup>2</sup> for solar PV projects (Gol 2015a). However, acquiring land becomes a cumbersome affair with the introduction of the new land law in the country in 2013, which has made the procedural requirement more stringent by redefining compensation payments and rehabilitation and resettlement benefits. The legislation also stipulates that potential developers in the private sector would require mobilizing the consent of at least 80% of the affected families in cases of land acquisition. Complications associated with acquiring land are not only felt during the project but also in pre-project development. For example, during the anemometry, masts are installed during the pre-development phase. In addition, land issues also emerge due to factors such as lack of clear guidelines for the utilization of land, ad hocism in maintaining land records, etc. (Thapar and Kumar 2017).

Another important risk is inherently associated with volatility of the foreign-exchange market, giving rise to foreign-exchange risks. This acts as a major deterrent to attracting the international finance into the sector. Hence, it is imperative to devise mechanisms to protect against foreign-exchange risks (Nelson and Shirmali 2014). Efforts have been made in this direction by devising a policy of adopting a dollar tariff policy with the facility of currency hedge for INR against key international currencies backed by government guarantee. However, it is contended that this mechanism is inadequate given the risk burden involved (CEEW 2016).

To minimize the aforementioned risks, it is important that some kind of public financing support is required in the high-risk areas. It is also imperative that some form of coordination should be there between federal government as well as provincial governments to minimize the transaction costs of potential investors. Given that renewable energy generates lot of positive externalities and continues to be characterized as 'merit good', it is important that public finance can be mobilized to mitigate such risks. The public sector should target to reduce the risk of private sectors by devising mechanisms to minimize such risks and constraints.

## **5.5 Poor Organization of Long-term Financing**

Long-term financing, which is imperative to meet the financial requirement of the sector, is poorly organized. For instance, the domestic bond market is at a very nascent stage and poorly crafted. There has been a tendency of investors to invest in low-risk and high-rating bonds, such as government bonds or AAA rating bonds, or other low-risk investment options. Given that the renewable energy market is still in a nascent phase of development, it has not been able to establish the creditworthiness to have independent bond issue, and hence has not able to attract adequate investors' interest.

Further, the long-term finance available through insurance and pension funds constitute only a small fraction of the household financial savings in India (CEEW 2016). Other non-banking financing companies have too limited an ability to provide the required finance. For instance, in India, corporate bond markets have also not evolved, as long-term investors such as insurance and pension funds are kept out of these markets by rating thresholds (Mytrah and PwC 2015).

It can be elicited from the above that the renewable energy sector faces a whole lot of risks of different types. Many of these risk factors can be minimized through government interventions. It emerged from a stakeholder survey carried out by NITI Ayogo that the public sector can act as a game changer by positioning itself strategically to minimize the risks of the sector (GoI 2015a). Some of the risks can be minimized by providing full and partial loan guarantees, underwriting the repayment of loans, socializing the costs of new transmission, creating necessary institutions to enforce the existing regulations and policy provisions, and facilitating foreign investments by assuming currency risks. For instance, as mentioned above, the government can support foreign renewable energy investors by reducing or removing the fees charged for sovereign investors and by absorbing hedging costs.

The government also can play proactive role in minimizing the risks and barriers faced during the project-development and project-commissioning phases by setting up a single window facility or by setting up Special Purpose Vehicles (SPV) that can hasten the process of acquiring land, getting necessary permission, connecting with the grid, and mitigating the risks associated with performance and curtailment. The market related risks, characterized by financial health of DISCOMs, policies related to open access, poor volume of transaction at short-term market, and grid integration issues, can be minimized by sustained and continuous reform of the power sector of the country. Some efforts have been already undertaken by government; however, still more is required to be done.

## **6. CONCLUSION AND POLICY RECOMMENDATION**

The assessment carried out in this paper clearly indicates that financing of renewable energy in India continues to face multiple conundrums. The problem is largely entangled with the nature of the financial market of India in general, such as short tenure of loans, high capital costs, and lack of adequate debt financing, etc. Sectoral contours further exacerbate the problem of mobilizing the necessary finance because of the technological specificities requiring high capital costs and almost no operational costs. In addition, inconsistencies at the policy and regulatory level, the juxta positioning of the renewable energy sector within the ambit of the power sector, and the lack of necessary support infrastructure, such as land, further compounds the problem. Efforts have been undertaken from time to time to minimize such risks and introduce innovative financing mechanisms that are in tune with the technological transitions and need of the sector. Innovative mechanisms, such as setting up of green banks, issuance of green bonds, infrastructure debt bonds, sourcing crowd funding, etc. are proved to be successful to some extent. This is evident, as recent statistics indicates that India globally is positioned as the third largest country in terms of energy investments (IEA, 2017).

However, given the transformative vision of producing 175 GW of renewable energy in the country by 2022, a whole lot more needs to be done. Most importantly, it is important that the government should act as a facilitator and should devise innovative policy mechanisms not only in terms of introducing innovative financing instruments, but also creating conducive environment which minimizes the associated risk factors. One such policy-level innovation calls for collaboration and a portfolio of investment arrangements. Collaborative efforts between a variety of stakeholders such as governments—both at the center as well as in provinces, financial institutions, investors, industrial agencies, and research organizations, can go a long way toward minimizing the risks. This has been well recognized by the NITI Ayogo in a recent report that lays down the renewable energy roadmap for India (GoI 2015a). There is also a need to improve and make the approvals and clearance systems more transparent to reduce the

transaction costs associated with such systems. This essentially requires further regulatory reforms in the sector. Provisioning of better technological data, better policy environments that involve continuously carrying out regulatory and tariff reforms, enforcing the regulations, and instituting robust and strong systems of permitting and approvals for new projects can address can create the necessary eco-system required for financing of renewable energy in India.

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