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MANAGING CREDIT RISK AND IMPROVING ACCESS TO FINANCE IN GREEN ENERGY PROJECTS

Purkayastha Dhruba

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Purkayastha Dhruba is the director of the US–India Clean Energy Finance Facility and works for the Climate Policy Initiative.

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Please contact the authors for information about this paper.

Email: dhruba.purkayastha@gmail.com

Asian Development Bank Institute
Kasumigaseki Building, 8th Floor
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500
Fax: +81-3-3593-5571
URL: www.adbi.org
E-mail: info@adbi.org

Abstract

The cost of finance has a relatively high impact on the returns and viability of clean energy projects compared with fossil fuel-based energy projects, because the operating costs for renewable energy projects are very low. Credit risk assessment and ratings, which have usually been an inappropriate measure of credit risk for clean energy finance, have a significant influence on the cost of finance. Factors like inadequate credit information, a lack of historical data at the project level, and the higher risk of technological obsolescence lead to credit market failure in clean energy finance, leading to mispricing of risk and poor capital allocation to clean energy infrastructure in the economy. Access to institutional finance is more constrained in the distributed renewable energy sector, as the transaction costs are high, consumer credit risk is high or unknown, and a variety of other challenges exist. It is important to ease these constraints, through appropriate policy and financing interventions to crowd in domestic banks, by improving the quality of credit information, both technical and commercial, creating suitable financial intermediaries, and providing risk mitigation solutions.

Keywords: corporate finance, financial risk, financing, ratings and rating agencies, renewable energy

JEL Classification: Q5, Q56

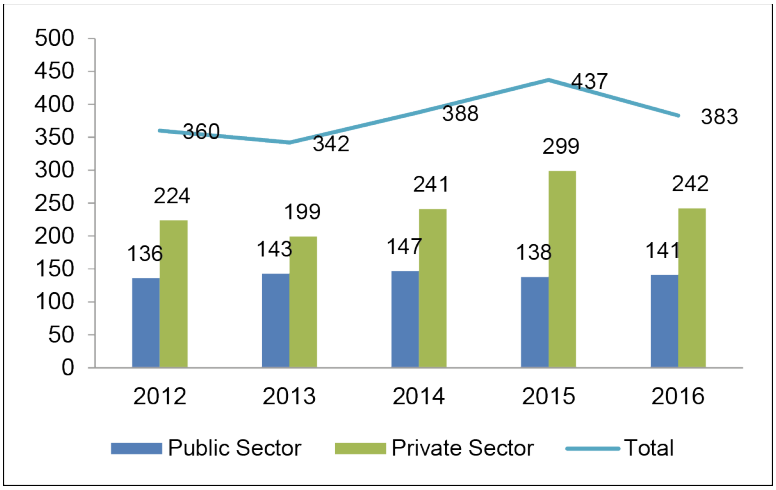
Contents

1. INTRODUCTION

The atmospheric concentration of CO_2 has been rising steadily. In 2016, the CO_2 levels in the atmosphere surpassed 400 PPM for the first time, and, in line with the projections, they are set to increase to the range of 500–1000 PPM by the year 2100 (IPCC 2014). This situation has garnered worldwide attention from governments, inter-governmental organizations, and corporations alike and has given a strong push for the uptake of green projects. It is possible to identify a project as a green project based on the actual project activity, classified as "use of proceeds" in financial data sets (IFC 2016). The project activity should provide environmental benefits in the broader context of environmentally sustainable development. These environmental benefits include, for example, reductions in greenhouse gas (GHG) emissions, the use of clean energy sources over traditional fossil fuel-based sources, and improved energy efficiency while utilizing the existing natural resources (G20 Green Finance Study Group 2016).

Green finance flows reached a record high of $437 billion dollars in 2015, followed by a 12% drop in 2016 to $383 billion, although this was still higher than the flows in 2012 and 2013. Taking annual fluctuations into account, the average flows across 2015/2016 were 12% higher than during 2013/2014 (Buchner et al. 2017), as Figure 1 shows.

Figure 1: Global Green Finance by Private and Public Actors
($ billion)



Source: Buchner, B. K., P. Oliver, X. Wang, C. Carswell, C. Meattle, and F. Mazza. 2017. "Global Landscape of Climate Finance 2017." Climate Policy Initiative.

The Green Climate Fund (GCF) has defined four strategic impact areas for the mitigation of carbon emissions—clean energy, sustainable transport, energy efficiency, and forests and land use. Clean energy has a major share in global mitigation efforts. The share of clean energy projects accounted for around 70% of the total green finance between 2015 and 2016, with investments of $312.2 billion and $241.8 billion, respectively (REN21 2017). These data show some progress in terms of the financing of green projects and clean energy projects; however, it still represents only a small fraction of global financing. Less than 1% of global bonds are labeled green, and less than 1% of the holdings by global institutional investors are green (G20 Green Finance Study Group 2016). In general, the institutional investor allocation to infrastructure is

small; for example, only 1% of global pension funds are invested directly in private and PPP infrastructure projects, and for green infrastructure projects, the figure is even lower (Della Croce 2011). In comparison, the total fossil fuel investments in the year 2016, at $825 billion (IEA 2017), were more than double those of green finance, $330 billion (Clean Energy Investment 2017).

For clean energy to play a central role in the growing energy demand, the share of renewables in the overall energy supply needs to double by 2030. This would require an average annual investment of more than $500 billion between 2015 and 2020, scaling up to an average of $900 billion between 2021 and 2030 (IRENA 2016). Researchers have estimated the cumulative investments that green infrastructure requires to be around $2 trillion per year until 2030, which is approximately 2% of the global GDP (Kaminker et al. 2013). The scale of investment necessary for green infrastructure is very large, and it would be necessary for private commercial sources to mobilize a large part of it through banking and institutional investor channels. The green investment allocation remains limited for a number of reasons, which include a lack of policy and regulatory certainty, investor inexperience, new technology, and a lack of suitable financing vehicles and instruments.

The high cost of finance is one such major factor that constrains green financing, particularly in the clean energy sector. The cost of finance is particularly important for clean energy projects because of their front-loaded capital structure, with capital costs accounting for up to 90% of the total lifetime costs. Access to low-cost finance can reduce the cost of clean energy by as much as 20% in developed countries (Zuckerman et al. 2016) and as much as 30% in developing countries (Nelson and Shrimali 2014). The cost of clean energy is contingent on the cost of capital, which is dependent on the credit risk perception of investors. Credit ratings usually measure credit risk in both the banking and the institutional investor channels, and credit ratings influence both pricing and capital allocation. Clean energy projects are a subset of infrastructure projects, and project finance structures usually finance them (with the exception of small distributed renewable energy projects, which may be more amenable to corporate finance). Emerging economies face even greater challenges, as the domestic funds are limited and expensive while foreign funds involve currency hedging costs that increase the cost of finance, thereby affecting the viability of the project. The availability of hedging solutions is also dependent on the credit ratings of the borrower or the project.

In terms of solutions to the barriers to clean energy financing, one category of suggested interventions focuses on credit risk mitigation to enable banking finance and structured financing to reach out to bond markets (IRENA 2016). The GCF has also advocated the use of risk sharing, credit enhancement, and guarantees for improving the access to institutional financing for green investments (Green Climate Fund 2017). Credit risk assessment approaches, including that of credit ratings, affect the cost of finance and therefore the pricing, the capital required, and the public cost of implementing risk mitigation solutions. This research paper focuses on credit risk assessment of clean energy projects, the implications of the use of credit ratings for credit risk assessment in clean energy projects to reduce the cost of financing, and possible credit risk mitigation mechanisms.

After the introduction, the paper consists of four sections, as described below:

1. A literature review and analysis of previous academic and industry research work on clean energy financing barriers and solutions.
2. The constraints to clean energy financing with a focus on credit risk assessment and the implications of the use of credit ratings for infrastructure and clean energy projects.
3. Risk mitigation solutions to improve the access to finance for clean energy projects, including measures to improve credit risk assessment for clean energy projects.
4. Conclusions and directions for future research.

2. LITERATURE REVIEW

Although the falling costs of renewable energy technology have significantly lowered the necessary upfront capital, the financing of renewable energy projects remains difficult in many parts of the world. Various academic and industry research works have tried to identify the issues that contribute to the lack of financing for clean energy projects. An OECD research paper on the role of institutional investors in financing clean energy cited the problems of scale, misalignment of terms, and shortage of data as some of the key barriers to institutional investor allocation to the infrastructure sector (Kaminker and Stewart 2012). The study further stated that, for clean energy investments, factors like new technology, buyer risk, and failure of credit ratings to communicate appropriate risks contribute to the lack of investors' interest in the sector. The study suggested the use of transitional financial instruments in addition to governments and multilateral development banks providing financing mechanisms to cover the risks, which are new and cannot be covered by the existing markets as possible mitigation mechanisms for clean energy finance. According to IRENA's report on unlocking renewable energy investment (IRENA 2016), the front-loaded cost structure of most clean energy projects is a major factor that obstructs the financing of clean energy projects. The study stated that the national financial systems are also an obstacle to clean energy investments, as the lack of experience and capacity gaps in the local financial markets lead to higher capital costs for clean energy projects. The report further identified some specific barriers that are particular to large-scale investors, such as insufficient investment deal size, high transaction costs, and financial regulations that constrain illiquid and risky investments. Another barrier associated with renewable energy projects compared with fossil fuels is the lower risk-adjusted rate of return (Yoshino and Taghizadeh-Hesary 2017).

The report suggested that public policy and finance can play an important role in catalyzing clean energy investments by enabling policies and creating debt-based finance structures and hybrid structures. Another research paper on perceived barriers and policy solutions in clean energy infrastructure investment used the Delphi process to list five major categories that act as barriers to clean energy investment—domestic policy barriers, domestic market barriers, general financial barriers, clean energy-specific barriers, and physical risks. These identified categories of risk lead to an increase in the expected returns from these projects and thereby an increased cost of capital. The study proposed to de-risk finance by creating public–private partnerships that will develop "investment grade" projects. It also called for better engagement within the institutional investment community for addressing policy and financing risk (Jones 2015).

The Green Climate Fund's research on the analysis of barriers to crowding-in and maximizing the engagement of the private sector discussed barriers on the supply as well as on the demand side for clean energy investment (Green Climate Fund 2017) and mentioned investors' risk perception as one of the important barriers. It stated that local financial institutions and institutional investors lack the understanding of low and moderate technological risks of some tested renewable technologies and hence demand high returns on investment. This misperception of risk leads to a high cost of finance and hence obstructs the development of the clean energy sector. The paper also cited a market gap due to the limited offering of a range of financial instruments as another major barrier to clean energy financing. The proposed solutions include public–private partnerships, hedging solutions for risks, and certain insurance products as some of the proposed measures to address the barriers. The focus of the solutions is on policy changes, regulatory interventions, and innovative finance structures for risk sharing and mitigation.

However, there are barriers that continue to constrain the financing and that have received less attention in earlier research. The scope of this paper is to address these research gaps, which include:

- Investors' credit risk perception of clean energy projects;
- The appropriateness of the existing credit assessment methods, like credit ratings, while evaluating clean energy projects;
- The inclusion of positive externalities of clean energy projects in credit assessment.

3. CONSTRAINTS IN CLEAN ENERGY FINANCE

According to the OECD's estimates, pension funds and insurance companies can potentially provide around $2.80 trillion per annum for clean energy projects (IRENA 2016). Despite the availability of capital, financing for clean energy projects remains constrained due to a number of barriers as well as investors' perception of risk regarding clean energy projects. Pension and insurance funds are long-term sources that can potentially fund green infrastructure projects needing long-term investments. Commercial banks, on the other hand, have short-term sources and lending for longer-term uses, and green infrastructure projects would increase the maturity mismatch for banks (Yoshino and Taghizadeh-Hesary 2018).

Credit risk and policy risk are two of the biggest constraints to mobilizing finance for clean energy projects. Governments and regulators across the world have taken a number of measures to reduce policy uncertainty and complexity by putting specific policies and targets in place. Investors' credit risk perception remains largely unaddressed. This, when coupled with the ineffectiveness of the existing credit assessment methods in the evaluation of clean energy projects, drives the cost of finance to a higher level, thereby exerting an impact on the viability of the project and leading to a lack of investment interest. An OECD study on institutional investment in green infrastructure discusses additional barriers concerning green infrastructure relative to conventional infrastructure.

Credit risk related to clean energy projects has both generic and specific challenges associated with it. The generic ones are those that pertain to wider infrastructure projects. As Table 1 describes, it is possible to consider clean energy projects as a subset of infrastructure projects and as being subject to the same generic infrastructure issues and additional issues that are specific to clean energy projects.

Table 1: Barriers to Institutional Investment in Green Infrastructure

Issues with Infrastructure Investments	Direct investing challenges: • Short-term investment horizon and the need for liquidity (illiquidity risk); • Difficulties with the bidding process and timing; a lack of investor best practice and expertise; • Asset and liability matching (ALM) application issues; diversification and exposure limits; • Need scale >$50 billion assets under management (AuM) and a deal flow to maintain a costly team; • Min $100 million deal size; expensive and time-consuming due diligence; higher transaction costs. Regulatory and policy issues: • Political uncertainty; • Illiquidity and direct investment restrictions, e.g., capital adequacy rules; • Uncertain new policy application, e.g., Solvency II for pension funds; • Accounting rules, e.g., mark-to-market for illiquid assets. Lack of a project pipeline and quality historical data: • Compounded by the exit of banks (Basel III/deleveraging); • Little historical pricing data or indices for investments such as private placement debt.
Issues Particular to Green Investments	Risk/return imbalance: • Market failures: insufficient carbon pricing and incentives; the presence of fossil fuel subsidies. Unpredictable, fragmented, complex, and short-duration policy support: • Retroactive support cuts; switching and stopping incentives; • The use of tax credits, popular with insurers, can discourage tax-exempt pension funds; • Unrelated policy objective discouragement, e.g., EU unbundling preventing majority ownership of both transmission and generation/production; • Fiduciary duty debate. Special species of risk, e.g., technology and volumetric, requiring expertise and resources; Competition for capital with other traditional infrastructure assets.
Lack of a Suitable Investment Vehicle	Issues with fund and vehicle design: • High fees to support the fund structure; • Liquidity trade-off with connection to underlying assets and associated benefits: difficult to offer liquidity without asset disconnect, churn, and leverage in funds; Nascent green bond markets, no indices/funds, restricted access to liquid vehicles (such as investment trusts): • Small pipeline of projects, high transaction costs, minimum deal size, and definition uncertainty; challenges with securitization; credit and ratings issues; • Historical lack of ratings; expensive process; • Absence of monoline insurers since the financial crisis.

Source: OECD, Institutional Investors, and Green Infrastructure Investments (2016).

This section discusses the issues of credit risk assessment, the use of credit ratings, and the implications for the financing of infrastructure and clean energy projects. Some of these issues may also render the proposed risk mitigation solutions ineffective or expensive.

3.1 Credit Risk in Infrastructure Projects

Infrastructure projects use project finance loans as a financing mechanism, and various studies' findings have shown that project finance loans are less risky than corporate finance loans with similar ratings (Beale and Fox 2002; Esty and Sesia 2004). Inadequate credit information and a lack of historical data are some factors that hinder effective credit assessment for infrastructure projects. An Asian Development Bank study linking financing structures and debt markets in India found that the credit spread in infrastructure projects is in a wide range with an average of 400–600 basis points over government securities (Rastogi and Rao 2011). The study further provided evidence that part of the credit risk is overestimated and suggested the use of credit enhancement and guarantee products for enabling bond market financing of infrastructure.

Analyses of infrastructure debt and respective credit ratings have led to the following findings:

a) infrastructure debt exhibits lower defaults and lower credit losses relative to corporate debt with a similar credit rating;

b) the level of defaults exhibited by infrastructure projects is lower than that expected from the credit ratings assigned to them; and

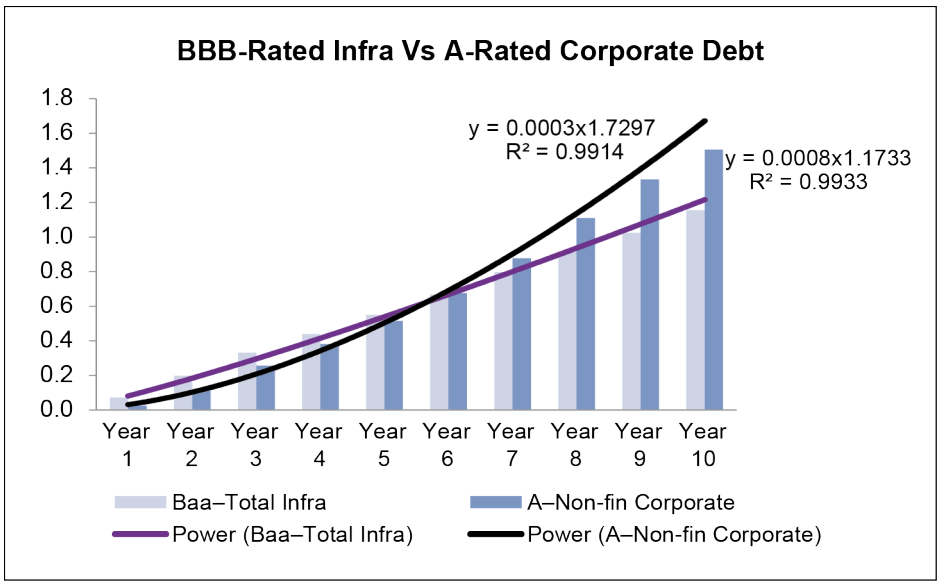
c) the credit quality of infrastructure debt shows improvement over the longer term, as the reducing defaults over time reflect, and this is apparent in the term structures (pricing of debt over time) of infrastructure project finance (Iyer and Purkayastha 2017).

Credit ratings' overestimation of credit risk is an issue associated with infrastructure finance as a whole, of which clean energy is a subset, and it is likely that the same issues apply to clean energy projects. Clean energy projects need very long-term financing, like infrastructure projects.

We may note that infrastructure projects tend to default less over time and hence it is difficult for credit ratings to provide an assessment of credit risk in infrastructure projects (Sorge 2004). Exhibit 3 graphically depicts a comparison of defaults from BBB-rated infrastructure debt with higher A-rated corporate debt. The lower BBB-rated infrastructure debt shows lower default rates than the higher A-rated corporate debt after 5–6 years.

This indicates the improving credit quality of infrastructure over the life of the project because of the reduced tendency to default over time. This pattern is not consistent with the typical use of credit ratings, in which investors' expect defaults to increase with increasing maturity, and hence credit ratings may not be useful in assessing the credit quality of infrastructure projects based on the conventional probability of default approach. However, this finding is consistent with the term structure of credit spreads on project finance, in which longer maturity project finance debt has lower spreads (Sorge 2004), which means that the financing market cannot rely on credit ratings for infrastructure project finance.

Figure 2: Comparison of Defaults from BBB-Rated Infrastructure Debt with Higher A-Rated Corporate Debt
(%)



Note: A and BBB (Baa) refer to credit rating grades.
Source: Iyer and Purkayastha (2017).

3.2 Credit Risks Specific to Clean Energy Projects

People also expect credit risk assessment using credit ratings for clean energy projects to exhibit similar issues to infrastructure projects, and clean energy projects face additional challenges, as described earlier. The lack of a track record of clean energy and technological obsolescence are two such challenges that act as a barrier to the financing of such projects. Moreover, there is information asymmetry that includes investors' lack of information on the commercial viability of such technologies as well as policy uncertainties regarding clean energy projects (G20 Green Finance Study Group 2016). Clean energy projects also face volumetric risks, which refer to volatility in the production volume because of the uncertain nature of wind and solar resources. Unlike conventional power plants, in which production is usually a stable quantity, clean energy projects can sometimes have volatile production depending on the environmental conditions (Kaminker and Stewart 2012). The uncertainties and the lack of information lead to excessive risk aversion and increase the expected returns from these investments as the investors perceive that some of the technologies might not work effectively or as anticipated.

The constraints to clean energy finance are aggravated for distributed clean energy projects, as they have a problem of scale and higher consumer or off-taker credit risk. The small size of these projects leads to insufficient investment deal sizes and higher transaction costs, causing large-scale investors to avoid such projects unless they are aggregated. One of the biggest barriers is apparently transaction cost risk due to severity and probability factors, which discourages institutional investors from investing. Investors can usually deal with the complexities of such financing provided that the cost of transactions is not high (Standard & Poor's 2010).

Investors perceive the credit risk in distributed clean energy to be very high or unknown. Developers are on a small scale with little or no credit history, which has a negative impact on the credit assessment, making financing riskier as well as expensive. Maturity mismatch is another risk associated with clean energy projects. It arises due to the inadequate availability of long-term funding relative to the demand (Yoshino and Taghizadeh-Hesary 2017, 2018). It also gives rise to longevity risk, which refers to a mismatch between the long-term capital commitments that clean energy projects require and the relatively short-term nature of regulations. Investors perceive longevity risk to have the highest probability and severity (Standard & Poor's 2010). This is a common challenge for projects in developing countries and often results in a lack of investments.[1] Clean energy projects are more exposed to this risk, as they have a more front-loaded capital structure and need larger upfront capital to match the longer tenures of project life. Clean energy projects have a high degree of uncertainty due to technology risk, which increases the perceived credit risk. This is aggravated for projects in developing countries, where currency and political risks are also present. Together, these risks make it difficult for clean energy projects to qualify for investment grade ratings. The G20/OECD Policy Note on Pension Fund Financing for Green Infrastructure discussed the implications of credit ratings for the financing of green infrastructure projects; it stated that the willingness of institutional investors depends on the state of the balance sheet of the holding companies of green infrastructure projects and their consequent credit ratings (for more information on credit ratings, please refer to Yoshino and Taghizadeh-Hesary 2014 and 2015). Rating agencies have assigned BB or lower ratings to wind and solar project bonds (Kaminker and Stewart 2012). Non-investment or marginal investment grade ratings make it difficult for these projects to attract investors, and the funds that are raised have high interest rates. Adding the above-described specific issues pertaining to clean energy projects to those already present in infrastructure makes the perceived risks for clean energy even higher, and conventional credit rating approaches to the assessment of credit risk seem to be constraining financing for clean energy from both banks and capital markets.

Bond finance is under discussion as an underutilized tool and as the next frontier for clean energy investments. The prescription includes (a) scaling up bond-financed clean energy projects using credit enhancement and risk sharing to mitigate the risks through demonstration projects and (b) creating a pipeline of rated and private placement deals to meet the demand of institutional investors for clean fixed-income securities (Milford et al. 2014). Any approaches to bond market finance at the clean energy project or business level would require credit ratings above the investment grade levels. The majority of issuers (over 80% by value) of green bonds are public institutions, banks, or financial intermediaries, which are likely to have better credit ratings, and not clean energy projects or businesses (Clean Bonds Initiative 2017).

3.3 Wider Financial Sector Constraints

A lack of experience and capacity gaps in the local financial sectors are the other factors that have a direct impact on investors' confidence. This is particularly important for clean energy projects, as they constitute a relatively new sector that is not yet fully commercialized. The above barriers have practical implications for investors investing in developing countries. A lack of transparency, the unavailability of swap markets or appropriate financial mechanisms, and unclear banking regulations restrict investors from investing in such markets. Clean energy projects also require early equity for the

[1] Longevity risk refers to regulations that are only in force for a short period compared with investors' time horizons and capital commitment, adversely affecting continuity and stability.

bankability of the projects. Developing markets, however, often lack frameworks for supporting exits and put/call options, making it difficult for investors to plan an exit strategy. This therefore limits equity and quasi-equity investments in such countries (Green Climate Fund 2017).

It may be noted that emerging regulatory frameworks for the banking and insurance sectors, such as Basel III and Solvency II, also limit lending and investment in clean energy projects. It is becoming increasingly difficult to obtain capital from commercial banks for green infrastructure. The new Basel III banking regulations are expected to have a negative impact on project financing with long maturities, the type required to fund green infrastructure. The absence of monoline insurance also imposes constraints on green infrastructure projects' access to capital markets (G20/OECD 2012).

4. MANAGING CREDIT RISK AND IMPROVING ACCESS TO FINANCE FOR CLEAN ENERGY PROJECTS

Access to affordable finance remains a major barrier to the growth of the clean energy sector. The sector needs new financing mechanisms, improved credit assessment methods, and policy interventions to overcome this barrier. Certain measures that the sector has undertaken in the past include regulations, taxes, and subsidies, which have been successful to an extent; the capital mobilization, however, still remains insufficient for the sector.

This section focuses on proposing some solutions to the constraints in clean energy finance, thereby improving the access to affordable finance. One of the approaches that IRENA provided, as Table 2 below details, focuses on the three major areas of (i) enabling policies, (ii) financial risk mitigation, and (iii) structured finance (IRENA 2016).

Table 2: Policies, Tools, that Reduce Barriers and Mitigate Risks

Enabling Policies and Tools	• Financial policies and regulations • Project preparation facilities • Project facilitation tools • On-lending facilities • Hybrid structures
Financial Risk Mitigation Instruments	• Guarantees • Currency hedging instruments • Liquidity facilities • Resource risk mitigation tools
Structured Finance Mechanisms and Tools	• Standardization • Aggregation • Securitization • Green bonds • Yieldcos

Source: IRENA (2016).

The focus of the advocated solutions is on mitigating risks and improving access to capital markets. Both financial risk mitigation and structured finance approaches would usually need to use credit rating as a tool for setting up risk mitigation–credit enhancement, partial credit guarantee facilities, and, in the case of structured finance, securitized instrument issuances to financial markets.

If the credit ratings overstate the credit risk in the infrastructure, they are also likely to do so for clean energy projects and may reduce the effectiveness of risk mitigation and structured finance initiatives. Clean energy projects also offer many implicit benefits to the economic, environmental, and social aspects. Traditional energy projects, on the other hand, entail negative externalities that impose harm on third parties. Credit ratings have traditionally been unable to factor in these externalities, resulting in underinvestment in clean energy projects and overinvestment in traditional projects (G20 Green Finance Study Group 2016).

4.1 Public Finance as a Risk Mitigation Mechanism

The share of public finance in clean energy investments currently stands at 15%, and researchers do not expect it to increase above this level (IRENA 2016). With appropriate policies in place, public finance institutions can be critical in addressing the constraints and barriers in clean energy finance, catalyzing private-sector investments. However, it is important for the use of public finance to be effective and efficient to scale up clean energy investments and crowd in commercial private capital.

Investors' perception of risks acts as a big stumbling block to clean energy investments, and the ability to mitigate these risks will be a key factor in determining the financing flows for the sector (OECD 2015). Public finance can play an important role in mitigating these risks and making such investments attractive to private investors. In clean energy finance, there is a general mismatch between investors' need for long-term, relatively low-risk investment and projects' currently available risk profile, as these projects have cash flows that face many risks and hence are not predictable. The method of structuring public finance can smooth the cash flow from these projects, thereby matching the risk–return profile of these projects to investors' requirement.

For clean energy projects, securing an investible grade rating is difficult. Public finance institutions, however, have generally high and stable credit ratings and can make use of them by offering a credit guarantee on behalf of the borrower.[2] This could benefit the borrower by securing financing with extended maturities from a variety of lenders, while lenders benefit from the reduced probability of default, as it is possible to draw guarantees to meet debt during periods of illiquidity.

A loan loss reserve, on the other hand, reduces the risk of repayment by keeping aside some capital as reserve funds. In the case of borrower default, loan loss reserve funds can repay the lender (OECD 2015). By streamlining the project cash flows, the loan loss reserve helps lenders by lowering the credit risk of the project, while they also benefit from the lower financing cost as well as a broader financing base.

4.2 Risk Mitigation and Structured Finance Approaches

Credit Enhancement: Credit enhancement is a risk mitigation concept that financial markets use to enhance their credit profile (which credit rating usually benchmarks) and enable access to market borrowings. Structured finance for securitization originally used the concept of credit enhancement, which involves the pooling of cash flows from loans, bonds, and assets and the issuance of securities against those cash flows. Credit enhancement has operated in many ways under many nomenclatures, such as bond insurance, financial guarantees, credit wraps, and so on, but these methods

[2] Yoshino and Taghizadeh-Hesary (2016) introduced a credit guarantee scheme, which is also applicable to the development of green infrastructural projects.

provide the same economic benefit. The global financial markets have used credit enhancement quite extensively, covering a wide variety of financial obligations, including loans, bonds, receivables, and swaps, with the core objective being to strengthen the credit profile of at least one of the participants in a financial transaction and to attract new sources of financing, thereby lowering the demands on the banking system. Credit enhancement can occur either externally or internally to the bond issuance. Internal credit enhancement is an approach to structuring bond issuances so that structuring provides the required credit enhancement by overcollateralization, cash reserve accounts, capturing excess spread, or subordination, enabling the issuance of different classes of securities. External credit enhancement refers to third parties providing credit support through instruments such as letters of credit, full and partial risk/credit guarantees, and bond insurance – which are usually in the nature of financial guarantees. By providing coverage for risks that are new, not already covered, or too expensive for private investors, it is possible to reduce the credit and default risk associated with clean energy projects. Credit or performance guarantees, insurance products, payment security mechanisms, and public finance stakes are some of the mechanisms that can act as credit enhancement tools. Credit enhancement is a risk mitigation concept to enhance the credit profile of bonds (which credit rating may benchmark) in financial markets and enable access to market borrowings. The effectiveness of these tools will, however, be limited until the credit assessment of underlying clean energy projects improves.

Managing Currency Risk: Currency risk is one of the major barriers to the financing of clean energy projects in developing countries. The high degree of political and country risk associated with developing countries increases the risk premium, thereby increasing the cost of clean energy. It also has an indirect impact on the financing of clean energy projects, in which it acts as a factor in credit assessment, thereby resulting in low ratings for projects. Foreign investors generally use long-term currency swaps to cover the currency risk. However, this becomes expensive and nearly doubles the usual cost of finance (Nelson and Shrimali 2014). Another solution for managing currency risk is to index the project cash flows to the currency of financing. This would reduce the exposure of currency risk for project developers and eventually lower the financing cost for the project. The host country government could play a key role in providing currency-indexed tariffs by undertaking the currency risk. Studies have suggested that national governments are better placed to undertake the currency risk, as they control the economic policy (Nelson and Shrimali 2014). A government can provide cheaper currency hedging by putting aside a hedge fund that would cover the risk of domestic currency depreciation. Addressing currency risks could have a partial impact, though, as the overall cost of finance is contingent on the credit quality of the project, and the access to currency hedging market instruments is dependent on the credit quality of the borrower or the project.

Structured Finance Mechanisms—Warehousing and Securitization: Use of structured finance mechanisms could help in enabling capital market financing for clean energy. Clean energy assets are typically small scale and illiquid in nature, which makes the refinancing of such projects difficult. Measures like warehousing and securitization can help in transforming illiquid assets into liquid and tradable instruments and can assist in the refinancing of the projects.

Warehousing is a process in which it is possible to aggregate smaller projects to reach a scale and securitize them into a special-purpose tradable asset. Rating agencies assess these securitized assets for default and then trace them in the secondary market as fixed-income instruments. The bundling of securities could diversify the risk for such instruments and can help in securing high credit ratings. Securitization can

benefit the sector in multiple ways. It can help to broaden the investor base by allowing developers to expand their sources of capital. Secondly, it can improve the liquidity of the sector. It can also help to create long-term financing structures with a lower cost of capital. These instruments will, however, have a bearing on the credit quality of the projects, as the underlying value is derived from the projects themselves and, if the credit ratings overstate the credit risks of clean energy projects, a greater amount of support capital will be necessary.

Bond Financing for Clean Energy: Securing investible-grade credit ratings has posed a big challenge for clean energy projects, and their absence results in investors avoiding these projects. Public finance institutions, on the other hand, generally have high credit ratings and can make use of them for catalyzing investments for the sector; they can play several roles, from issuing new bonds to providing third-party guarantees to other bonds to improve the credit profile of clean energy projects. Facilitating bond financing for clean energy can help to unlock large-scale and long-term non-bank financing for projects. Bond financing has typically been low for pre-construction- and construction-stage projects, as they lack an established track record (IRENA 2016). Green bonds or dedicated clean energy bonds could address this issue, as it is possible to tailor them to investors' risk profiles across the project life cycle.

Bonds could be full recourse, backed by the creditworthiness of the issuer, or alternatively backed by the cash flows from the project (IRENA 2016). The credit ratings assigned to the latter type of bonds would again depend on the credit assessment of the underlying projects and might not attract investments until the credit assessment measures improve. Monoline insurance could also play an effective role in improving the access to bond markets for larger green infrastructure and clean energy projects.

4.3 Possible Policy Solutions for Addressing Credit Risk in Clean Energy Projects

Addressing policy barriers that limit financing for clean energy is of the utmost importance, as some behavioral economists' work has suggested that not only a rational risk–return perspective but also the energy policy drive the investment behavior in clean energy finance (Chassot, Hampl, and Wüstenhagen 2014). The lack of a long-term transparent and coherent policy and a regulatory framework often hinders private-sector investors from investing in clean energy projects. A long-term policy commitment from the government leads to a stable investment environment and ensures a stable revenue flow from projects. Transparency in policy measures helps investors by providing them with a support mechanism and reducing the cost of capital. In the energy sector, the incumbent technologies have the benefit of economies of scale and have created a lock-in into these technologies. There are further barriers, like network economies and information failures, that limit the growth of new clean energy technologies. This often leads to market failure and hence would need specific clean energy policies, like lending guidelines for clean energy, dedicated clean energy targets, and funding technical commercialization. These policies can address these market failures associated with technological learning and spillover effects (Mitchell et al. 2011).

Another policy solution could be stronger deployment policies for clean energy, which could lead to a greater demand and stronger uptake of clean energy projects. This could lessen the uncertainty over future regulation and attract longer-tenure funds from investors.

4.4 Improving Credit Risk Assessment for Clean Energy Projects

Credit assessment is one of the major barriers to the growth of clean energy finance. Credit ratings are the usual mechanism for credit assessment and securing an investible grade rating is usually an issue for clean energy projects. This often results in a lack of interest from investors and hence underinvestment in the sector. Rating agencies have generally been conservative towards infrastructure projects. The long-term nature of such projects and other associated risks result in lower credit ratings for such projects. People perceive clean energy investments to be riskier considering the technological risk, the relative lack of a track record, and the policy uncertainty surrounding the sector. These perceptions lead to sub-investment-grade ratings and low interest from investors. In addition, the performance of clean energy projects has a relatively high degree of volatility and this volatility often results in further downgrading of ratings from an already-low rating level. S&P and Fitch have both downgraded the ratings of wind energy projects to the range of BB to B and changed the outlook to negative due to the underperformance of projects (Kaminker et al. 2013).

This situation is still improving in developed countries, where projects are able to secure low investment grade ratings. However, in developing countries, where the sovereign ratings are low and there is a higher degree of political risk, these factors combine to downgrade credit ratings further and block access to institutional finance. Studies have suggested that, in developing countries, the political economy concerns can drive up the borrowing cost by 2% to 6%, thereby having a negative impact on credit ratings (Inderst and Stewart 2014). The issue at hand suggests that the clean energy sector, which is already experiencing a number of financing barriers and policy uncertainties, possibly receives a further influence from the use of credit ratings as an assessment mechanism.

Clean energy projects are a different asset class and may need a different approach for assessment. The use of technology to carry out remote resource assessment and the availability of standardized credit information could help in reducing the transaction costs for the credit assessment of clean energy projects. Clean energy projects are also different from conventional fossil fuel-based energy projects, and they have many implicit benefits and positive economic externalities. A clean energy project may have higher construction costs but positive externalities, like reductions in emissions and pollution, and these benefits accrue to third parties. Neither the cash flows nor the credit assessments through credit ratings capture these externalities (G20 Green Finance Study Group 2016). While the short-term relationship between green projects and credit may be difficult to establish, it is intuitively clear that, in the long run, green infrastructure projects are likely to have good long-term credit quality.

A credit assessment framework of “green” credit ratings could be a possible solution that would internalize the implicit benefits of clean energy projects. A green credit rating could integrate environmental and social factors into the assessment mechanism, thereby improving the overall outlook of such projects. Lenders have used certain initiatives, like Equator Principles and the UNEP Finance Initiative, for the assessment of project finance structures; their application, however, remains limited due to a lack of consistency between risk management and green lending guidelines (G20 Green Finance Study Group 2016). A universal credit assessment framework for clean energy projects could be effective, as it can address this lack of consistency by removing the difficulties in measuring the provision and performance of clean energy lending. This modified rating approach, which could incorporate green factors, could be useful in attracting investment from institutional investors.

Another example could be the approach that the Global Infrastructure Basel's (GIB) Credit SuRe ratings took for infrastructure projects, which incorporated environment, social, and governance (ESG) factors into the rating mechanism. A similar framework is applicable to clean energy projects; it is possible to factor the ESG factors that are material to any energy projects into the rating methodology. An assessment based on such a rating methodology could ensure transparency for the overall impact that the project creates and can be particularly effective in attracting ESG-sensitive investors.

Global rating agencies, such as Moody's and Standard & Poor's, have recently launched green bonds assessment (GBA) and green evaluation products, respectively. They positioned green evaluations as second assessments, which they defined as asset-level environmental credentials that aim to provide investors with a more comprehensive picture of the green impact and climate risk attributes of their portfolio. Moody's Investors Service has published its GBA methodology, which offers a consistent, standardized, and transparent framework for evaluating an issuer's approach to managing, administering, and allocating proceeds and reporting on environmental projects that green bonds finance across various security types globally.

5. CONCLUSION

The typical prescriptions for enabling clean energy finance that institutions and development banks endorse focus on a three-pillared approach: (i) enabling policies, (ii) risk mitigation (primarily credit risk), and (iii) structured finance (innovative financial instruments for access to capital markets). Risk mitigation approaches, like credit enhancement—partial credit guarantees, first-loss default guarantees, and risk-sharing facilities—would need credit risk measurement, and the usual practice is to rely on credit ratings. For structured finance approaches, like securitization, green bonds, and yieldcos, credit ratings provide the assessment of credit risk for the instrument or structure, which is necessary for access to capital markets and determines pricing. Commercial bank financing for clean energy also uses credit ratings for decision making and capital provisioning. Bank regulators use credit ratings for risk weights, which then determine the capital adequacy.

If credit ratings overstate the credit risk in infrastructure projects, and as clean energy projects also develop as project finance structures, it is likely that they will also overstate the credit risk for clean energy projects. The use of credit ratings may be constraining the allocation of institutional capital to clean energy projects. The use of risk mitigation solutions and structured finance approaches for increasing the flow of institutional finance to clean energy projects may not be effective if they use the benchmark of credit ratings.

The effective cost of credit enhancement based on credit ratings for enabling the financing of clean energy projects would be higher than that ideally required as capital from public finance sources, and the price of risk mitigation would be higher. For access to capital markets through structured financial products, like securitized receipts, enhanced credit ratings, which often operate through additional collateralization or external credit guarantees, are necessary. Credit ratings continue to play an important role in providing market signals for placement, the pricing of bonds, and access to bank financing. The problem of low credit ratings for clean energy projects requires close examination to determine whether it is possible to make the credit ratings of infrastructure projects accurate in assessing risks in line with their economic and green characteristics.

The effective use of public finance can play a role in improving the risk profile of the sector by targeting risks specific to clean energy, like the lack of historical data and technological risks, through a payment security mechanism; addressing refinancing risk through securitization can help in ensuring stable cash flows for the lenders, reducing risk, and improving credit ratings for projects in the sector.

To address the policy barriers, developing financial risk mitigation and finance structured mechanisms to improve the access to institutional finance may not have the desired impact on clean energy finance if it follows conventional credit rating approaches, which tend to attach higher credit risk to clean energy projects. Rating agencies seem to overstate credit risk in clean energy projects, and, because they do not factor positive environmental externalities into credit ratings, it may be useful to modify the approach to credit risk assessment to include sustainability measures.

In addition to the People's Republic of China and India, Southeast Asian countries need to scale up their clean energy investments significantly, which would need low-cost financing. Credit support mechanisms, such as credit guarantees, could enable domestic and international capital flows. Credit enhancement facilities could be useful in enabling clean energy projects to access bond markets. Public financial institutions are well placed to do so as a separate business, and this may pave the way for the market entry of other international insurance/reinsurance companies in this line of business. Enabling regulation for financial guarantee business would be necessary for third parties and insurance companies to offer credit enhancement products. Some regulatory constraints on long-term institutional funds' investments in bond markets may also diminish. With the availability of credit enhancement and correction in credit ratings for infrastructure debt, the investments from pension and insurance funds in clean energy would increase.

In the long run, green factors are likely to reduce the long-run credit risk; hence, it may be useful to include positive externality factors of clean energy in credit rating frameworks, which would then tilt the playing field for both commercial banks and institutional investors and help in correcting the credit market failure for clean energy finance.

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