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Bond financing for renewable energy in Asia

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HIGHLIGHTS

- This study looks at the current financing gap and RE financing landscape in developing Asia.
- LCY corporate bonds, asset backed projects bonds and financial green bonds could help to address the financing gap for RE in the region.
- Policy recommendations for building the fixed income market for RE projects are provided.

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ABSTRACT

Addressing the financing gap for renewable energy (RE) projects in Asia is critical to ensure that the rapidly increasing energy needs could be met sustainably. This paper explores the cause of the financing gap in Asia and proposes the use of bond financing to address the financing gap. Specifically, three fixed income instruments, namely local currency denominated (LCY) corporate bonds, asset backed project bonds and financial green bonds, will be assessed. Whilst the potential for these three instruments to mobilize large flows of private sector financing is great, key supportive policies aimed at reducing the capital market bias for conventional power generation technologies and supportive RE policies are required. Another key aspect would be the necessary deepening of local and regional fixed income markets before such capital market instruments are able to play a big role.

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1. Introduction

Driven by rapid economic growth and demographic changes, Asia's share of world energy consumption is expected to rise from around a third in 2010 to more than half by 2035 if they continue on their current growth path (ADB, 2013). At the same time, anthropogenic climate change is shifting the global development pathway towards cleaner and more sustainable energy use, signalling the need for rapidly developing economies in Asia to incorporate more clean and green capacity into their energy needs. Most Asian economies have acknowledged the benefits and thus have embraced the need for the introduction of more renewables into their energy mix. Various supportive policies, such as the establishment of renewable energy targets and the introduction of Feed-in-Tariffs (FiTs) have been seen across the region.

The potential for large-scale renewable energy (RE) deployment is very high. According to a 2010 International Energy Agency (IEA) report (Ölz and Beerepoot, 2010), apart from Singapore, who faces serious land constraints, each Association of

Southeast Asian Nations (ASEAN) member state are capable of generating between 120 and 400 TWh of energy annually from RE sources by 2030. Despite favourable policies and the increasing cost-competitiveness of RE projects,¹ a sizable investment gap is still seen in the industry. A report by Sustainable Energy for All, estimated that to meet its goal of achieving a global 50% of electricity generation from renewable sources by 2030, there is an annual funding gap of US\$167billion (SE4ALL, 2015). Albeit their ambitious target, their results showcase a significant lack of investment in the RE sector. Such claims are also supported by academic literature with Ekholm et al. (2013) warning that lack of financing constrains the region's ability to meet its RE investment target. Thus it is important to examine the causes of the financing gap in the region and propose solutions to ensure that sufficient capital is channelled into the RE sector to ensure future energy needs of the region are met sustainably.

This paper aims to first provide a comprehensive understanding of causes of the financing gap in Asia and propose

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¹ International Renewable Energy Agency (2015), finds that wind and hydro-power are already cost competitive with conventional fossil fuel plants. Solar PV have also reached grid parity in various economies in Asia.

solutions to bridge this gap. The paper then proposes the use of fixed income instruments, i.e. bonds, to close the existing financing gap. Specifically, three different instruments, local currency (LCY) corporate bonds, asset-backed project bonds and the financial green bonds, will be explored in detail.

2. Literature review

The financing gap could be framed using two different but interrelated aspects of RE project economics: access to finance and the cost of capital. The access to finance refers to the pool of finances available for RE projects whereas the cost of capital refers to the cost at which financing is raised. The availability of financial resources directly impacts RE deployment as it determines if a RE project can proceed to the deployment and operational stage. RE projects are typically financed with a mix of equity and debt. Whilst the portion of debt ranges around 70–90% in developed economies, RE projects in emerging economies would require higher equity injection (30–40%) due to the inability to raise sufficient debt (UNEP, 2007). This creates pressure for RE project developers in developing economies to raise higher equity contributions, and their inability to do so usually leads to the failure of those RE projects to reach financial closure. Existing studies from the UNEP (2005) have also showcased that challenges of raising equity is one of the major contributing factors to the slow deployment of low-carbon projects. Glemarec (2011) echoes this view, claiming that raising equity capital is critical for RE projects in developing countries.

The cost of capital impacts the profitability of projects, which is a key investment criterion for financiers (Eyraud et al., 2011; Sonntag-O'Brien and Usher, 2006). Various existing literature have framed the cost of capital to be the main hindrance to RE mobilization given that the higher cost of capital will directly impact project returns, thereby affecting the projects bankability. Wisser and Pickle (1998) argued that the reduced cost of capital could improve the RE project returns, thereby improving project attractiveness to investors. Using a discounted cash flow model, Wisser and Pickle (1998) showed that financing inputs, such as required return on equity, debt interest rates and debt tenure, have significant impacts on the levelized cost of energy (LCOE) for RE projects. In addition, their study showed that the implicit elements of financing such as the length of debt tenures can also affect project profitability. Specifically, their model showed that simply increasing the debt tenure from 12 to 20 years will reduce LCOE for wind and solar PV by 12% and 17% respectively (Wisser and Pickle, 1998). Their results were supported by a research piece from the Climate Policy Initiative (Nelson and Pierpont, 2013) which estimated that unfavourable financing terms, specifically the high cost of debt in India, is expected to increase RE costs by 24–32% in India compared to US. In this paper, we define financing gap to be the inability of utility-scale RE project developers to gain required capital amounts at an appropriate cost.

There seem to be two contributing factors for the financing gap in Asia. Firstly, capital market failures have placed RE projects at a financing disadvantage compared to conventional power projects. Capital market imperfections may arise due to imperfect information, risk aversion, or agency problems (Wisser and Pickle, 1998). First and foremost, it is important to recognize that investors typically benchmark utility-scale RE projects with conventional fossil fuel power generation projects (IPCC, 2014). Compared to such conventional energy projects, the relatively nascent RE industry faces issues with regards to lack of financier familiarity, due to imperfect information in the industry. The lack of understanding of the risks of the industry may contribute to higher perceived risk of such projects, of which higher returns are

expected from the project to compensate investors for the higher risk taken (Sovacool, 2009). In addition, RE projects require high upfront capital cost as a proportion of total costs. The high initial costs are also often front-loaded which signals that even when all other financing terms are similar, RE projects are considered more costly and therefore less commercially attractive to investors (Brunnschweiler, 2010).

Given the nascent nature of the industry, most RE players are new small and medium enterprises (SMEs), with smaller market capitalization and possibly poorer track records as compared to established conventional energy producers. Under the current financial system, RE SMEs would be perceived to be less creditworthy as compared to established conventional energy players, therefore is expected to have higher cost of capital, making their projects less attractive to investors (Wisser and Pickle, 1998). The size of RE developers and their lack of track record not only increase their cost of capital, but also limit their choice of financial instruments. Typically, established organizations can leverage on the use of corporate finance, which are debt raised based on the balance sheet of the organization with the cost of financing attached to the credit worthiness of the organization. However smaller organizations, such as RE project developers typically do not have the market capitalization and the track record to rely on such financing instruments (Wisser and Pickle, 1998). These smaller organizations would have to rely on project financing, which is debt raised on the credit worthiness of a specific project, which are backed by project economics alone (Wisser and Pickle, 1998). Given higher associated risks, such debt usually comes at a higher cost. Carlos and Khang's assessment of biomass energy projects in Southeast Asia (Carlos and Khang, 2008) validates such statements. Carlos and Khang (2008) examined the financing structure of typical biomass projects in the region and highlighted three main sources of finance: balance-sheet financing, corporate finance and project finance. Their study found that while corporate finance is the most commonly used financing channel, projects utilizing the higher cost project finance often face difficulties in attaining financial closure. The smaller size of RE industry players also translates to higher transaction costs (Curnow et al., 2010), which may limit their ability to raise additional capital from external financing sources.

Acknowledging the lack of financing for RE globally, Zadek and Zhang (2014) argued for stronger intervention in the financial system, which is a potential solution to the financing constraints faced by RE projects. Unfortunately, the relative immaturity of the financial system in the region would have largely limited the scale of such interventions in Asia. Currently, financial systems in Asia remain highly bank-dominated. With the exception of Singapore, Malaysia and Thailand, most ASEAN countries still rely heavily on the banking sector with minimal involvement of the capital markets, with least developed countries such as Cambodia, Lao PDR and Myanmar still in the process of building a functional banking system. The relative immaturity of the level of financial development in the region is also viewed to have a widening effect on the financing gap faced by RE projects (Painuly and Wohlgemuth, 2008). The lack of financial diversification widens the financing gap as there is a lack of financial intermediation to match investments and investors with the appropriate financial instruments, which results in both inadequate access to capital and increased cost of capital (ADB, 2015; Painuly and Wohlgemuth, 2008).

Due to their dominance in the financial sector, banks are the most active in financing RE in the region. Bank based RE financing could be done through term loans, project loans, mezzanine loans and refinancing. A review of the database of Bloomberg New Energy Finance (BNEF) reveals that term loans are popular instruments for RE financing in Asia, particularly in India and China.

BNEF (2015) finds that asset finance (mostly in the form of term loan instruments) account for 73% of total RE investment in China. While banks are likely to continue to play a dominant role in financing RE in the region, new Basel III regulations could make banks more reluctant to lend long term. The new Basel III rules aim to ensure that banks have liquid and high quality assets so that they can better ride out periods of stress. These liquidity requirements tend to penalize long-term loans for which there is no active secondary market. RE loans tend to fall under this category and will likely find it harder to access bank financing. It may also raise the financing cost. Although banks still have some time to implement the new Basel III regulations, they may have started cutting back already on long-term lending as these loans will still likely be on their books when the Basel III regulations come into force. In addition, by its nature, RE projects tend to have project structures which may make them less attractive from the perspective of bankers. Typically, under the current financing landscape, financiers would tend to reasonably favour conventional energy projects which have a longer track record, a lower upfront costs to maintenance cost ratio, shorter payback periods and favourable policy incentives over RE projects (Sonntag-O'Brien and Usher, 2006). There needs to a shift in incentives to motivate a change in preference towards RE projects. Furthermore, commercial banks in emerging economies are expected to already hold large energy-related assets from national utilities, thereby limiting their ability to lend to emerging RE sectors (IPCC, 2014).

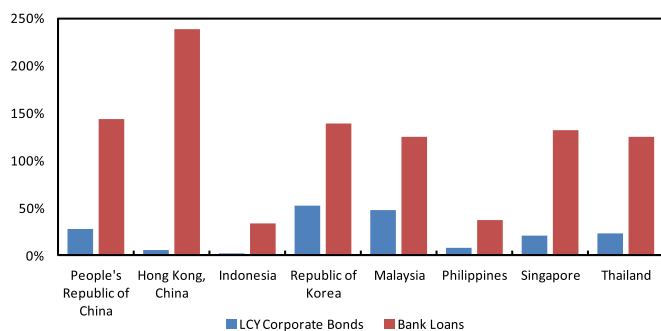


Fig. 1. LCY Corporate Bonds and Bank Loans as a Share of GDP. GDP=gross domestic product, LCY=local currency. Note: Data as of end-December 2014. Source: Produced by the authors using data from Bloomberg LP.

The lower level of capital market development (stock and bond market) compared to the banking sector in the region, limit the ability of RE developers to seek alternative sources of finance (Fig. 1). Government bonds dominate the domestic fixed income market, with corporate bond issuances rarely accounting for more 40% of domestic GDP (ADB, 2015). In terms of equity markets, only Singapore, Malaysia and Thailand were able to have a market capitalization surpassing their GDP. The restricted development of capital markets constrains private investment channels, thus forcing RE developers to seek public sector finances. Within Asia, multilateral development banks such as World Bank and Asian Development Bank (ADB) have provided technical assistance and financing for RE projects. These institutions offer market-based financing and also concessional financing for low-income countries and are seen to be very active in facilitating RE investment in Asia. ADB has set up various financing facilities to support RE development in the region. The Clean Energy Financing Partnership (CEFPF) was established in 2007 with the aim to provide financial resources to for clean energy projects. From 2005 to 2009, ADB has invested a total of \$5 trillion in clean energy in Asia (ADB, 2014). Spratt and Griffith-Jones (2013) argue that support from multilateral banks may serve to leverage private sector finance for

RE projects. Indeed, evidence of this implication has been illustrated with the 320 MW Sarulla Geothermal Power Development Project in North Sumatra, Indonesia. ADB provided the initial \$350 million financing support through its ordinary capital resources, its Clean Technology Fund (CTF) and the CEFPF. After which, it was able to leverage on private finance from six commercial banks to provide a \$1.17 billion loan package. In spite of its ability to leverage on the private sector and mobilize capital into the RE sector, such public sector financing channels are generally believed to be unsustainable investment due to limited fund size and slow churn rates.

Besides supporting RE deployment by introducing favourable policies, the government is also seen to be a direct financier of RE projects in the region. Besides direct equity injection, the public sector is also seen offering soft loans from public financial institutions or issuing loan guarantees. However, given that government finances are already overstretched in many developing countries in Asia, it is unlikely that this financing channel can mobilize the sufficient funds to fill the investment gap. Gujba et al. (2012) noted that international donors and government financing are playing a more important role in RE financing in Asia. However, with large pool of investable funds in Asia, illustrated by the expanding assets under management (AUM) of Asian institutional investors (PwC, 2014), private sector is expected play a major role in financing RE.

The financing gap in Asia is hypnotised to be due to capital market imperfections favouring conventional power projects over RE projects and the lack of financial diversity and development in the region. Arguably, the main constraint of RE financing in Asia would be in the limited availability of different financial instruments in the region. Despite the inherent unfavourable financing conditions of RE, developed economies are not experiencing investment shortfalls similar in scale as Asia. In the same SE4ALL report cited earlier, European economies are seen to be mobilizing sufficient funds into the RE sector (SE4ALL, 2015). Although an argument could be made that favourable policies were introduced to account to prioritise RE investment, the same could be said of Asian economies. Across Asia, policymakers have adopted various RE supporting policies such as FITs, which have been utilized in Europe. The difference between European RE markets and Asian market then lies in the existing RE financing landscape. European markets have seen the effective utilization of innovative financial instruments, such as green bonds, yieldcos and other alternative instruments. In contrast, banks or public sector agencies largely fund RE in Asia. Therefore, the key contributor to the financing gap in Asia would be the lack of diversity of financial instruments in Asia to match projects with suitable investors by aligning their risk and return paradigms.

3. Analysis and discussion

With the lack of financial diversity being the major contributing factor of the investment gap, opening up alternative financing channels would serve to bridge the financing gap and rapidly mobilize funds into RE project in the region. Tapping private sector funds would be critical in expanding the pool of credit available. Bond instruments are well-positioned to address the symptoms of the financing gap, namely access to finance and cost of capital.

Firstly, the flexibility of bond instruments allow for funds to be raised from investors from the whole risk spectrum, hence expanding the total credit pool. Whilst risky-taking investors may invest in junk bonds with high yields issued by companies or projects with poor credit ratings, more risk-averse investors may choose to invest in investment grade bonds issued by organizations or projects with strong credit ratings. Also, since bonds offer the opportunity to disperse ownership of the debt across a group

of investors, financiers find it easier to invest indirectly in RE through bond as opposed investing directly through loans or equity ownership. Furthermore, the presence of a secondary market for bonds promotes liquidity, thereby offering financiers a short-term exit strategy, and a shorter payback period. This is of particular interest for investors with short investment horizons.

Secondly, the attractiveness of bond instruments lies in their ability to garner interest from a specific investor group which have an interest in RE project. Globally, institutional investors, such as insurance funds, asset managers, sovereign wealth funds (SWFs) and pension funds, are increasingly interested to invest in RE projects. These institutional investors have approximately \$80 trillion assets under management (Nelson and Pierpont, 2013), representing an extensive source of potential RE financing. These investors have a long term risk outlook and are increasingly trying to limit their carbon and climate risk exposure. An important element here is that funds that have long-term liabilities would seek to balance those liabilities with long term assets. This allows institutional investors to become a more significant source of long-term investment in renewables. Green infrastructure investments, such as RE projects, offer investment opportunities for institutional investors that are a good fit with their long-term liabilities and investment mandates. A 2013 survey conducted by EY found that nearly one-third of institutional investors surveyed expected to increase RE investments in the next three years, and 15% expect it to increase by over 10% (EY, 2013). Such assertions are supported by market data with BNEF claiming that institutional investors' interest in RE financing led to massive growth in green bonds, yieldcos and quoted project funds (Frankfurt School, 2015). However to attract these investors, the investment will have to be packaged in a form that they are familiar with and comfortable to invest in. Currently, 50% of assets held by institutional investors are in the form of bonds (Nelson and Pierpont, 2013).

In terms of lowering the cost of capital, the cost of bond financing is likely to be lower than equity investments and other debt based financing such as bank loans. Corporate finance theory dictate that fixed income products are likely to be cheaper than bank loans due to the lower monitoring costs and dispersed ownership. Dispersed ownership translated to distributed risk, thereby contributing to a lower risk premium and therefore lower financing cost. Moreover, bonds offer a more compatible term structure for RE project as compared to bank loans. Typical bond tenures range between 7 and 15 years, aligning with the payback periods for RE projects. In addition, bonds debt structure is aligned to the project cash flow of RE projects. Due to the capital-intensive nature of RE technologies, the initial years of the project lifecycle is likely to experience negative cash flows. Bank-based financing would require the project make amortized payments of both principal and interest. This will place additional constraints for debt repayment prior to the recovery of capital. Bond financing allows for delayed principal repayments, which allows RE projects to generate returns and cover the capital costs across a range of payback periods. As such, implicit cost of financing are also reduced with the usage of bonds. Fixed income instruments, specifically asset-backed securities, when used as refinancing tools, could also serve to lower cost of financing and reduce the investment gap by freeing up cash to invest in new projects.

Taking a policymaker's perspective, the promoting the use of alternative financing mechanisms such as bonds, have benefits that goes beyond bridging the investment gap. It could also serve to promote diversification of the financial infrastructure. The current overreliance on bank financing creates multiple self-feeding issues that may increase the vulnerability of the existing financial system. Firstly, the domination of one financing channel may crowd out development of other capital markets, thereby limiting the total credit available. In addition, the homogeneity of the

financial system, with rigid risk and return structures restricts both the borrower and lenders pool. Furthermore, it introduces systemic risks into the financial system, thereby increasing risks of financial instability. This would, in turn, contribute to the problem of deterring active domestic private sector participation in the financial market, thereby impeding financial market development. This then, creates a self-fulfilling prophecy of a limited market. In addition, the heightened financial risks involved in the inherent homogenous financial system deter participation from international financial intermediaries with more sophisticated markets. Without foreign participation and the increased sophistication brought along by this participation, developing Asian financial markets are likely to remain illiquid and small. The homogenous financial structure seems to promote a series of self-feeding reactions that could only serve to limit market growth and widen the financing gap of RE projects. The promotion of bond instruments to finance RE projects could serve to drive in domestic, regional and international institutional capital that would not only offer larger pools of available credit to RE projects, but also deepen the current financial system. Furthermore, the deepening of financial systems also contributes to the gradual improvement financial intermediation services.

Financing of RE projects through the capital market could promote transparency in the market, thereby minimizing information asymmetry in the industry. The disclosure requirements of capital markets requires both project developers and financiers to provide a greater diversity of perspectives from various stakeholders, such as investors and intermediaries that could provide independent evaluation and second opinions on the projects. Furthermore, the transparency and disclosure requirements would help to strengthen price discovery, information identification and risk pricing for the projects. As the market deepens, related expertise could be built internally, thereby expanding and improving the financial services sector, enforcing strength of related infrastructure, thereby contributing to building of the national capital markets.

The ensuing sections explore three different bond instruments, namely local currency (LCY) corporate bonds, project bonds and financial green bonds, which can be utilized for RE financing in the region.

In particular, LCY corporate bonds refer to corporate bonds issued by RE companies in local currency. Corporate bonds are typically backed by the balance sheet of the issuing organization, and thus is considered recourse financing. Project bonds, on the other hand, refer to fixed income instruments that are backed solely by the economics of the underlying project or assets. Bondholders have no access to the balance sheet of the issuing organization in case of a bond default and thus is viewed as non-recourse financing. Project bonds could be issued at the start of the project lifecycle or at the operational phase as asset-backed securities (ABS). Green bonds refer to an emerging bond class that are marketed as green. Green bonds could take the form of corporate bonds, project bonds and asset-backed bonds. Flexibility of the green bond instrument allows financial institutions who aim to increase lending to RE sectors to raise funds publicly through issuing a financial bond, thereby widening the financial options for RE players.

3.1. Local currency corporate bond

The most direct way to utilize bonds for RE financing would be for RE companies to issue corporate bonds. Globally, RE sector bonds have been increasing rapidly. Since 2010, total bonds issued by RE corporations have increased from \$5.2 billion to \$18.3 billion (Fig. 2). Asia has been leading the way in using bonds. However, almost all (90%) of the renewable sector bonds in Asia has come

from China (Fig. 3). This is consistent with the overall trend of increasing investment in RE sector in developing countries. Zadek and Flynn (2013) find that about half of global RE infrastructure investment in 2012 came from developing countries with China accounting for the bulk of it. China presents a successful case-study for other Asian countries, particularly those with strong domestic LCY markets such as Malaysia, Singapore and Thailand. Strong government support in both the RE and financial intermediation industry have facilitated the rapid expansion of RE in the People's Republic of China, thus to emulate the Chinese success story, similar policies could be introduced.

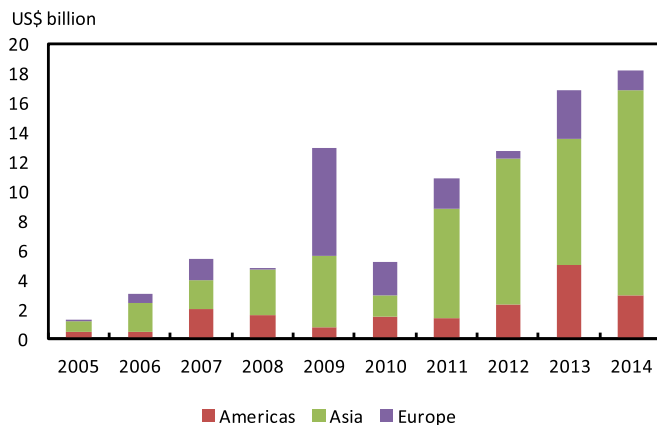


Fig. 2. Renewable Energy Sector Bonds by Region. Source: Produced by the authors using data from Bloomberg LP.

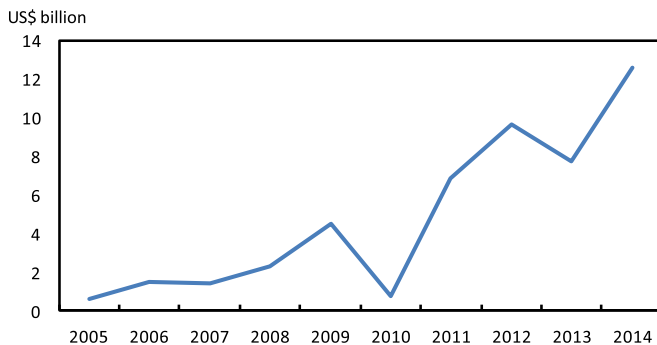


Fig. 3. People's Republic of China's Renewable Energy Sector Bond Issuance. Source: Produced by the authors using data from Bloomberg LP.

One example of a recent RE bond issuance is Trina Solar Limited² from China. Trina Solar Limited is a large scale integrated solar power products manufacturer including crystalline silicon PV modules and solar system developer which issued a total of US\$ 115 million convertible senior notes in 2014 at 3.5% yield. Trina Solar's first offering was in June 2014, of which a private placement with institutional investors for US\$ 140million issuance was completed. RE corporate bonds were met with favourable investor demand, as represented by the oversubscription of a similar bond in October bond which was able to increase borrowing from US\$ 100 million to US\$ 150 million.

Like Trina Solar, many RE players view accessing foreign debt

could be seen as a way to bypass inefficiency of local financial markets and gaining lower costs of capital. But it comes at a price as international debt tends to be priced in foreign currency, usually US dollar. So taking on foreign debt would usually mean taking on exchange rate risk, as the revenue from the RE projects would be in domestic currency. The foreign exchange rate risk could be hedged but it would then probably offset most of the benefits in terms of lower yields. In addition, regional RE players without international recognition may face investor unfamiliarity, thereby increasing perceived risks and cost of financing.

With the region's LCY bond markets rapidly expanding, most RE project developers have signalled a preference to issue in local currency (Fig. 4). The main appeal of LCY corporate bonds is that it is able to channel domestic and regional funds back into the region. Overall, Asia remains a capital surplus region with most economies running current account surpluses. With high savings rates across the region, the region is not short of capital. However, the current trend we are seeing is the outflow of large sums of domestic capital flowing into the low-return less risky overseas assets as reflected by the region's growing foreign exchange reserves. Thus it is important for policymakers to shift capital flows back into local investment projects. The creation of RE fixed income products, which creates investment instruments with a low-risk, steady returns paradigm, may serve to attract new domestic and regional institutional investors, thereby facilitating the inflow of capital back into the region while expanding the available credit pool for RE projects.

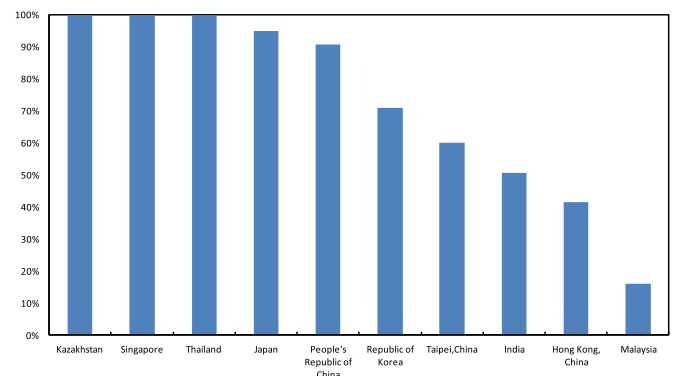


Fig. 4. LCY-Denominated Renewable Energy Bonds as Share of Total. Source: Produced by the authors using data from Bloomberg LP. Note: As of end 2014.

The target investors for LCY corporate bonds are domestic and regional investors. Better knowledge of local conditions increase willingness to finance RE projects. Local investors are usually better able to assess the complicated risks of building and delivering RE projects. Better understanding of domestic regulations could also be an advantage to domestic investors. This is especially true in Asia where environmental regulations and incentives for investment in RE are evolving quickly. By being closer to the regulators may allow for domestic investors better opportunity to take advantage of investment opportunities opening up. Regional investors, when equipped with sufficient information and transparency, are also well-positioned to invest in RE in the region. Regional players are more familiar with the region and thus assessing the risks and returns on RE projects differently from that of advanced economies investors. However, such investments must be facilitated by loosened regional capital controls, increased forex risk management tools and regional cooperation.

3.2. Asset-backed project bonds

In addition to "general use" bonds, there is a growing trend towards using project bonds. With project bonds, proceeds are

² Trina Solar was founded in 1997 and specializes in manufacture of crystalline silicon photovoltaic modules and system integration. It has various international offices spanning Asia, Europe and North America. Trina Solar listed on the New York Stock Exchange in 2006.

tied to specific projects or assets. Only cash flows from the underlying assets will be used to service the bond. Creditworthiness of the bond is thus based solely on the ability of the project to generate the necessary cash flows to cover the cost of the bond and provide a return to the investors. Therefore, the organization that develops the project is not liable in the case that the project fails.

Tighter prudential regulations for banks brought in after 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 the new Basel III regulations. This hurts projects with long term paybacks such as RE projects. With the payback period from RE 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. This is particularly useful for organizations with a preference for non-recourse finance.

While there is no explicit deterrent of using project bond financing at the initial planning and construction phases, such arrangements are rare. This is due to several factors. Firstly, debt restructurings are common for pre-construction loans for infrastructure project. Debt issuances do not offer this flexibility with its rigid covenants (Ehlers et al., 2014). Moreover, the main investor group for bonds are institutional investors who are ill-equipped to deal with pre-construction and construction risks. These institutional investors prefer mature assets with stable cash-flows, a structure that is highly aligned with operational RE assets. Banks are most likely to fill this pre-construction financing gap by extending bridging loans to RE developers whilst the bond issuance is being lined up. Additionally, asset-backed securities utilizing the yield company or “Yield Co” model, presents opportunities for RE financing. The “Yield Co” investment structure is targeted at lowering cost of capital for RE projects by bundling various operational assets together. Under such structures, the risks are reduced with pre-construction and construction risk eliminated and the diversification of assets. The success of the “Yield Co” model suggests that there could be great potential for the securitization model to help improve liquidity and diversify the risk of RE project bonds. Alafita and Pearce (2014) finds that securitization on solar asset backed securities can help reduce project financing costs significantly. The first “Yield Co” was NRG Yield³ which raised \$500 million in 2014 to finance a wind farm. In January this year, TerraForm Power⁴ issued \$800 million green bond at a fixed coupon of 5.875% to finance its acquisition of a wind farm. A comparison of the cost of financing of NRG Yield and its parent company, NRG Energy,⁵ validates claims that securitization reduce cost of financing. NRG Yield’s coupon rate has 80 basis points advantage over bonds of similar tenor issued by its parent company. Moreover, the issuance of asset-backed bonds would allow RE players to “flip” their investments, thereby freeing up cash to invest in new projects, further contributing to the closing of the financing gap.

³ RG Yield, Inc, established in 2012, is a dividend growth-oriented company, to serve as the primary vehicle through which NRG Energy, Inc. owns, operates and acquires contracted renewable and conventional generation and thermal infrastructure assets. The Company owns a diversified portfolio of contracted renewable and conventional generation and thermal infrastructure assets in the U.S. Each of these assets sells substantially all of its output pursuant to long-term offtake agreements with creditworthy counterparties, which represents secure cash flows.

⁴ TerraForm Power is a diversified owner of clean power generation assets in developed markets. This includes solar and wind assets located in the U.S., Canada and other developed markets. The assets are acquired through its sponsor, SunEdison, and other high-quality third parties.

⁵ NRG is one of the largest solar power developers in the United States and offers services that range from electricity service to electric vehicle charging, rooftop solar to home maintenance.

However, for the securitization model to succeed, it is important to ensure that the securitized security is liquid and easily traded. This means there will need to be a well-developed bond market and some standardization of the assets. It would also involve having 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.

3.3. Financial green bonds

Green bonds, whereby the issuer commits to the use of bond proceeds only to environmentally-friendly products, has emerged to be a potential financing channel for RE. The key differentiating feature is that a green bond is marketed as green to investors and their proceeds are ring-fenced to green projects. This is in contrary to conventional bonds, of which the bondholder has no say over how the proceeds of the bond are utilized.

When referring to green bonds, it is important to differentiate between labelled and non-labelled green bonds. Labelled green bonds⁶ refers to bonds being marketed as green bonds, while the non-labelled green bonds universe refers to bonds that are used for environmentally friendly projects, but are not marketed as green bonds. Labelling provides an effective way to define and distinguish green bonds as a specific sub-universe of environmental or green bonds. Thus, a particular strength of the (labelled) green bonds instrument to the issuer would be the ability to highlight environmentally friendly attributes and hence potentially attract investors with an Environmental-Social-Governance (ESG) mandate, which they were previously unable to tap due to information asymmetry and low visibility of their bond issuance. Issuing a green bond would also increase the visibility of the bond to conventional investors, as the pool of green bond issuances is smaller than the pool of conventional bond issuances and the investor group for both asset classes are overlapping. The ability to highlight green attributes of green bonds could also improve overall publicity and improve organization image, thereby broadening their access to capital.

Another strength of the green bonds is the flexibility of the instrument. This flexibility is reflected in terms of the issuer requirements, possible types of issuance and the terms of issuances. It is important to note that any organization is eligible to issuance a green bond. The green credentials of the bond issuance lies not upon the issuer, but the underlying projects or assets linked to its issuance. While accrediting the green credentials to an underlying asset opens up areas of controversy, particularly in terms of safeguarding green claims, it facilitates the active participation from a diversified spectrum of organizations. A strong argument for the case would be that all organizations would need to transit towards a low-carbon society, and as such, would require financing. Limiting the issuance of green bonds for only “green” organizations would therefore lock-in business-as-usual operations for a variety of organizations as they would lack the financing tools to shift to a low-carbon model. For example, while RE companies may wish to issue a corporate green bond to finance their projects; other power generation organizations, who wish to expand into the RE sector may also issue a green bond that is tied to the RE related section of their operations. By opening up such financing channels, it can be argued that organizations would be better positioned, and therefore, have a higher likelihood to engage in environmentally friendly investments.

Due to the flexibility of the green bond issuance, various financial sector players are seen to be tapping this market to gain

⁶ Henceforth, all references to green bonds would refer to the labelled green bonds segment.

additional funds to lend to low-carbon projects. The emergence of financial green bonds widens existing financing channels for RE projects. Since proceeds from green bonds would have to be earmarked to green projects, green financial issuances would then imply the ring-fencing of an available pool of credit for green projects such as RE, ensuring the availability and stability of the flow of funds into green energy. At the discretion of the financial institutions, preferential interest rates may also be offered. Currently, the market is witnessing the issuance of green financial bonds from commercial banks, policy banks and governmental agencies. Such issuances are critical in bridging the financial gap as they address challenges of raising initial capital. As highlighted in the earlier section, bond instruments are well-suited for refinancing purposes. Financial green bonds would be able to bridge this gap as expanded credit facilities may allow more funds to flow into initial start-up funds or as bridging loans.

Against these benefits, there are also additional costs associated with issuing labelled green bonds. For example there are additional costs for certifying and monitoring the bonds. There could also 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 could make some green claims contentious. Without a proper legal framework, issuers and investors will have to decide themselves what qualifies as a green bond. Being a new market, industry standards and practices is still in the formation stage.

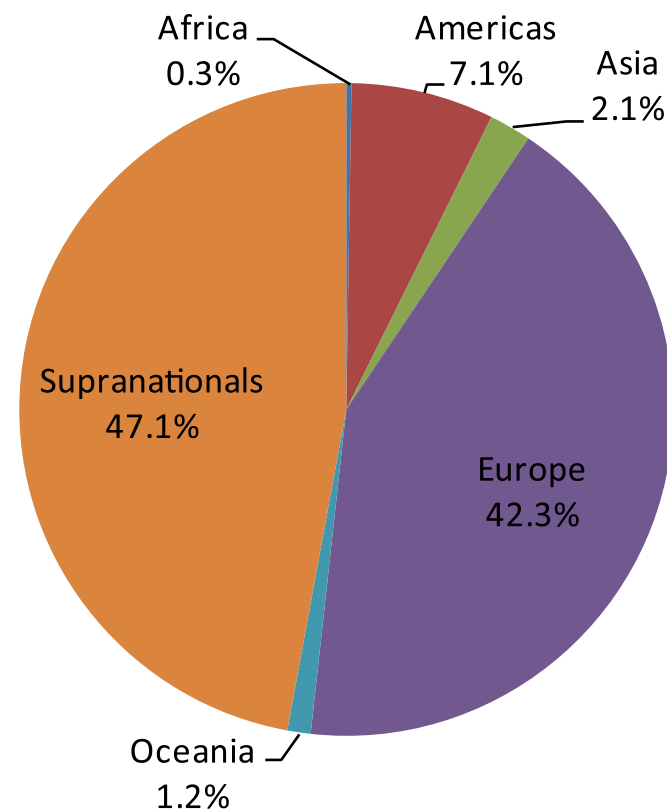


Fig. 5. Green Bond Issuance by Region, 2007–2014. Source: Produced by the authors using data from Bloomberg LP.

Financial green bonds are typically well-equipped to deal with both the higher transaction costs and the lack of standardization of green. Firstly, these issuers, mainly banks and public sector agencies, are typically well-capitalized and have capacity to internalize the transaction costs. In addition, monitoring of the use of proceeds would be significantly easier for financial institutions. Moreover, such financial sector players typically have the ability to

assess the environmental friendly nature of their loans. Therefore, financial green bonds seldom draw controversy. Given large benefits and limited costs, there have been a couple of financial green bonds issued in Asia. ADB has been one of the key players in the supranational, subnational and agencies (SSA) bond issuers (Fig. 5) whilst commercial banks are also warming to the idea. To date, ADB has issued various labelled and non-labelled green financial bonds. ADB sold its first Clean Energy Bonds raising US\$232 million to support its renewable energy and energy efficiency projects in Asia and the Pacific in September 2010. This was followed in May 2012 with the second sale of Clean Energy Bonds raising US \$339 million. More recently, in March 2015, ADB raised US\$500 million from its inaugural green bond issue, aimed at channelling more investor funds to ADB projects that promote low-carbon and climate-resilient economic growth and development in developing Asia. Issuances from commercial banks were also able to gain investor interest. The Export-Import Bank of India's⁷ US\$500 million bond was 3.2 times oversubscribed whereas a LCY financial green bond issuance by Yes Bank⁸ was able to double its bond issuance amount due to oversubscription. This gives rise to optimism that apart from financial green bonds, other corporate issuances would also be able to gain investor interest.

Looking back at the recent green bond issuances in Asia, most LCY denominated issuances are able to attract significant proportions of local institutional investors, whereas bond issuances denominated in international currencies were able to gain international investors. Although current trends seem to indicate regional demand for green bonds, it is important to note that Asian fixed income markets are largely undersupplied, and thus the investor demand may in fact be in response to the bond issuance itself, rather than the "green" factor. Although the eventual move towards corporate green bonds will be preferred, cautious analysis to assess market interest is required. In the meantime, green financial bonds can serve to provide interim support by reducing financing barriers of gaining debt finance.

4. Policy recommendations

Having highlighted the potential of utilizing fixed income instruments to close the financing gap in Asian RE industry, it is now opportune to discuss elements of appropriate enabling environments to facilitate the uptake of conventional RE fixed income instruments and green bonds.

4.1. Levelling the playing field for RE projects

While bonds offer a promising avenue for financing RE projects, policy actions are needed to improve inherent project economics of RE projects to attract investor participation. These can be justified by the positive environmental externalities that RE offers. Possible policies include the introduction of carbon pricing or tax credits for RE projects.

Additionally, there is a perception that RE firms are risky. But generally, RE firms are not necessarily riskier. Donovan and Nuñez (2012) find that from the perspective of an international investor, the risks of RE firms in India, Brazil and PRC are comparable with

⁷ Export-Import Bank of India is the premier export finance institution set up in 1982 under the Export-Import Bank of India Act 1981. Government of India launched the institution with a mandate, not just to enhance exports from India, but to integrate the country's foreign trade and investment with the overall economic growth.

⁸ Yes Bank, is India's fifth largest private sector Bank, with a pan India presence across all 29 states and 7 Union Territories of India. Yes Bank offers services in banking, finance and wealth management.

that of the overall market. The risks from the perspective of a domestic investor are more varied. Indian RE firms have higher than average market risk while Brazilian firms have lower than average market risk. Meanwhile Chinese firms have average market risk. Furthermore, to a certain extent, investors may have been underestimating the risk of conventional energy firms. The threat of tighter environmental regulations in the future could severely affect their profitability. Moreover, while operational and market risk exist for conventional power plant throughout the lifecycle of the projects, such risks are largely mitigated during the operational phase for RE projects. Therefore, an important priority now is to help narrow the information gap for lenders who are contemplating investing in RE. Making data on RE project costs and performance more transparent will facilitate the participation of institutional investors and reduce the cost of financing. Before investing in infrastructure projects, investors typically would like to examine the track record of similar projects. Without historical data on past financial performance, investors may be reluctant to invest because they lack the information to make the necessary estimate 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 RE from their assessment and mapping of RE resources.

Another way to level the playing field for RE projects is to provide credit 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 provide low cost financing for RE projects. This can help narrow the cost disadvantage. As more RE projects are operational, investors may become more comfortable with investing in them and the need for guarantees or low cost financing will diminish. Tax incentives or exemptions for RE projects can also help reduce the cost differentials.

At the same time, polluting industries with negative environmental externalities should also bear the burden of their pollution. Traditionally, fossil fuel energy sources have not face the full costs of the pollution they generate. To level the playing field between fossil fuel and RE sources, fossil fuel energy sources should face higher costs. Higher taxes could be imposed on fossil fuel sources to reflect more accurately the cost of the pollution that they cause. This would reduce the return on investing in fossil fuel, thus making RE more competitive.

A stable regulatory regime can also work to reduce the risk of investing in [Polzin et al. \(2015\)](#) finds that a long-term supportive policy framework for RE goes a long way towards promoting investment in RE capacity. Given the long-term nature of many RE investments, the stability of the policy framework is very important. [Fabrizio \(2013\)](#) found that US states that have backtracked in their regulations to promote RE attracted less investment suggesting the policy uncertainty can deter new investment. [Abolhosseini and Heshmati \(2014\)](#) argued that feed-in-tariff could be useful to reduce the risks to investors for RE projects. Supportive policies that are long-term and do not depend on annual budget allocations tend to be favoured by investors.

4.2. Building deep capital markets

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. Improving rules and legislation concerning capital mobility not only increases attractiveness, but also affects the accessibility for investors to tap the market. Besides building demand among domestic investors, it is also important to explore expanding the investor pool beyond national borders. This

further highlights the importance of capital mobility. Currently, regional cross-border financial investment remains limited, as represented by the minimal regional presence of financial institutions. Intra-regional dialogues have been initiated to improve regional capital market integration. The Asian Bond Market Initiative was initiated in 2003 to promote the development and greater integration of bond markets in Asia within the region. To help standardize market practices and harmonize regulations for cross-border bond transactions, the ASEAN+3 Bond Market Forum was established in 2010. More recently, the ASEAN Economic Community which comes into effect at the end of 2015 can help to promote greater integration among the region's capital markets. Such efforts aimed at harmonizing financial regulations, information systems, accounting standards should be continued. However, these initiatives face various technical challenges, especially due to the heterogeneous level of financial development across the region. One potential issue that may arise from capital market integration and increased cross-border investments would be the determination of the appropriate cost of borrowing for a regional financial instrument when central banks rates are different across the region. We view the disparities of cost of borrowing across the region to be a function of different risks profiles and also differing standards. The accurate assessment of an "appropriate yield" would have to be based on the accurate assessment of risks with the required information. Information transparency remains an issue for cross-border investors. In addition to lack of information, the lack of a basis of comparison due to different accounting and governance standards creates additional issues for investors. Such challenges would have to be overcome to improve investor confidence in regional investments.

One way to encourage broader participation of SME RE players in the bond market and deepen the capital market is to facilitate retail bond issuance. The retail bonds are typically issued in smaller volume which could be attractive to small and medium sized companies. This can enable smaller RE companies to also tap the bond market for financing. At present, apart from China, India and Thailand, the region does not have capital markets dedicated for SMEs. Policies aimed at building the legal and regulatory infrastructure for SMEs to tap capital markets is thus required.

4.3. Preventive mechanisms for the robustness of green bond label

The lack of robust definition of green and the self-regulating nature of the industry has raised doubts on safeguarding the green bonds label. One way to prevent abuse of the green bond label would be the creation of a national standard/system. This will entail creating a set of consistent step-by-step guidelines to ensure both the financial and environmental integrity of the green bond being issued. A procedural standard introduces flexibility into the kind of projects that could be considered green while still ensuring procedural stringency. Such guidelines could be based on international standards such as the Green Bond Principles, or a nationally recognised scheme for identifying green investments, should that be available. By adopting a procedural approach to regulating the sector, investor confidence in the institution would not be compromised as consistency is achieved.

In addition, national and regional financial market regulators could work with industry players to lay out specific legal and financial penalties for the violation of green claims. Supporters of the green bond instrument have conducted industry consultations on how to tackle potential legal contention in the area. Regional regulators could engage these industry experts to lay out formal penalties of abuse.

5. Conclusion and policy implication

The paper established that the financing gap in Asia is largely due to the lack of financial diversity and immature capital markets, and proposed the expansion of bond instruments, particularly LCY corporate bonds, Asset-backed Project bonds and Financial Green bonds, to bridge the financing gap.

Due to the heterogeneous nature of Asian economies, different economies would have place focus on different policy recommendations. Advanced economies such as Singapore could look at promoting the use of innovative financial instruments such as green bonds. Progressive emerging markets such as Indonesia, Thailand, Malaysia and Philippines are already seen to be introducing various favourable RE policies, thus focus could be on building its fixed income markets. Lastly, it would be some time before newly emerging economies such as Cambodia and Vietnam would be able to maximise the use of bond financing for RE. However, given high risk is major concern for investors in the region, these countries could focus on reducing financial barriers towards RE projects.

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References

- Ölz, S., Beerepoot, M., 2010. Deploying Renewables in Southeast Asia.
- Abolhosseini, Shahrouz, Heshmati, Almas, 2014. The main support mechanisms to finance renewable energy development. *Renew. Sustain. Energy Rev.* 40, 876–885.
- Alafita, T., Pearce, J.M., 2014. Securitization of residential solar photovoltaic assets: costs, risks and uncertainty. *Energy Policy* 67, 488–498.
- Asian Development Bank, 2013. Asian Development Outlook.
- Asian Development Bank, 2015. Asia Bond Monitor.
- Bloomberg New Energy Finance (BNEF), 2015. Clean Energy Investment – Q3 2015 Factpack.
- Brunnschweiler, C.N., 2010. Finance for renewable energy: an empirical analysis of developing and transition economies. *Environ. Dev. Econ.* 15, 241–274.
- Carlos, R.M., Khang, D.B., 2008. Characterization of biomass energy projects in Southeast Asia. *Biomass Bioenergy* 32 (6), 525–532.
- Curnow, Paul, Lachlan, Tait, Millar, Ilona, 2010. Financing renewable energy projects in Asia: barriers and solutions. *Renew. Energy Law Policy (RELP)* 1 (1), 101.
- Donovan, Charles, Nuñez, Laura, 2012. Figuring what's fair: the cost of equity capital for renewable energy in emerging markets. *Energy Policy* 40, 49–58.
- Ehlers, Torsten, Packer, Frank, Remolona, Eli, 2014. Infrastructure and corporate bond markets in Asia Financial. *Flows Infrastructure Financing*. pp. 67.
- Ekhholm, Tommi, Ghoddusi, Hamed, Krey, Volker, Riahi, Keywan, 2013. The effect of financial constraints on energy climate scenarios. *Energy Policy* 59, 562–572.
- Ernest and Young (EY), 2013. Institutional investor survey results: Pension and Insurance Fund attitudes towards investment and renewable energy infrastructure.
- Eyraud, L., Wane, A.A., Zhang, C., Clements, B., 2011. Who's Going Green and Why? Trends and Determinants of Green Investment. International Monetary Fund, Washington, D.C., USA.
- Fabrizio, Kira R., 2013. The effect of regulatory uncertainty on investment: evidence from renewable energy generation. *J. Law Econ. Organ.* 29, 765–798.
- Frankfurt School, 2015. Global trends in renewable energy investment 2015. Frankfurt School – UNEP Collaborating Centre.
- Glemarec, Y., 2011. Catalyzing Climate Finance: A Guidebook on Policy and Financing Options to Support Green, Low-Emission and Climate-Resilient Development. United Nations Development Programme, New York, NY, USA. pp. 160.
- Gujba, Haruna, Thorne, Steve, Mulugetta, Yacob, Rai, Kavita, Sokona, Youba, 2012. Financing low carbon energy access in Africa. *Energy Policy* 47 (Suppl. 1), S71–S78.
- Intergovernmental Panel on Climate Change (IPCC), 2014. Intergovernmental Panel on Climate Change. IPCC Secretariat, Geneva.
- International Renewable Energy Agency, 2015. Renewable Power Generation Costs in 2014.
- Nelson, David, Pierpont, Brendan, 2013. The Challenge of Institutional Investment in Renewable Energy. Climate Policy Initiative.
- Painuly, J.P., Wohlgemuth, N., 2008. Renewable energy financing – what can we learn from experience in developing countries? *Energy Stud. Rev.* 14 (2).
- Polzin, F., Migendt, M., Täube, F.A., Von Flotow, P., 2015. Public policy influence on renewable energy investments—A panel data study across OECD countries. *Energy policy* 80, 98–111.
- PricewaterhouseCoopers, 2014. Asset Management 2020: A brave new world.
- Sonntag-O'Brien, Virginia, Usher, Eric, 2006. Mobilizing finance for renewable energies. *Renewable Energy: A Global Review of Technologies, Policies and Markets*, Earthscan, London. pp. 169–195.
- Sovacool, Benjamin K., 2009. Rejecting renewables: the socio-technical impediments to renewable electricity in the United States. *Energy Policy* 37 (11), 4500–4513.
- Spratt, Stephen, Griffith-Jones, Stephany, 2013. Mobilizing Investment for Inclusive Green Growth in Low-Income Countries. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Bonn.
- Sustainable Energy for All (SE4All), 2015. Scaling Up Finance for Sustainable Energy Investments.
- United Nations Environment Programme (UNEP), 2005. Public Finance Mechanism to Catalyze Sustainable Energy Sector Growth. United Nations Environment Programme, Geneva, Switzerland, pp. 68. ISBN: 92-807-2592-0.
- United Nations Environment Programme (UNEP), 2007. Guidebook to Financing CDM Projects. United Nations Environment Programme, Geneva, Switzerland, pp. 104. ISBN: 978-87-550-3594-2.
- Wiser, R.H., Pickle, S.J., 1998. Financing investments in renewable energy: the impacts of policy design. *Renew. Sustain. Energy Rev.* 2 (4), 361–386.
- Zadek, Simon, Flynn, Cassie, 2013. South-Originating Green Finance: Exploring the Potential. Geneva International Finance Dialogues, Geneva.
- Zadek, Simon, Zhang, Chenghui, 2014. Greening China's Financial System: An Initial Exploration. International Institute for Sustainable Development.