Financing Renewable Energy Projects in Developing Countries: A Critical Review

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Abstract. Access to clean and stable energy, meeting sustainable development goals, the fossil fuel dependency and depletion are some of the reasons that have impacted developing countries to transform the business as usual economy to a more sustainable economy. However, access and availability of finance is a major challenge for many developing countries. Financing renewable energy projects require access to significant resources, by multiple parties, at varying points in the project life cycles. This research aims to investigate sources and new trends in financing RE projects in developing countries. For this purpose, a detail and in-depth literature review have been conducted to explore the sources and trends of current RE financial investment and projects, to understand the gaps and limitations. This paper concludes that there are various internal and external sources of finance available for RE projects in developing countries.

1. Introduction

It is indisputable that the growing concerns over climate change are provoking a worldwide transformation in the way that governments and industries seek to supply energy while at the same time learning, creating and implementing new measures to aid in minimising greenhouse gas emissions and other environmental impacts. One of the major energy policy strategy applied in many countries worldwide is the employment of renewable energy sources (RES). Because energy is one of the main sectors that fuels the global economic activity. Consequently, the expansion in population growths, which is estimated by \cite{1} to be 2.3 billion more people by 2050 compared to 2016, the living standards and demand, that are estimated by \cite{2} to increase by 21\% by 2030, are interlinked and influence the development of a country. The decisions made and implemented for and on the energy sector infrastructure, especially in the investment aspect, would lock the financial strategy at the very least for a few decades. This relates to how efficient the energy sector growth across the economy. The energy sector is directly connected to the sustainability and vibrancy of a countries economy. Any major decision made in the Energy sector will have a ripple effect throughout the economy. Until recently Renewable energy (RE) investments were treated in the same manner as any other investment, yet RE investments possess certain characteristics that require a high level of understanding, some of the key aspects are:

- The feasibility of the investment (This depends on the policy and regulations and the impact on the economy that such measures can have)
- The durability and real implementation of any subsidies, grants, tradable certificates or tax credits.
- Basic financial analysis.

The governments of many developing countries have embarked on the path to low-carbon development to create and increase energy access, economic opportunities and to reduce carbon emissions.
emissions. However, because of scarce public funding and investments, the international community and the private sector engagement will play a major role.

The RE markets is a 19-26 Trillion-dollar investment opportunity, estimated by [3]. The renewable energy industry faces a rapidly increasing opportunity and challenge to grow the business and financial strategies to exploit this investment properly. Current and ongoing cost reductions in renewable power generation technologies can aid developing countries in achieving national and international energy and emissions policy goals, in energy security and reliability and affordable energy; along with promoting access to electricity for all at a lower cost than traditional sources. As Germany, Costa Rica and many more countries have demonstrated. Through the use of Biomass, hydropower, geothermal, solar and onshore wind power for Electricity that shows competitively-levelling cost of RE compared to fossil fuel-fired power generation. Being solar, the most impressive of this Levelized cost of electricity (LCOE) for RE. Solar energy cost generation alone has halved just between 2010 and 2014. Technology enhancements, occurring simultaneity as the reduction in the installed costs of RE sources have augmented the competitiveness of Renewable Energy in the energy market to be equal, and in some cases the LCOE of some RE, like offshore wind even lower than for fossil fuels.

| Table 1. New characteristics in renewable energy financing |
|---------------------------------------------------------|
| Cost Reduction  | Policy Support  | New & Improved Technology |
| New & improved renewable Systems | Investment | Research and investment |
| Higher investment | Sustainable goals | Development |

The global investment for renewable energy has been exponentially increasing over the years. Due, in part, to the new financial characteristics, that have been implemented in current years (Table 1). The amount of money committed to renewables projects has risen, according to some studies [4]-[6] 5% in 2015, a record high of $285.9 billion, however, according to some research, this drop down 18% in 2016. Along with this record high, 2015 is also the year where investment in renewables in developing countries surpass that in developed countries. Were, China, India, Brazil, South Africa, Mexico, Chile, Morocco, Uruguay, the Philippines, Pakistan and Honduras, together invested over $156 billion in renewable energy investments; developed countries invested only $130 billion. Meanwhile, renewables projects possess attractive advantages for developing countries, such as, the built time, wind farms can take from nine to twelve months, solar parks in three-to-six months, compared to fossil fuel (coal and gas plants) that can take several years to be completed, not to disregard the longer time that nuclear energy takes to installed. Along with the high competitiveness of renewable in current energy markets. However, even with all this improvement policy support for renewables remains fickle.

This study compares main funding mechanisms employed by governments, institutions and businesses to finance renewable energy development programs or projects: feed-in tariffs, tax incentives, and tradable green certificates; in addition to new support mechanisms that have appeared in later years: co-operative funds, hybrid Bonds revolving fund, Tax equity loans, loan loss reserve and crowd funding.

2. Discussion of economic opportunities of financing renewable energy projects

A fundamental concept to understanding the economic competitiveness of any energy project is the real costs of the project versus the benefit achieved throughout its life cycle, regardless if it is fossil or renewable. This concept is the foundation for many investments decisions because it is based on the capital cost, fuel cost and financial costs of the project. These cost at the same time are based on the sum of the cost over the lifetime of the project over the sum of the electrical energy produced over that lifetime. This is subjective to the access to precise, comparable, dependable and current information on the actual costs and life cycle operation of renewable energy technologies and projects. The financial instruments can be created, design and implemented by the private or public sector. As these encompasses the government and non-government own enterprises.
2.1. Private sector

The government of many developing countries has taken measures to commit and ensure a reduction in carbon emission. For this purpose, renewable energy transformation steps have been taken. However, the financial struggles that many developing countries face, in some cases, and almost impossible challenge. The private sector engagement is a necessity rather than an option, as this sector can facilitate and aid in the renewable energy investment with strong benefits not just for the country but also for the non-government businesses as well. As [7] explains an appropriate financial and political framework for the cooperation of the private sector in renewable energy projects. Also, the risk and perceive risk must be addressed as to attain the engagement of this sector fully. However, as [8], [9] highlight, developing countries use public and concessional resources to attain the aid of the private sector, even though this does not fully address the different challenges or the risk that the private sector experiences. On the other hand, [3], [10], [11] point out that the use of this instruments to engage the private sector has dual a benefit of being more sustainable and minimising the instability that this could bring to the industry; while augmenting the competitiveness of the renewable energy market.

2.2. Public sector

Many developing countries have embarked on a renewable energy transformation, due to the agreement and international commitment to reducing global emission, in addition to creating economic opportunities and increasing energy access of the population; however, most developing countries lack the financial means to achieve this. However, as many researchers have shown[10]-[14], policymakers in developing countries tend to implement a particular financing instrument (Tax incentives, Loans and more) without, in most cases, analysing which instrument or combination of tools would be most effective for the project or country at the time. Affordability is one of the critical challenges that developing countries faced when implementing renewable energy. Also, the standard process for any energy projects, be it finance by the public or private sector, is first obtaining a power purchase agreement (PPA) or through “yieldco”. Although, according to many new researchers [15]-[17], this is also changing along with the funding sources. The new trends that have already been used in 2015 by:

- the UK [17] demonstrated winning bids at 11% below the agreed for onshore wind and offshore a 14% and 18% below the officially set price.
- In South Africa [18] auctions awarded contracts to onshore wind at 41% less in local currency terms than the first auctions
- and Germany [19] the second PV auction in 2015 awarded contracts 7.5% below the previous feed-in tariff level. These auctions allow developed and especially developing countries to offer the generation agreement of energy for keen and in some cases, very reduce prices compared to the traditional PPA. Allowing for the tariff prices to diminish and the competitiveness of the market, particularly the RE, to flourish.

2.3. Investment sources

Traditionally renewable energy (RE) projects had two ways of obtaining funds:

- Borrowing from a bank (Loan). However, Banking institutions will focus on the repayment of the debt and not on the return of the transaction [20]. In such cases, due to the emphasis of the banks, the return for such ventures tends to be smaller than in other funding methods.
- Through equity capital (selling stakes or shares in the business, among others). Equity capital has greater expect returns due to the level of risk that is taken. In some cases, some companies might expect between a 25-35% of return, due to the perceived risk versus the real risk [21]. Also, stakeholders place a greater pressure and expectations on RE projects than traditional financial institutions do. Other ways to finance through equity is by “on balance sheet” funds (from funds drawn internally, treasury department), this is usually done by the utility companies as part of a corporate RE strategy. However, the specific role played by equity may
change over the lifecycle of the RE project as it is refinanced, depending on existing and new actors that would like to benefit from the project.

Per [22], equity funding is a popular option. As of 2015 financing of RE projects through utility-scale for wind farms and solar parks was of $199 billion in comparison to the 188 billion of the previous year, showing a 6% increase in a years’ time. In general, the growth in equity funding in RE in 2015 was between 5.8-12% over previous years, in areas such as roof-top solar projects, reinvestment of equity and acquisition activities.

According to [23]-[25], an important difference between this two methods is also, in which RE projects they are utilised. Loans are usually applied to RE projects with traditional and proven technology and approaches, while equity is used more for new and innovative RE technology projects and methods. Another factor would be the financial options of the country; in some countries, local financing options are plentiful; in others, they are few and far between. The key features of these financial tools have been described in table 2. Other innovations in the funding of RE projects come from Europe; since 2012 new inflation-linked notes have appeared as a way for organisations to access the return flows of RE project, specifically the wind and solar.

Table 2. Key features of traditional funding for RE

| Source of Funding | Equity | Loans |
|-------------------|--------|-------|
| Source of Funding | Wide range of sources (Insurance companies, pension funds, mutual funds, Stock Market, Real Estate and more) | Financial Institutions (Banks) |
| Target | New Technologies, Methods and Markets | Mature Technology and markets |
| Risk | Low-Medium (Depending on the source of funding) | High |
| Return time | 3-10 years (Depending on the RE project and on the Equity that is funded) | 2-5 years (Depending on the specific terms of the Loan) |
| Types | Venture Capital, Private Equity and Funds | Personal, Commercial, Small business and more |
| Benefits | • Diversity • Liquidity • Public Trading transparency of the market price | • Money guarantee • None involvement in the RE project by the banks • Accessibility and options • Tax Benefits |
another go to tool for developing countries. These taxes, are created and implemented to aid in the communication of the government's policies, programs and plans for the development of renewable energy to the energy companies, investors and other entities. As Table 3 shows the main characteristics of Tax incentives and the reason why they have such a successful implementation in developing countries.

| Table3. Key features of Tax Incentives (Production tax credit, PTC and investment tax credits, ITC) |
|---------------------------------------------------------------|
| Improve funding for renewable energy technologies | Encourage, increase and improve, renewable energy market adoption |
| Job creation in the renewable energy sector | Encouragement of public investment in renewable energy |
| Increase R&D in local renewable energy technology | Create and encourage renewable energy education and training programs |

On the contrary internal and international loans are more than a financial tool for developing countries, they are almost a way of life, especially international loans from global institutions or others countries treaty. This is due to loans being a financial tool (agreement between the actors) implemented in most case by banks as a means of providing finance or capital for companies, investors or individuals to support normal business or project operations. For this, the financial institution will conduct an assessment of the company’s or country’s financial strength and stability of the project projections and returns, and debt is calculated priced accordingly to the market at the time with a return period and interest rate calculated and agreed upon in the contract. Also, these agreement place few restrictions on how the company or country can use the funds, provided certain general conditions be met.

Another financial tool that is gaining popularity in developed countries are the Bonds (As can be seen in Table. 4). A bond is a loan or better known as a debt investment that is based on a coupon (fixed or variable interest rate) of an investors loan to an entity (typically corporate or governmental) for a fixed period. In renewable energy, bonds are better known as green bonds, which are any variety of bonds that the incomes will be solely used to finance (re-finance) in full or partly a new and existing renewable energy project. It is often used to raise money to fund an acquisition or a new development. This type of financial tool is rarely used in developing countries.

| Table 4. Different types of Green Bonds |
|----------------------------------------|
| Green Use of Proceeds Bond |
| Green Use of Proceeds Revenue Bond |
| Green Use of Proceeds Project Bond |
| Green Use of Proceeds Securitized Bond |
| Pure Play |
| Hybrid Bond |
| Other types will appear as the renewable energy market matures |

A cooperative fund or trust is a self-governing alliance of people that have united voluntarily to fulfil a common economic, social and (or) cultural need(s) through a jointly and democratically owned and controlled business. Crowdfunding is an alternative finance form that has become a popular financing tool in the last couple of years [25]. This tool allows a project, an organisation or a company to gain its funds from the general and global public using open calls on the internet, on a dedicated and detailed web page and platform. This is a result of the progressiveness of the information and communication technology (ICT), the increased use and popularity social networks and the rapid advance and use of interactive technology. Crowdfunding can indeed be defined as an ‘economic superstructure’ of social networks and crowdsourcing.
2.4. Risk and return

An important area of understanding any finance and investment subject is a risk and return. The purpose of any business is at its core the generation of income. In this same way, financial institutions are based in on the return of the investment versus the risk that has or will be undertaken. This is directly proportionate; a higher risk of investment equals a greater return. The RE sector utilises finance from across the entire risk-reward spectrum (Table 5).

Table 5. Different risks of investing in RE

| Country | Governed by the stability, status, seriousness and transparency of the government, it is the legal system, business practices and links to the risk encore by currency. |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Economic | Depends on the inflation and future projection of the currency, local financial regulation, market growth and GDP |
| Financial | Based on the coupons or interest rates, refinement of agreements or projects, insurance of business, projects and companies along with asset liquidation and shares in the company |
| Currency | Subject to the exchange rate fluctuation, currency controls, devaluation, currency flow |
| Political | Influenced by the changes in the legal framework, directly link to the countries risk. However, more dependent of the policies and implementation of them. |
| Security | Refers to the asset insurance and robust legal framework in correspond to the ownership and operations of a project |
| Perceived | Based on the popular perception and social knowledge of the actors involved in the project and financing. Influenced by a subjective understanding of the individuals based on past cases or projects. |

3. Conclusion

Financing Renewable energy in developing countries has become a revolution and necessity, as the global initiatives to mitigate climate change grow more critical. Renewable energy targets have been implemented in at least 164 countries. Developing countries, especially, have a challenging future when it comes to the transformation to renewable. This is due to the core challenges that developing countries face: (1) Financing Renewable Energy, (2) Knowledge Management of renewable energy, (3) Legal framework and implementation of this context for renewable energy and (4) Political leadership and transparency. In this paper, the focus is on the economic understanding, as developing countries lack the means to implement renewable energy projects on their own successfully. This usually leads developing countries to maintain old and unfitting financial methods and tools for the renewable energy projects. This is in part due to a perceived but unfounded risk of the new financial methods. As many developed countries around the world step up efforts in the financial direction, a better understanding of the economic impact will support informed policy and decision makers. Also, this will maximise the benefits of the implementation of renewable energy. Due to the specific situation of developing countries, it is hard, if not impossible, for the governments alone to accurately evaluate and determine which renewable energy technologies and financing tool are the most appropriate. Developed countries have anchored the investor's confidence by creating credible and time sensitive renewable energy targets, this also helps in mapping the trajectory of the renewable energy development in the current energy sector and provides with a future projection for financial tools. Consequently, these renewable energy targets must be based and backed by comprehensive and dedicated policies, regulations and legal frameworks; along with in-depth education programs and knowledge management. As the deployment of policies is not enough, due to the situation of developing countries, a mix of policies is the best approach for developing countries. These measures
To double the share of renewables by 2030, global annual investments in the renewable power sector need to be in the range of USD 500 billion to USD 750 billion between now and 2030 (compared to over USD 270 billion in 2014). The greatest shares of new investments will need to come from private sources. As deployment grows and new markets emerge, developers are improving in forecasting cash flows, while financiers can more accurately assess risk and design financing products suited for renewable energy projects. Nevertheless, actual and perceived risks continue to slow down investment growth in renewable energy, especially in new markets. Policymakers and international financial institutions must deploy the right policy and fiscal tools to address these risks and mobilize private sector investment. Public funding will continue to remain a major catalyst and will need to increase. Implementing tax incentives or Green Bond trading mechanism could be considered ideal policies to aid in the growth of the renewable energy market and the countries' economy. However, the discussion regarding the new and standard financial renewable portfolio policies showed that the firsts are successful when used for new and innovative technologies and projects, but are linked to a high risk that many developing countries are not willing or possess the knowledge on how to handle. Also, the latter are appropriate financial policies when it is applied by the government, and have a low risk for the investors. Finally, a review of funding mechanism for each country is needed as each case differs to others. Also, financial tools alone cannot transform a country to the use of renewable energy, it must be a joint effort, of not only the actors (Government, industry and population) but of the different sectors, business plan, technology, education and resources.
4. References

[1]. UNEP, 2012. Financing renewable energy in developing countries. UNEP finance initiative – innovative financing for sustainability. Feb-12.

[2]. Taylor M, Daniel K, Ilas A and Young So E, 2014. Renewable Power Generation Costs In 2014. IRENA

[3]. UNEP, 2009. Private financing of renewable energy -A guide for policymakers-. 

[4]. Chirambo, D, 2016. Addressing the renewable energy financing gap in Africa to promote universal energy access: Integrated renewable energy financing in Malawi. Renewable and Sustainable Energy Reviews, 62, pp.793–803.

[5]. Lee, C W & Zhong, J, 2015. Financing and risk management of renewable energy projects with a hybrid bond. Renewable Energy, 75, pp.779–787.

[6]. UNEP, 2016. Green Finance For Developing Countries. Inquiry: Design of a sustainable financial system. May-16

[7]. Abolhosseini, S & Heshmati, A, 2014. The main support mechanisms to finance renewable energy development. Renewable and Sustainable Energy Reviews, 40, pp.876–885.

[8]. UNEP and SEFI, 2007. Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency in OECD and Developing Countries. Global Trends In Sustainable Energy Investment 2007

[9]. UNEP and SEFI. 2004. Financial Risk Management Instruments for Renewable Energy Projects

[10]. Cicea, C et al., 2014. Environmental efficiency of investments in renewable energy: Comparative analysis at macroeconomic level. Renewable and Sustainable Energy Reviews, 30, pp.555–564.

[11]. Ferroukhi R, Lopez-Peña A, Kieffer G, Nagpal D, Hawila D, Khalid A, El-Katiri L, Vinci S and Fernandez A, 2014. Renewable Energy Benefits: Measuring the Economics. IRENA

[12]. Malik, I A et al., 2014. Turn on the lights: Macroeconomic factors affecting renewable energy in Pakistan. Renewable and Sustainable Energy Reviews, 38, pp.277–284.

[13]. Ming, Z et al., 2014. Review of renewable energy investment and financing in China: Status, mode, issues and countermeasures. Renewable and Sustainable Energy Reviews, 31, pp.23–37.

[14]. Griffith-Jones S, Ocampo J A, Spratt S, 2012. Financing Renewable Energy In Developing Countries: Mechanisms And Responsibilities. European Report on development

[15]. Ng, T H & Tao, J Y, 2016. Bond financing for renewable energy in Asia. Energy Policy, 95, pp.509–517.

[16]. Wang, T, Gong, Y & Jiang, C, 2014. A review on promoting share of renewable energy by green-trading mechanisms in power system. Renewable and Sustainable Energy Reviews, 40, pp.923–929.

[17]. Repowering London, 2013. Case study of renewable energy co-operatives: Brixton Energy Solar 1, Solar 2 & Solar 3

[18]. Cory K, Couture T, and Kreycik C, 2009. Feed-in Tariff Policy: Design, Implementation, and RPS Policy Interactions. Technical Report NREL/TP-6A2-45549 March.

[19]. Blazejczak, J et al., 2014. Economic effects of renewable energy expansion: A model-based analysis for Germany. Renewable and Sustainable Energy Reviews, 40, pp.1070–1080.

[20]. Bobinaite, V & Tarvydas, D, 2014. Financing instruments and channels for the increasing production and consumption of renewable energy: Lithuanian case. Renewable and Sustainable Energy Reviews, 38, pp.259–276.

[21]. Omri, A, 2014. An international literature survey on energy-economic growth nexus: Evidence from country-specific studies. Renewable and Sustainable Energy Reviews, 38, pp.951–959.

[22]. Couture T D, Cory K, Kreycik C and Williams E, 2010. A Policymaker’s Guide to Feed-in Tariff Policy Design. Technical Report NREL/TP-6A2-44849 July.

[23]. World Bank and CIF, 2012. Financing renewable energy Options for Developing Financing Instruments Using Public Funds

[24]. Justice S, 2009. Private Financing of Renewable Energy- A Guide for Policymakers. UNEP

[25]. CEDRO, 2015. Crowdfunding and the Energy Sector, Empowering Lebanon With Renewable Energy. August-15