

Financing and risk management of renewable energy projects with a hybrid bond



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ABSTRACT

Although many incentive schemes and renewable energy policies, such as feed-in tariffs and tax credits, have been imposed to boost renewable energy investment, renewable energy investment still necessitates huge initial capital costs and involves numerous uncertainties. Unless the problems are well addressed, renewable energy developments are hindered. In this paper, we present a new financing instrument, called hybrid bond, to build renewable energy projects. The hybrid bond consists of a portfolio of renewable energy projects. It does not only financially support the initial capital costs, but also manages the risks associated with renewable energy investment. Key risks including market risks, credit risks, liquidity risks, operational risks and political risks are identified and managed. In the proposed framework, it reveals that the sale of a hybrid bond can finance a substantial share of upfront capital costs of renewable energy projects and the use of hybrid bond is able to manage major uncertainties.

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1. Introduction

In the past decade, renewable energy investments have been prevalent worldwide. In 2012, the investment total for renewable power and fuels was \$244 billion, which was six times that of 2004 [1]. Renewable energy development plays an increasingly important role in producing sustainable energy, reducing environmental pollution, enhancing energy security, creating new jobs, etc. However, while there are a number of benefits, financing renewable energy projects and managing the connected risks are still highly challenging. Therefore, effective finance and risk management tools are essential elements in the successful development of renewable energy projects.

Due to the limited budget from the government, public, private and institutional investors are important players for future sustainable developments. Therefore, it is challenging and necessary for policymakers to create environments that will entice investors and utilities to support renewable energy efforts. One of the most common methods used by government is to set renewable energy targets and obligations [2]. However, simply establishing targets and obligations, while still employing the same financing

paradigm, does not proactively encourage investors and developers to develop renewable energy resources. In this paper, a new financing tool, called a hybrid bond, is proposed. With the use of portfolio management techniques, tranche techniques and statistical tools, the risk of uncertainties from renewable energy projects is managed. The goal of financing renewable energy projects is also achieved through the sale of hybrid bonds.

This paper is divided into the following sections. Section 2 presents a brief review of existing methods to finance renewable energy projects. Section 3 introduces the structure and risk management of the hybrid bond. The implementation of the hybrid bond is presented in Section 4, and the conclusion is drawn and presented in Section 5.

2. Financing renewable energy projects

Historically, the development of renewable energy resources has faced a number of hurdles, primarily related to cost, regulation, and financing. With the recent sustained increment in the cost and the associated price volatility of fossil fuels, the economics of renewable energy development have become more attractive to investors. Traditionally, market-based incentives and policies have been proposed as solutions to increase renewable energy investments. These methods aim to drive down the levelized generation costs to cover the gap between renewable energy and grid electricity prices and to provide sufficient returns for external contributors to supply project

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financing. However, policy uncertainties for developers and investors, including deadlines, level of support, length of support and sustainability of support, have hindered renewable energy investment. Furthermore, as the benefits from these schemes are not received until the start of electricity production, these incentives do not directly overcome the inherent high startup capital costs of renewable energy development.

Rather than relying on market-based incentives and policies, many proposed and practical frameworks have been applied to finance renewable energy developments. Renewable projects are financed using balance sheets, operating leases and power purchase agreements (PPA partnership), which have been widely adopted in non-residential photovoltaic projects [3]. Because renewable energy projects are capital-intensive and the amount of revenue collected during operations is small compared to the startup costs, it is not uncommon for developers to seek outside investors to finance the project. These methods have successfully supported part of the upfront capital costs. Another proposal to finance renewable projects is from bond issuance. Accordingly, the use of carbon revenue bonds has been recommended and studied. This method reveals that the sale of carbon revenue bonds is able to finance a significant portion of a project's initial cost [4]. An example is the bond-PPA hybrid model that has been implemented in New Jersey. The model is a financing option by which a public entity issues a government bond at a low interest rate and transfers the low-cost capital to a renewable energy developer in exchange for a lower PPA price. Five deals have been finalized using the model, and governments have achieved significant energy cost savings [5]. Other means to finance renewable energy projects include state, municipal, and utility loan programs, as these programs offer some attributes that are considered more favorable than those offered by traditional lending institutions. For example, such programs usually provide long-term, fixed rate loans, and reduced consumer-transaction costs. In the United States, there are already 128 loan programs that successfully sponsor renewable energy developments [6]. A non-traditional strategy to finance renewable energy projects is securitization. This particular mechanism groups vast sources of capital by pooling projects and creating small tradable securities that can be easily priced, purchased and sold. Therefore, capital can be raised at lower costs [7]. Six financing structures are found that finance wind projects. These structures include corporate structure, strategic investor flip, institutional investor flip, back leveraging, cash leveraging and cash and production tax credit leveraging [8]. The financing structure is selected based on the developer's ability to use tax benefits and to provide capital funding as well as on the financial robustness of the renewable energy project.

Risks associated with financing renewable energy projects include but are not limited to market risk, credit risk, liquidity risk, operational risk and political risk. Market risk and credit risk can be easily quantified and hedged while liquidity risk, operational risk and political risk cannot. While a utility business is defensive in nature, the performance is relatively stable during different periods of the economic cycle. As electricity sales revenue is usually steady, it, too, lowers the default rate of a utility business relative to other sectors. Furthermore, production tax credits, investment tax credits and feed-in tariffs also enhance the defensive characteristics of renewable energy development [9]. With thorough due diligence and risk management, market risks and credit risks connected with renewable energy investments are reduced and manageable. However, there are also liquidity risks, operational risks and political risks. First, the breakeven point of a renewable energy project often requires a long time horizon. Second, throughout the time horizon, a secondary market rarely exists. Trading with respect to a renewable energy project is difficult and causes renewable energy

investments to be highly illiquid, thereby increasing the liquidity risk. Operational risk is a broad discipline that focuses on the risks arising from the people, systems and processes associated with the operations. History tells us that a blackout can endanger millions of people and result in great economic loss [10,11]. We also know that most renewable energy resources are discontinuous and volatile in nature, which causes a major concern in the operation of renewable energy. With respect to political risk, the energy sector tends to be the most sensitive to micro-political risk [12]. Thus, a change in the political climate in a given region can greatly affect a business endeavor. Policy uncertainty can also turn an economically sound renewable energy project into an impractical project [13]. As a consequence, there is usually high political risk associated with renewable energy projects.

In this article, we develop a financing instrument that securitizes future income in the form of a hybrid bond that a renewable energy developer can sell to potential investors and receive funds to subsidize upfront capital costs. The hybrid bond overcomes the problem of high initial capital costs associated with renewable energy projects. At the same time, the hybrid bond, which consists of different renewable energy sources, addresses the problem of risks associated with financing renewable energy developments. A portfolio of renewable energy projects is formed to stabilize future revenue that is intended to reduce the market risk and credit risk faced by investors. Furthermore, while a hybrid bond can solve the liquidity problem because the secondary bond market is widespread, excessive revenue is set aside to protect investors in case of under-performance of projects, developer default or other uncertainties.

3. Structure and risk management of hybrid bond

3.1. Basic framework of hybrid bond

A bond is a type of investment whereby the borrower or issuer is obligated to make scheduled payments to the investor, and as such, it is often used to raise money to finance an acquisition or a new development. A hybrid bond, which is sold in exchange for upfront investment capital, shares the same concept. As renewable energy projects are grouped together, future revenues from these projects are securitized to form a hybrid bond. Accordingly, project developers are obligated to make scheduled payments to bondholders that include the principal payment and the coupon payment. A coupon payment is usually made throughout the life of the bond, while the principal payment is made on the date of maturity. According to this model, the concept of asset-backed security (ABS) is applied. The value of ABS is derived and collateralized from the income payments by a specified pool of underlying assets. Pooling

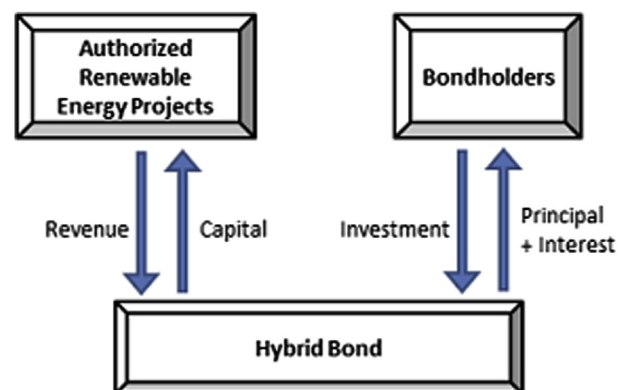


Fig. 1. Basic framework of hybrid bond.

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