

Bond Financing for Renewable Energy

Introduction

Energy needs in Asia are huge. The Asian Development Bank (ADB) estimates that Asia's share of world energy consumption is expected to rise from around one-third in 2010 to more than one-half by 2035.⁷ The use of renewable energy will increase by 50% over this period but will still account for only 13% of the world's total energy supply in 2035. To ensure that the growing energy needs of Asia can be met sustainably, there will have to be increased diversification of energy sources away from fossil fuels and toward renewable energy. Greater use of renewable energy can result in lower costs through technological and efficiency improvements, and by reaping the benefits from economies of scale.

Investment in renewable energy is gaining momentum across the globe. In 2014, global investment in renewable power reached US\$270 billion, driven by the construction of solar energy plants in the People's Republic of China (PRC) and Japan totaling US\$75 billion.⁸ While developed economies were initially the primary investors in renewable energy, investments in developing economies have grown at a faster pace in recent years. In 2014, investment in renewable energy in developing economies was almost on par with that of developed economies. The economy with the largest investment in renewable energy in 2014 was the PRC at US\$83 billion, which is more than double the amount of renewable energy investment in the United States (US) (US\$38 billion).

Asian economies have stepped up their investment in and use of renewable energy. India and the PRC have both rapidly expanded their wind power capacity. Global Wind Energy Council data show that at the end of 2014, the PRC had the world's largest installed wind power capacity at 115 gigawatts (GW), or slightly less than one-third of the global total. The PRC has also been ramping up its installation of solar power capacity in the face of declining prices for solar panels.

It is clear that renewable energy has many environmental and social benefits. These include very little carbon emissions, no air pollution, stable costs, and a more resilient energy system. Further, the cost of renewable energy technology has been falling rapidly. The latest International Renewable Energy Agency report finds that wind and hydropower are already cost competitive with conventional fossil fuel plants.⁹ The fall in solar panel costs means that solar photovoltaic technology is getting closer to being cost competitive as well. As technology improves, the cost of renewable energy is expected to continue falling. Advances in energy storage could further encourage the deployment of renewable energy. However, without sufficient improvement in energy storage, it will be difficult to have a large proportion of energy generation from renewable sources such as wind and solar.

There has been a lot of attention aimed at facilitating greater adoption of renewable energy. Policies to promote renewable energy include stricter environmental measures, emissions trading system, and taxes on polluting industries. These policies have an important role to play in fostering the development of renewable energy sector. At the same time, there is also a need to look at the financing aspects of renewable energy projects.

The main constraint for adopting renewable energy now lies more in the availability and cost of financing. While the flow of financing for renewable energy has grown, much more investment is needed. Stronger intervention in the financial system is necessary as there is still no comprehensive strategy for financing the necessary investments in renewable energy. Most renewable energy projects have high initial costs and very low operating costs. This means that renewable energy projects will require significant long-term financing. The availability and cost of financing is an important factor in whether a renewable energy project is viable. Improvements in financing can lower the cost of a renewable energy project. Low operating costs mean that increased emphasis is placed on the financing costs. Improving the efficiency of investments can ensure that renewable

⁷ ADB. 2013. *Asian Development Outlook*. Manila.

⁸ Frankfurt School-UNEP Centre. 2015. *Global Trends in Renewable Energy Investment 2015*. Frankfurt am Main.

⁹ International Renewable Energy Agency. 2015. *Renewable Power Generation Costs in 2014*. Abu Dhabi.

energy projects become more affordable, which will promote their spread.

This special section will explore the various financing options available for renewable energy. It will then examine developments in using bonds to finance renewable energy projects. For example, there has been some success in Asia, particularly in the PRC, with corporations raising a large amount of funds in the domestic bond market to finance renewable energy operations. This section will also chart the growing popularity of “green bonds.”

Financing Options for Renewable Energy

The large upfront costs and extended payback period of renewable energy projects means that the availability and cost of financing plays a critical role. Without the proper financing framework, the necessary investments in renewable energy may not take place. Funds may instead flow toward conventional sources of energy where risks are lower. Lack of financing can deter much-needed investment in the renewable energy sector and constrain a region’s ability to meet its renewable energy investment targets.¹⁰ In the aftermath of the 2008/09 global financial crisis, there was a large drop in investment in renewable energy, underlining the close link between financing and investment.¹¹

There are several financing channels available for renewable energy projects. These include multilateral development banks, governments, and private investors. Within Asia, multilateral development banks such as the World Bank and ADB have provided technical assistance and financing for renewable energy projects. These institutions offer both market-based and concessional financing at below market rates for low-income economies. They have been very active in facilitating renewable energy investments in Asia. In poorer economies, external support such as that from multilateral banks is needed to help facilitate private sector financing for renewable energy investment.¹²

In Asia, ADB has undertaken efforts to combat climate change. Working to increase the amount of renewable energy utilized in the region is part of this effort. ADB’s annual investment in clean energy has exceeded US\$2.0 billion since 2011, reaching US\$2.3 billion in 2013. Most of ADB’s clean energy investment goes toward renewable energy, which totaled US\$1.4 billion in 2013. ADB launched the Asia Solar Energy Initiative to develop 3 GW of solar-generated electricity in 2010. To achieve that goal, ADB plans to invest US\$2.25 billion and leverage an additional US\$6.75 billion in solar power investments. In the wind sector, ADB launched the Quantum Leap in Wind Initiative to develop 1 GW of wind-generated energy.

Governments can also play an important role in supporting the financing of renewable energy. They can support renewable energy by offering subsidies to cover the high costs of renewable energy projects and put in place regulations that reduce investment risks. Public authorities can also provide financing for renewable energy projects at rates cheaper than commercial terms. This can be in the form of soft loans from public financial institutions or loan guarantees. However, given that government finances are already overstretched in many developing economies in Asia, it is unlikely that government can act as the direct financier in most cases. Instead, the government’s role will be to put in place the proper policies and regulations that can attract financing from the private sector, both domestically and internationally.

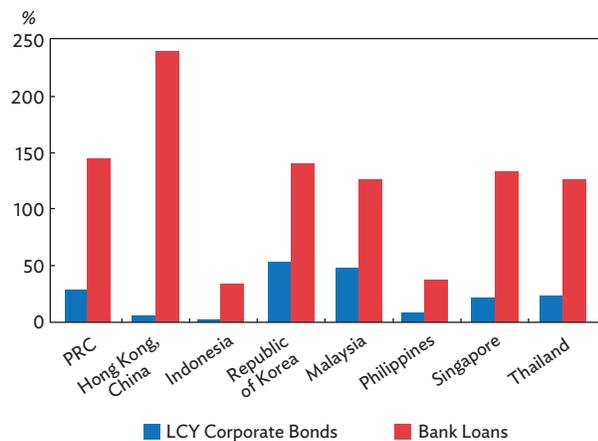
As mentioned above, it is unlikely that the public sector will be able to take on the additional burden of directly financing the large investment needs of renewable energy projects. While in Africa international donors and governments may play a more important role in financing, the large pool of investable funds available in Asia suggests that the private sector will play the primary role. The appeal of investing in developing economies has been increasing as their growth performances have outpaced those of developed economies by a considerable margin since the global financial crisis. Some developing Asian economies have a natural advantage in terms of renewable energy potential. Having a relatively less developed conventional energy sector could also be an advantage as it allows for the potential to “leap frog” to more modern technology without having to deal with the sunk costs of previous energy investments.

¹⁰ T. Ekholm et al. 2013. The Effect of Financial Constraints on Energy Climate Scenarios. *Energy Policy*. 59. pp. 562–72.

¹¹ S. Fritz-Morgenthal et al. 2009. *The Global Financial Crisis and its Impact on Renewable Energy Finance*. Nairobi: United Nations Environment Program.

¹² S. Spratt and S. Griffith-Jones. 2013. *Mobilising Investment for Inclusive Green Growth in Low-Income Countries*. Bonn: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

Figure 13: LCY Corporate Bonds and Bank Lending to Private Sector as a Share of GDP



PRC = People's Republic of China, GDP = gross domestic product, LCY = local currency.

Note: Data as of end-December 2014.

Sources: IMF IFS, Haver Analytics, CEIC, and Bloomberg LP.

The banking sector is the main source of project financing in Asia. Banks dominate the region's financial sector, with bank lending to private sector exceeding the size of the corporate bond market in a number of economies (**Figure 13**). There are several ways that banks can finance renewable energy projects, including loans, project loans, mezzanine loans, and refinancing. A typical corporate loan has no restrictions and could be put to any use; therefore, lending is based on the overall health of the company.

Project finance is becoming more popular in Asia. This is when loans are secured for a specific project asset and serviced by the revenues from the project. Banks can also provide mezzanine loans, which are subordinated loans meant to serve as supplementary financing. This tends to be riskier lending that lies in between secured debt and equity. As mezzanine loans are riskier, they usually have higher returns.

While banks are likely to continue to play an important role in financing renewable energy, new Basel III regulations might make banks more reluctant to lend long-term. The Basel III rules aim to ensure that banks have enough liquid, high-quality assets so that they can better ride out periods of stress. These liquidity requirements penalize long-term loans for which there is no active secondary market. Renewable energy project loans tend to fall under this category and therefore these projects will likely find

it harder to access bank financing. It will also likely raise their financing costs as well.

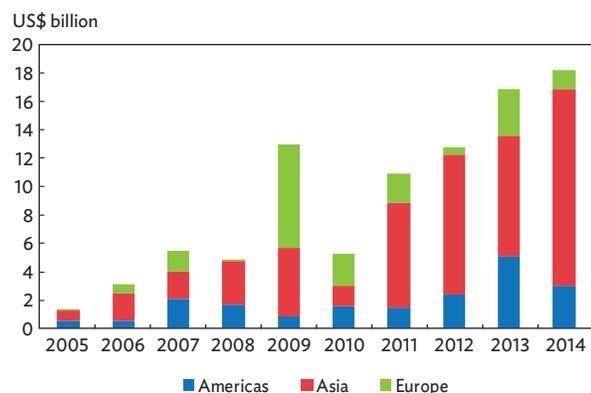
Banks in Asia have relatively little experience in financing renewable energy projects as they often require technical skills to properly evaluate that banks do not possess. Further, the limited track record for renewable energy projects makes them harder to evaluate. Finally, renewable energy projects tend to have large upfront costs and an extended payback period, making them less attractive from the perspective of bankers.

This all suggests that the bond market may become the preferred source of financing for renewable energy projects. The September 2013 issue of the *Asia Bond Monitor* highlighted the significant potential of emerging Asian bond markets to finance infrastructure projects. As will be discussed below, there are many similarities between renewable energy project financing and infrastructure project financing.

Bond Financing for the Renewable Energy Sector

Given the heightened interest in investing in renewable energy, there is a large pool of potential investors. To attract these investors, an investment will have to be packaged in a form that investors are both familiar and comfortable with. Large investors, such as pension funds and sovereign wealth funds, have traditionally allocated a large proportion of their portfolio to bonds. Thus, there is a huge pool of investment assets available: the Climate Policy Initiative has estimated the global pool of institutional assets at around US\$80 trillion. The development of bond markets for renewable energy is also supported by the general trend toward increased investor interest in environmentally friendly projects.

Globally, the issuance of renewable energy sector bonds has been increasing rapidly. Total bonds issued by renewable energy corporations increased from US\$5.2 billion in 2010 to US\$18.3 billion in 2014 (**Figure 14**). While Asia has been leading the way in the issuance of these bonds, almost all renewable sector bond issuance in the region originates in the PRC (**Figure 15**). In 2014, 90% of Asia's renewable sector bonds came from the PRC. This is consistent with the overall trend of the PRC dominating investment in the renewable energy

Figure 14: Renewable Energy Sector Bond Issuance by Region**Notes:**

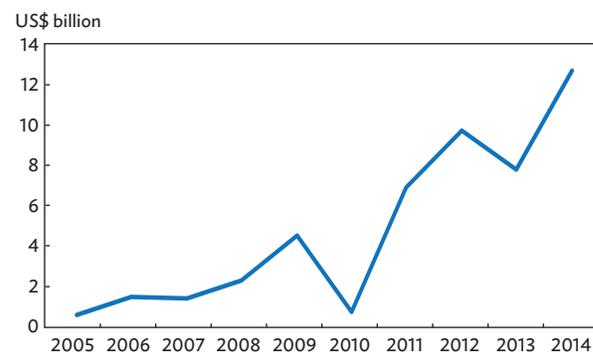
1. Americas refer to Brazil, Canada, Mexico, Panama, Peru, and the United States.
2. Asia refers to the People's Republic of China; Hong Kong, China; India; Japan; Kazakhstan; Republic of Korea; Malaysia; Singapore; and Taipei, China.
3. Europe refers to Austria, Cyprus, Denmark, Finland, France, Germany, Hungary, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Russian Federation, Slovakia, Sweden, Switzerland, Turkey, and the United Kingdom.

Source: Bloomberg LP.

sector among developing economies. About half of global renewable energy infrastructure investment in 2012 came from developing economies, with the PRC accounting for the bulk of it.¹³

One reason that Asia has been a leader in renewable energy bond issuance is because Asia has a large pool of funds available for investment. Asia remains a capital surplus region. In particular, the PRC has a high savings rate and large current account surplus. At the moment, much of the surplus capital from Asia is invested in low-yielding assets in the developed world. There is great potential to invest some of these funds in the renewable energy sector.

Being more familiar with the region might lead to Asian investors assessing the risks and returns on renewable energy projects in the region differently than investors from advanced economies. Better knowledge of local conditions may make domestic investors more willing to finance renewable energy projects. Better understanding of local regulations could also be an advantage to domestic investors. This is especially true in Asia where environmental regulations and incentives for investment in renewable energy are evolving quickly. In addition,

Figure 15: People's Republic of China's Renewable Energy Sector Bond Issuance

Source: Bloomberg LP.

domestic investors would not need to take on exchange rate risk, which is an important factor for international investors.

In many developing economies in Asia, reducing financing costs for renewable energy projects is a critical step. Relatively underdeveloped financial markets mean that the cost of financing tends to be higher in these economies. With renewable projects having higher upfront costs, this puts them at a competitive disadvantage compared to conventional projects.

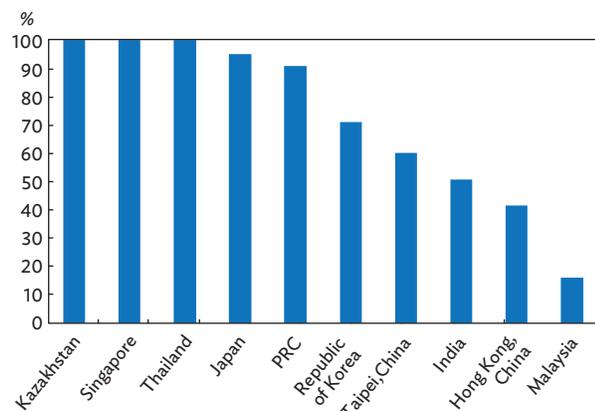
Accessing foreign debt could be seen as a way to bypass the inefficiency of local financial markets. But it comes at a price as international debt tends to be priced in foreign currency, usually US dollars. So taking on foreign debt usually means also taking on exchange rate risk as the revenue generated from the renewable energy project would be in domestic currency. While the foreign exchange rate risk could be hedged, this would probably offset most of the benefit from lower yields.

Fortunately, the region's local currency bond markets are expanding. Having a well-functioning and liquid local currency bond market can help investors finance their activities. In Asia, economies with well-developed bond markets have been able to mobilize large amounts of funds. That is why most renewable energy sector bonds in Asia are being issued in a local currency (**Figure 16**).

One recent example of a renewable energy company issuing bonds is Trina Solar Limited in the PRC. Trina Solar Limited is a large-scale, integrated solar

¹³ S. Zadek and C. Flynn. 2013. *South-Originating Green Finance: Exploring the Potential*. Geneva: Geneva International Finance Dialogues.

Figure 16: LCY-Denominated Renewable Energy Bonds as Share of Total



PRC = People's Republic of China, LCY = local currency.
 Note: Data as of end-December 2014.
 Source: Bloomberg LP.

power products manufacturer, including crystalline silicon PV modules, and a solar power system developer. In October 2014, Trina Solar Limited issued a total of US\$115 million of convertible senior notes due in 2019. The proceeds will be used for developing new solar projects.

Another renewable energy company that has tapped the bond market is GS Yuasa Corporation in Japan. Its business includes the manufacture and supply of batteries, power supply systems, lighting equipment, and other electrical equipment. In March 2014, GS Yuasa Corporation issued a JPY25 billion zero coupon convertible bond maturing in 2019.

While concerns about climate change are driving policymakers' attention, businesses also have reason to be interested in renewable energy. There are increasing expectations that carbon will likely be taxed or charged in the future. A World Bank publication reveals that Royal Dutch Shell, Rio Tinto, and Pacific Gas and Electric Company—firms that all have large carbon-intensive operations—are preparing for the time when carbon will be taxed.¹⁴ Companies are also under growing scrutiny over their environmental track record. With fiscal conditions worldwide under increasing stress, governments are under pressure to cut back on fuel subsidies. Thus, carbon

taxes could strengthen government balance sheets while promoting growth in the renewable energy sector.

Rising Interest in Green Bonds

While renewable energy companies have been active in issuing bonds, the proceeds from the issuance need not necessarily be used for green projects. A recent innovation is the development of green bonds in which there is a commitment by the issuer for the proceeds to be used for projects with environmental benefits. Most green bonds issued to date have been used to finance climate change mitigation or adaptation, including clean energy, energy efficiency, mass transit, and water technology. Green bonds can be either plain vanilla, Treasury-style retail bonds, with a fixed rate of interest and redeemable in full upon maturity, or asset-backed securities comprising several green projects. Most green bonds issued are use-of-proceeds bonds in which the funds raised from the bond issuance are earmarked for green projects. While the proceeds can be used only for green projects, the bond is backed by all of the assets of the company issuing the bonds.

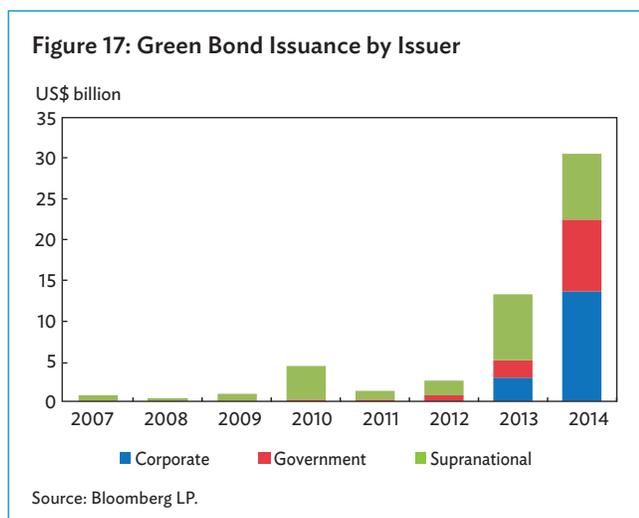
Growing interest in green bonds is the result of investors adhering more closely to environmental, social, and governance (ESG) criteria. The UN Principles for Responsible Investing Initiative list more than 1,000 investors as signatories, representing about US\$45 trillion in assets under management. In January 2014, a group of financial institutions launched the Green Bond Principles to establish voluntary process guidelines and clarify an approach for issuance of green bonds. Private sector interest was high after seeing strong demand for green bond issuance among multilateral development banks. Citigroup, Bank of America Merrill Lynch, JP Morgan, and Crédit Agricole were the original backers of the Green Bond Principles. The support has since swelled to 55 underwriters, issuers, and investors as signatories.

The Global Sustainable Investment Alliance found that assets invested based on sustainable principles had grown from US\$13.3 trillion in 2012 to US\$21.4 trillion in 2014. As a proportion of professionally managed assets, the share of such investments rose to 30.2% in 2014 from 21.5% in 2012. However, the share in Asia remains very low at only 0.8%, compared with almost 60% in Europe.

¹⁴ Partnership for Market Readiness. 2015. *Preparing for Carbon Pricing: Case Studies from Company Experience—Royal Dutch Shell, Rio Tinto, and Pacific Gas and Electric Company*. Washington, DC: World Bank.

While the amount of sustainable investment assets is still low in the region, it has been increasing. Between 2012 and 2014, this amount grew 32.0% to reach US\$53 billion. Malaysia; the Republic of Korea; and Hong Kong, China are the largest markets in the region for sustainable investment. The leading role of Malaysia is due to the large size of its Islamic funds market in which all investment are based on *shariah* (Islamic law) principles.

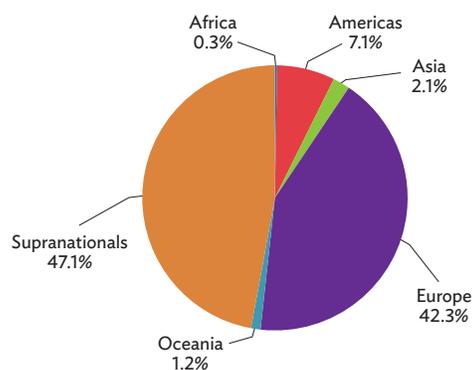
As awareness in sustainable investing continues to grow, it is expected that the share of sustainable investment assets will rise substantially. There have been moves to urge institutional investors to divest themselves of investments in fossil fuels companies. The Association for Sustainable and Responsible Investing has documented several new national policy and regulations that are facilitating this process.¹⁵ India and Viet Nam have strengthened their corporate reporting requirements for sustainable business practices. Stock markets in the PRC; Hong Kong, China; and Singapore have introduced guidelines on sustainability reporting. Importantly, some public pension funds have taken steps to integrate sustainability principles into their investment decision-making process. As of August 2014, 160 large institutional investors in Japan, including the Government Pension Investment Fund with JPY130 trillion under management, had endorsed the Principles for Responsible Institutional Investors. Given the large pool of assets that these funds manage, this could have a significant impact on facilitating greater investment in renewable energy.



Given the growing demand, it is not surprising that the green bond issuance is surging. In 2014, total issuance of global green bonds reached US\$30.5 billion, more than double the amount in 2013 (**Figure 17**). Most green bond issuance has come from supranationals, including the multilateral development banks. European government entities and corporates are a close second (**Figure 18**). In Asia, green bonds have been slower to take off. Part of the reason is that there is a smaller pool of assets in Asia that are targeted at sustainable investing. However, there have been plenty of renewable energy firms that have successfully raised funds in Asia. It is just that they did not choose to label their bonds as green bonds.

Green bonds were first issued by multilateral development banks as part of their efforts to combat climate change. They have been well-received and highly rated. The European Investment Bank (EIB) pioneered the first green bond issuance in 2007. To date, EIB is the largest issuer of green bonds with a total of EUR7.4 billion raised across 10 currencies, of which EUR4.3 billion was raised in 2014 alone. Most of the funds raised from the issuance of green bonds were invested in energy efficiency and renewable energy projects. The World Bank issued its first green bond in 2008 to support climate change mitigation and adaptation projects. Since then, the World Bank has issued over US\$7 billion worth of green bonds.

Figure 18: Green Bond Issuance by Region, 2007–2014



Notes:

1. Africa refers to South Africa.
 2. Americas refer to Canada, Peru, and the United States. Asia refers to Japan; Republic of Korea; Taipei, China.
 3. Europe refers to Austria, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, and the United Kingdom.
 4. Supranationals refer to African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, European Investment Bank, International Bank for Reconstruction and Development, International Finance Corporation, and Nordic Investment Bank. Oceania refers to Australia.
- Source: Bloomberg LP.

¹⁵ Association for Sustainable and Responsible Investment in Asia. 2014. *Asia Sustainable Investment Review 2014*. Hong Kong, China.

In Asia, ADB sold its first clean energy bonds in 2010, raising US\$232 million to support renewable energy and energy efficiency projects. This was followed in 2012 with the second sale of clean energy bonds, raising US\$339 million. In March 2015, ADB raised US\$500 million from its inaugural green bond issue, aimed at channeling more investor funds to ADB projects that promote low-carbon and climate-resilient economic development.

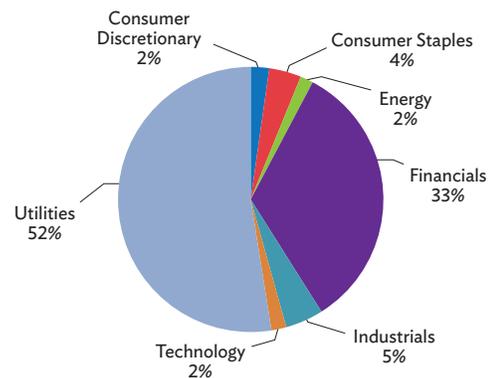
The attraction of multilateral development bank bonds is that they rank equal to the banks' other obligations and therefore have the same AAA credit rating. Institutional investors, who are traditional buyers of multilateral development bank bonds, are also attracted to them because it gives them the opportunity to invest in environmentally friendly projects at little risk. Reflecting the importance of the multilateral issuers, most green bonds have an investment grade rating, with the bulk being rated AAA (Figure 19).

For corporate green bonds, utilities have been raising more than half of the funds in the green bond market. However, financial firms are also big issuers (Figure 20). Financial firms issuing green bonds earmark the funds raised for lending to environmental projects. Corporate issuance of green bonds is concentrated in the European markets (Figure 21). At the moment, Asia has only a very small slice of the corporate green bond market. Part of the reason for the limited issuance in Asia is that it is

still a relatively new trend in the region. The benefit of labeling bonds as green is the ability to access a broader range of investors with environmental and sustainable goals as part of their investment criteria. The growing pool of such investors suggests that there is potential for lower costs and increased liquidity in the green bond market.

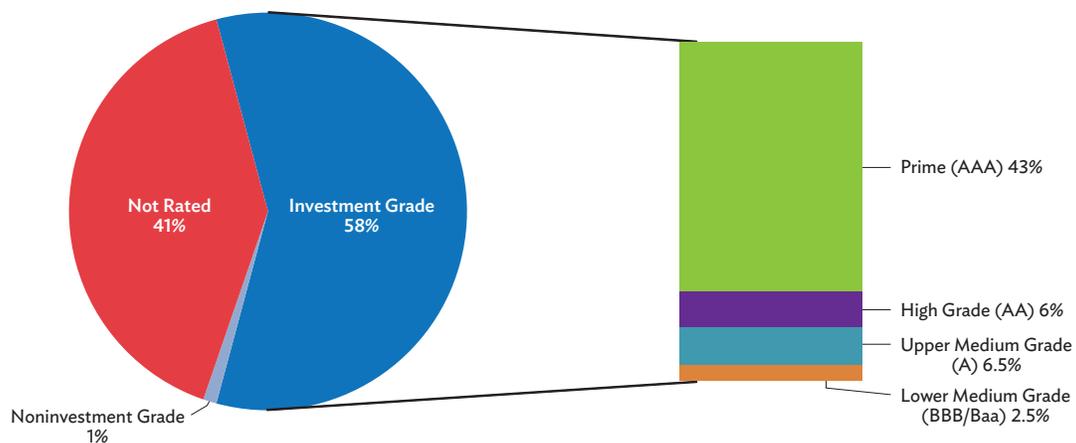
However, the pool of investors in Asia is still very small so issuers will have to target investors in developed economies. Another important plus of issuing green bonds is the benefit to a company's reputation. It is

Figure 20: Corporate Green Bond Issuance by Industry, 2007–2014



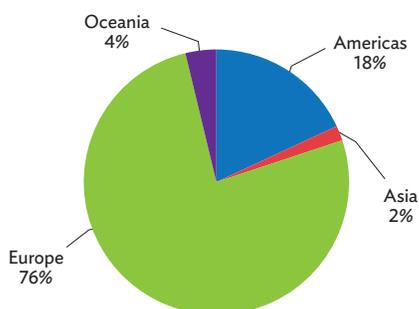
Source: Bloomberg LP.

Figure 19: Green Bond Ratings



Note: Data as of end-December 2014.
Source: Bloomberg LP.

Figure 21: Corporate Green Bond Issuance by Region, 2007–2014



Notes:

1. Americas refer to Canada, Peru, and the United States.
 2. Asia refers to Taipei, China. Europe refers to Austria, France, Italy, Norway, Spain, Sweden, and the United Kingdom.
 3. Oceania refers to Australia.
- Source: Bloomberg LP.

a visible way to signal the company's commitment to environmental goals. However, a study on Chinese firms found that those that have been lauded for environmental achievements had not seen any positive impact on their valuation.¹⁶ This suggests that the halo effect of an environmental company seems to be limited in the PRC for now.

Against these benefits, there are also additional costs associated with issuing green bonds. For example, there are costs associated with certifying and monitoring the bonds. There could be risks that investors may seek penalties if the funds are not used for their stated environmental purposes. The lack of a universal standard on what is considered a green bond is also problematic. Without a proper legal framework, issuers and investors will have to decide for themselves what qualifies as a green bond.

The corporate green bond market in Asia is still nascent as there have been only two issuances to date. The first one was by Advanced Semiconductor Engineering, a provider of semiconductor packaging and testing services based in Taipei, China. In 2014, it issued a US\$300 million 3-year green bond via its subsidiary, Anstock II Limited. The bond yielded 125 basis points above US Treasuries, which is roughly comparable with the yield on the company's other bonds. The bond issue was met with strong investor

interest and most of the bonds were taken up by Asian investors.

In February 2015, Asia's second corporate green bond was issued by India's fifth largest private bank, YES Bank, which raised US\$156 m through a 10-year green bond with the proceeds to be used to finance infrastructure projects in renewable energy. KPMG India will be providing annual assurance services on the use of the proceeds in accordance with green bond principles.

Green bonds are still a sliver of the overall bond universe, at just 0.06% of the total at the end of 2014. But with the right support and policy, there is tremendous potential for green bonds. The corporate green bond market must develop to ensure liquidity and attract new investors. To further facilitate green bond investment, Barclays and MSCI introduced a new Green Bond Index that tracks the global market for such bonds. Bank of America Merrill Lynch has also launched a Green Bond Index. These indexes will make it easier to track the performance of green bonds and could lead to the introduction of passively managed green bond funds that can open up the market to a larger group of investors.

Project Bonds for Financing Renewable Energy Projects

In addition to general use bonds, there is a growing trend toward using project bonds in which funds are raised to finance a specific project. The cash flow from that project will be used to cover the servicing costs of the loan. In a project bond, the creditworthiness of the bond is based on the ability of the project to generate the necessary cash flow to cover the servicing costs of the bond and provide a return to the investors. This is in contrast to conventional bonds where the issuing firm's entire balance sheet is available for servicing the loan. When investing in project finance bonds, investors must scrutinize the project's construction, operating costs, and revenues to evaluate the payout.

Project finance can be used to finance large infrastructure projects that might otherwise be too risky or burdensome for a company's balance sheet. With project finance, the lenders provide funding for the project based solely on the risk-and-return profile of the project. Therefore, the company that develops the project is not liable in case the project fails.

¹⁶ T. Lyon et al. 2013. How Do Investors Respond to Green Company Awards in China? *Ecological Economics*. 94. pp. 1–8.

Renewable energy investments are similar to long-term infrastructure investments. This means they tend to appeal to investors with a long investment horizon such as pension funds, which need to have long-term investment assets to match their long-term liabilities. As with infrastructure projects, most of the risk in renewable energy projects is in the construction phase. Once the project is up and running, the risks are relatively minimal. Renewable energy projects have very low operating costs and a well-defined stream of revenue if there is a long-term contract or feed-in-tariff.

The introduction of tighter prudential regulations for banks since the global financial crisis has made project financing from banks more expensive and difficult to obtain. Long-term loans are riskier and now attract a higher risk weight under Basel III regulations. This hurts projects with long-term payback periods such as renewable energy projects. With the payback period from renewable energy projects very similar to that of bonds, it may make sense to package and structure it as a project finance bond. This could be more cost effective than going through a bank.

Another concern that investors may have with renewable energy project bonds is that they can lack liquidity. To get around this problem, the “Yield Co” structure is gaining popularity in the US. The first Yield Co was NRG Yield, which raised US\$500 million in 2014 to finance a wind farm. In January 2015, TerraForm Power issued a US\$800 million green bond to finance its acquisition of a wind farm. The Yield Co investment structure is targeted to long-term investors seeking higher yields in the current low interest rate environment. A Yield Co purchases renewable energy projects that are already operating and generating a predictable cash flow. As a Yield Co invests in renewable energy projects that are already up and running, most of the construction and operating risks are eliminated. It also allows the original project developer to recoup their investment, allowing them to invest in other projects. Yield Cos are usually structured by securitizing several different renewable energy assets to make them more liquid. Further, a portfolio of assets is also more diversified and less risky. Structures like this could help attract additional investors to the renewable energy market. Lowering the cost of capital is essential for renewable energy projects, given the higher upfront costs.

The success of the Yield Co model suggests that there is potential for the securitization model to help improve liquidity and diversify the risk of renewable energy project bonds. A study on securitization of residential solar PV assets was found to help reduce project financing costs significantly.¹⁷ However, for the securitization model to succeed, it is important to ensure that the securitized security is liquid and easily traded. This means there needs to be a well-developed bond market and some standardization of the assets. It also requires a regulatory framework that allows for the securitization of revenue streams. Greater transparency and availability of data could also make it easier to attract investors.

Policy Challenges Ahead

While the case for financing renewable energy is compelling, there are several key policy challenges that need to be overcome to ensure that financing needs can be met. Bond financing can help attract a new class of investors to finance renewable energy projects. Several economies in the region with large developed bond markets have successfully raised funds for large infrastructure projects. Deep capital markets are important to ensure sufficient liquidity to facilitate the issuance of bonds. In addition, it will be important to develop a pool of long-term investors that can invest in these long-term bonds.

Although their financing capacity for renewable energy projects may be limited, governments still have an important role to play. Regulatory policies have a strong influence on the financing environment. In the PRC, the government has taken action to promote the development of renewable energy since 2005.¹⁸ While substantial progress has been made, more needs to be done such as increasing the rate for solar feed-in tariffs and creating more incentives for local governments to pursue energy conservation.

A stable regulatory regime can also reduce the risk of investing in renewable energy. A supportive policy framework for renewable energy goes a long way toward promoting long-term investment in renewable

¹⁷ T. Alafita and J.M. Pearce. 2014. Securitization of Residential Solar Photo Voltaic Assets: Costs, Risks, and Uncertainty. *Energy Policy*. 67. pp. 488–98.

¹⁸ K. Lo. 2014. A Critical Review of China’s Rapidly Developing Renewable Energy and Energy Efficiency Policies. *Renewable and Sustainable Energy Reviews*. 29. pp. 508–16.

energy capacity.¹⁹ US states that have backtracked on policies to promote renewable energy have attracted less investment, suggesting that policy uncertainty can deter new investment.²⁰ Feed-in tariffs could be useful to reduce the risks to investors for renewable energy projects. Supportive policies that are long-term and do not depend on annual budget allocations tend to be favored by investors.²¹

While bonds offer a promising avenue for financing renewable energy projects, there are challenges that have to be overcome. Renewable energy projects tend to be at a disadvantage as they have shorter track records and higher up-front costs than conventional energy projects. Further, renewable energy projects may also face higher transaction costs compared with conventional energy projects. This is because renewable energy projects tend to be smaller in scale. One way to level the playing field for renewable energy projects is to provide guarantees that can reduce the cost of financing. Traditionally, this guarantee has been provided by governments, but it carries a fiscal risk. Hence, the cost of providing the guarantee has to be carefully weighed. Another way would be to set up a dedicated fund to help finance renewable projects. As more renewable energy projects are up and running, investors may become more comfortable with them and the need for guarantees or special funding will diminish.

There is a perception that renewable energy firms are risky investments even though this is not necessarily the case. In a study on the cost of equity capital for renewable energy, it was found that from the perspective of an international investor, the risks of renewable energy firms in Brazil, the PRC, and India were comparable with those of the overall market.²² The risks from the perspective of a domestic investor are more varied. Indian renewable energy firms have higher-than-average market risk, while Brazilian firms have lower-than-average market risk. Meanwhile, Chinese firms have average market risk. To a certain extent, investors may have underestimated the risk of conventional energy firms as the threat of tighter environmental regulations in the future could severely affect their profitability.

An important priority is to help narrow the information gap for lenders who are contemplating investing in renewable energy. Making data on renewable energy project costs and performance more transparent will facilitate the participation of institutional investors. Before investing in infrastructure projects, investors typically examine the track record of similar projects. Without historical data on past financial performance, investors may be reluctant to invest in renewable energy projects because they lack the information to make the necessary estimates of future returns. Making historical data publicly available would improve transparency in the investment process. Governments can also provide more information about the availability of renewable energy from their assessments and mapping of renewable energy resources.

Conclusion

There has been tremendous growth in the issuance of renewable energy bonds. Most renewable energy bonds labeled as such have come from AAA-rated supranationals. The market has to develop beyond these highly-rated issuers to embrace other corporations. A wider variety of issuers offering different risk-and-return tradeoffs will broaden the market. The use of project bonds and asset-backed securities is also helping to develop the markets.

While the PRC has been a major issuer of unlabeled renewable energy bonds, the region as a whole is lagging behind. Success in the PRC has been due to corporates tapping into a large pool of liquidity. The rise of renewable energy bonds has coincided with strong government support for renewable energy, which led many state-owned enterprises to invest in the sector. Thus, investors in the PRC's bond market are less worried about risk because of the perception of an implicit guarantee from the government.

More renewable energy companies in Asia are expected to tap the bond market to finance investment needs. While only a few investors in the region have ESG investment criteria, momentum in favor of such criteria is growing. Large international investors are also keen to invest in Asia given low yields in the advanced economies. Innovative public-private partnerships can help increase the leverage of public funds and make corporate green bonds more attractive to large investors.

¹⁹ F. Polzin et al. 2015. Public Policy Influence on Renewable Energy Investments—A Panel Data Study across OECD Countries. *Energy Policy*. 80, pp. 98–111.

²⁰ K. R. Fabrizio. 2013. The Effect of Regulatory Uncertainty on Investment: Evidence from Renewable Energy Generation. *Journal of Law, Economics, and Organization*. 29, pp. 765–98.

²¹ S. Abolhosseini and A. Heshmati. 2014. The Main Support Mechanisms to Finance Renewable Energy Development. *Renewable and Sustainable Energy Reviews*. 40, pp. 876–85.

²² C. Donovan and Laura Nunez. 2012. Figuring What's Fair: The Cost of Equity Capital for Renewable Energy in Emerging Markets. *Energy Policy*. 40, pp. 49–58.