

https://dspace.org/

A comparative analysis of renewable energy financing models in Brazil, China, India and South Africa

Kamara, Rivhatshinyi Nicole

2016

https://hdl.handle.net/10539/23771

Kamara, Rivhatshinyi Nicole (2016) A comparative analysis of renewable energy financing models in Brazil, China, India and South Africa, University of the Witwatersrand, Johannesburg, <https://hdl.handle.net/10539/23771>

Downloaded from a DSpace repository. https://dspace.org/

A COMPARATIVE ANALYSIS OF RENEWABLE ENERGY FINANCING MODELS IN BRAZIL, CHINA, INDIA AND SOUTH AFRICA

By

Rivhatshinyi N Kamara

Thesis submitted in fulfilment of the requirements for the degree of
Master of Management in Finance & Investment

in the

FACULTY OF COMMERCE LAW AND MANAGEMENT
WITS BUSINESS SCHOOL

at the

UNIVERSITY OF THE WITWATERSRAND

SUPERVISOR: Professor Kalu Ojah

Johannesburg 2016



DECLARATION

I, Rivhatshinyi N. Kamara declare that this is my own work excerpt as indicated in the reference and acknowledgements. It is being submitted for the degree of Master of Management in Finance and Investments at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

_____ _____

Signature of candidate Date

ACKNOWLEDGEMENTS

I would like to acknowledge my gratitude to my family, especially my husband Edward, for being patient with me and encouraging me to complete this dissertation. In addition, I would like to thank Professor Kalu Ojah for supervising and giving me direction on the dissertation's subject matter. I also want to acknowledge my late mother, Tshiphiri Rose who instilled in me the value of education and taught me to never stop learning. I also wish to thank the ladies at the IDC Info Centre, who assisted me greatly with obtaining some of the information required to complete the dissertation.

ABSTRACT

This thesis reviewed research papers, reports, conference documents and policy documents that looked at financial models used to finance RE projects in Brazil, China, India and South Africa.The comparison between the financing models revealed the following; Both Brazil and China's financing model is a centralised government led model which might not necessarily work in the South African context. The India decentralised model is similar to the South African model, with the exception that corporate finance is widely used in India and Project Finance in South Africa. Thus there are lessons to be learnt from each country, however no single country financing model was found to be suitable for South Africa.

Accordingly, this paper therefore recommends that South Africa's model be altered to incorporate project bonds. The use of these bonds in the current financial model will ensure that banks are able to lend to projects on short term basis; thus, managing their liquidity and their asset--liability effectively. Further, some institutional investors have shown an interest in funding projects at the construction stage, and the inclusion of project bonds would ensure that more of these investors play a role in financing projects.

Key Words

GDP-Gross Domestic Product; GW- Gigawatts; DoE-Department of Energy; REIPPPP- Renewable Energy Independent Power Producer Procurement Programme; BEE-Black Economic Empowerment; RE-Renewable Energy; SSA-Sub Saharan Africa; PPA-Power Purchase Agreement; FIT-Feed In Tariff; DFI-Development Finance Institution; MDB-Multilateral Development Bank

TABLE OF CONTENTS

DECLARATION 2
ACKNOWLEDGEMENTS 3
ABSTRACT 4
Introduction 9
1.1 Background 9
1.2 An overview of renewable energy market in South Africa 11
1.3 Motivation for the study 12
1.4 Objectives of the study 12
1.5 Research questions 13
1.6 Significance of the study 13
1.7 Overview of research methodology 14
1.8 Structure of Thesis 14
Chapter 2 15
Literature Review 15
2.1 Electricity and Development 15
2.2 The economics of renewable energy - The financing challenge 17
2.3 Sub-Saharan Africa specific challenges to investment in RE projects 22
2.4 Current state of investment into renewable power 28
2.5 Financing renewable energy power projects 33
Chapter 3 46
Methodology 46
Chapter 4 48
Financing Models in Brazil, China, India and South Africa 48
4.1 Brazil 48
4.2 China 52
4.3 India 56
4.4 South Africa 59
4.5 Challenges with the current financing model in South Africa 69
4.6 Comparative analysis 71
Chapter 5 75
Proposed financing model for South Africa 75
5.1 Overview 75

5.2 Government issued bond/ concessionary funding 76
5.3 Project bonds 77
5.4 A blend of Project bonds and Project Finance 78
5.5 Other Models 79
Chapter 6 81
6.1 Conclusions and Recommendations 81
6.2 Suggestions for further research 82
References 83

List of Figures

Figure 1 Steps from electricity supply to poverty reduction 15
Figure 2 Financing challenges 20
Figure 3 Role of public finance in the "valley of death" 21
Figure 4 Effects of fossil fuel subsidies 23
Figure 5 Effects of high transaction costs 23
Figure 6 Unsustainably low energy prices 24
Figure 7 Effects of energy sector policies 25
Figure 8 Effects of political, legal and economic stability 26
Figure 9 Effect of the effectiveness of law enforcement 26
Figure 10 Effect of currency risk 27
Figure 11 Investment flow 28
Figure 12 Investment by region 29
Figure 13 Investment by technology, 2014 31
Figure 14 Investment by type, 2014 32
Figure 15 Countries implementing mechanisms to support RE development 36
Figure 16 RE projects in the CDM programme, 2012 38
Figure 17 Installed power capacity in Brazil by source 49
Figure 18 China installed capacity by fuel type, 2014 53
Figure 19 Cumulative renewable power capacity over a 9 year period 53
Figure 20 Installed power capacity by sources, 2014 56
Figure 21 Installed power capacity by sources, 2014 60
Figure 22 Barriers to finance 63
Figure 23 Sources of finance 63
Figure 24 Project finance model in REIPP 65
Figure 25 Approved capacity - Wind 66
Figure 26 Approved capacity- Solar 66
Figure 27 Split of debt providers 67
Figure 28 Debt providers in Round 1, 2 & 3 67

List of Tables

Table 1 Returns required by equity investors 43
Table 2 PE, Venture and infrastructure funds 44

Table 3 Renewable energy investors in India, 2012 58
Table 4 REFIT and REIPP prices 61
Table 5 Macroeconomic data 73
Table 6 Comparison Table 74
Table 7 Financing model assessment matrix 80

Chapter 1

Introduction

1.1 Background

Energy is undoubtedly a major driver of economic development, for this reason its role in a socio-economic development cannot be overlooked. Research has been done to show how the availability of energy contributes to economic growth and development (Odalaru & Okonkwo, 2009), with some research implying a causal relationship between energy usage and economic growth as measured by Gross Domestic Product (GDP) growth (Frontier Economics, 2007), whilst other research has suggested that it would be almost impossible to increase per capita income without increasing the use of energy. The economic success and prosperity of most developed economies is underpinned by access to energy, which provides services such as, heating used for warmth and cooking, transport in the form of oil and gas, further energy allows for communities to be able to communicate, access better health and education and subsequently earn higher incomes that leads to an all-round improvement in the quality of life. (IEA, 2014).

It is therefore not surprising that attaining a varied and sustainable energy supply for generations to come is top of the agenda for policymakers around the world. This agenda is urgent in Africa where governments face huge challenges in providing reliable and sustainable energy to a growing population. The lack of access to energy also has implications on the competitiveness of African based businesses and manufacturing companies, as they find it hard to be competitive due to the high energy input cost. The competitiveness of these companies can be further linked to slow job growth and lower GDP growth, with research showing this adverse effects on GDP to be as much as one to three percent (Castellano, Kendall, Nikomarov, & Swemmer, 2015).

Sub-Saharan Africa (SSA) has a 26% electricity access rate, which ranks amongst the lowest in the world. It is estimated that less than a quarter of SSA has access to electricity (Eberhard, Foster Briceño-Garmendia, Ouedraogo, Camos, Shkaratan, 2008). According to the African Development Bank (AFDB) Africa requires an estimated additional 7000 Megawatts (MW) installed capacity, in order to meet the

continent's demand and support economic development (UNEP,2012). The challenges encountered in accessing energy are in contrast to the vast abundance of natural resources on the continent with most countries on the continent possessing Renewable Energy (RE) potential in excess of the current demand (Deichmann, Meisner, Murray, & Wheeler, 2010). It is estimated that solar alone can provide as much as 10 Terawatts (TW), wind 109 gigawatts (GW) and hydro 350 Gigawatts (GW) (Castellano et al., 2015).

Apart from the well documented reasons for RE development such as the vast abundance of resources and the fact that RE helps reduce carbon emissions, in the African context the use of RE could be a potential game changer. The deployment of RE projects provides an opportunity for Africa to benefit from manufacturing components locally, creating much needed jobs and increasing overall electricity access. Despite the many benefits outlined above, barriers currently exist in the form of; economic, political, legal, technical and non-financial constraints. Considerable amount of research has been done on how financing challenges hinder RE development (IEA, 2014; Brunnschweiler, 2009; Deichmann et al., 2010).

The problem of financing RE can be looked at from two perspectives;

- Firstly RE projects are capital intensive and funding these projects requires long term funding which is mainly available from well-developed capital markets. In Africa and other emerging economies banks are the main providers of capital. Access to capital from banks is usually scarce in developing countries, and consequently RE projects in these developing countries are at a distinct disadvantage as the capital markets are underdeveloped, with the result that the country cannot afford the high costs associated with RE.
- Secondly RE projects compete with traditional fossil fuels which are often cheaper and readily available in Africa (Brunnschweiler, 2009).Therefore the need to find effective financing models is most imperative in Africa.

The arguments presented above highlight three key issues:

1. It emphasises the role of energy in economic development, the proposal then drills down to Africa and from an African perspective it is further shown how the

growing population needs access to energy in order to achieve economic growth.

2. That RE is seen as a solution to increasing access to electric power given the abundance of RE resources on the continent.
3. Availability of financing is a major barrier to RE development on the continent.

This thesis will focus on the financial constraints and evaluate financial models employed in other developing markets in comparison to those used in South Africa.

1.2 An overview of renewable energy market in South Africa

The term RE is used to describe energy sources that harness non-depletable sources of energy to produce electricity; examples include Biomass, hydro, wind, solar and geothermal (DoE, 2003).The financing referred to in this thesis is mainly that associated with large grid connected power plants, this definition that is applied throughout this thesis. South Africa is a market leader in deploying Renewable Power (RP) after successfully implementing its Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). Other countries in North Africa including Morocco and Tunisia have also made plans to grow their RE generating capabilities.

In South Africa, ESKOM provides almost 95% of the country's electricity (EIA, 2015). The electricity crisis of 2007 was one of the main drivers for renewable power project development in the form of Independent power producers (IPP's); it was then that the government recognised that Eskom acting alone would not be able to meet the country's growing power demand. The government then made plans to increase the country's generating capacity through the introduction of IPP's. In the Integrated Resource Plan (IRP), the government of South Africa set out to add 50 000 MW to the grid by 2028 generated by RE technologies (Clean Energy Pipeline, 2014). The IRP is considered the back bone of what eventually became known as (REIPPPP), under which the Department of Energy (DoE) first issued a Request for Proposal (RFP) in 2011, requesting for 3 625MW from IPP's using various renewable energy technologies.

To date, 64 successful bidders have been awarded, with private sector investment totalling US$14 billion and the projects are expected to generate 3922 MW of RE power (Eberhard, Kolker, & Leigland, 2014). These projects attracted both domestic and international investors with the 64 successful projects having over 100 shareholders. Local commercial banks were the greatest funders, with 68% of debt raised locally (Eberhard et al., 2014).

1.3 Motivation for the study

Much research has been carried out on financing renewable energy in developing countries (World Bank, 2012; IEA, 2014; Brunnschweiler, 2009; Deichmann et al., 2010). Only one study was found on models for financing clean infrastructure in middle income countries. South Africa's REIPPPP is an African first and many lessons can be observed from the process. This thesis will serve to identify and compare the current financing models employed by Brazil, China, India and South Africa. These countries were chosen as they are all part of the BRICS[1] which consists of five large developing countries. It is believed that these emerging economies will have the largest growing demographic and economic potential and thus energy will play a major role in these countries' growth. Financing models used in Brazil, China, and India will be compared to those used in South Africa, and an alternative financing model will then be proposed for South Africa.

1.4 Objectives of the study

This thesis is restricted to examining financing models in Brazil, China, India and South Africa. The main objective is to propose solutions to the problems encountered in financing RE in South Africa. This thesis will thus look at the following specific objectives:

1. Look at the financing models that are currently used in Brazil, China, India and South Africa
2. Evaluate the benefits and disadvantages of each model
3. Propose the most effective alternative financing model for South Africa

[1] Excludes Russia as the country's energy mix largely consists of nuclear power which is not considered in the thesis.

1.5 Research questions

This thesis aims to address the following research questions:

1. What financing models have been used in India, China and Brazil to finance RE?
2. What are advantages and disadvantages of these models in each country?
3. How are these models different or similar to the financing model used in South Africa?
4. What is the most efficient model for financing RE in South Africa

1.6 Significance of the study

The power sector in South Africa currently faces three main challenges (Pegels, 2010);

- First is the inadequacy of power supply, which has resulted in power outages in 2008 and 2015 (with the effect on the economy estimated at between USD 253 and 282 million (EIA, 2008)
- Second is the dominance of Eskom in the power sector, which implies that in order to increase capacity Eskom needs to build new plants, Eskom's balance sheet cannot sustain the power expansion required
- Third is the environmental damage caused by high emissions from the coal fired power plants

To combat these challenges, alternative sources of energy need to be sought, new investment needs to be put towards RE power plants as they diversify the power generating sources.

The need to expand and diversify the source of energy is well understood however the financing of such initiatives remains a challenge. In particular, the ability of the current financing model to encourage the growth of the RE sector as well as to meet DoE's stated objectives remains to be seen. The key issue with the current financing model is that it is heavily dependent on commercial banks providing non-recourse project financing type funding. However such funding presents an asset liability mismatch as these banks take in short term deposits and therefore need to match their loans with the deposits received. The Basel III requirements could further increase the costs

associated with non-recourse project finance as the loans provided to such projects will adversely impact the banks liquidity ratios. The research undertaken in this thesis will look at the why the current financing model is not effective and propose an alternative model that can be used to finance RE projects going forward.

1.7 Overview of research methodology

The thesis will start with literature review on the financing of RE projects on a global scale, thereafter mechanisms and financing channels will be discussed. RP financing model in Brazil, China India and South Africa is then presented, with emphasis on the benefits and disadvantages of each model and why the financing model is used in each country. The literature study will involve analysis of books, papers, journal articles that analyse the financing models employed in each country.

1.8 Structure of Thesis

The thesis, thus far, has commenced by giving an overview of RE market in South Africa; thereafter highlighted the author's motivation and objectives for the research. Research methodology and layout of the thesis is then presented. The remainder of the report is encapsulated sequentially in the following chapters:

The thesis will continue from the introduction given above to present literature review in Chapter 2. A detailed methodology will be presented in chapter 3. Following from the methodology the current financing models in each country will be analysed and compared in Chapter 4. Based on the finding from chapter 4, an alternative financing model will be proposed in chapter 5, thereafter conclusions and recommendations will be made in chapter 6.

Chapter 2

Literature Review

2.1 Electricity and Development

Energy mainly used for heating, lighting, cooling, and mechanical power and cooking is considered an essential input to economic development in any country, thus its role in improving quality of life cannot be overlooked. Of all modern energy types, electricity is most cited as a national development objective. Electricity access in less developed countries allows for participation in income generating activities, and thus in this way electrical energy is seen as an intermediate input of production which eventually leads to economic growth.

Much research has been done to show how access to electricity can play a role in poverty alleviation through aiding 'productive uses' of electricity (IEG, 2008; Kooijman-van Dijk 2008; Martinot, Chaurey, Lew, Moreira, & Wamukonya, 2002; Meadows, Riley, Rao, & Harris, 2003)) .(Attigah & Mayer-Tasch, 2013) cite (Kooijman-van Dijk 2008) in an attempt to show how electricity supply contributes to poverty reduction. Although the link between electricity and poverty is not a direct one, Kooijman-van Dijk (2008) asserts that the provision of electricity is the initial step which if available and used would enable an entrepreneur to increase production and eventually have a knock on effect on income levels.

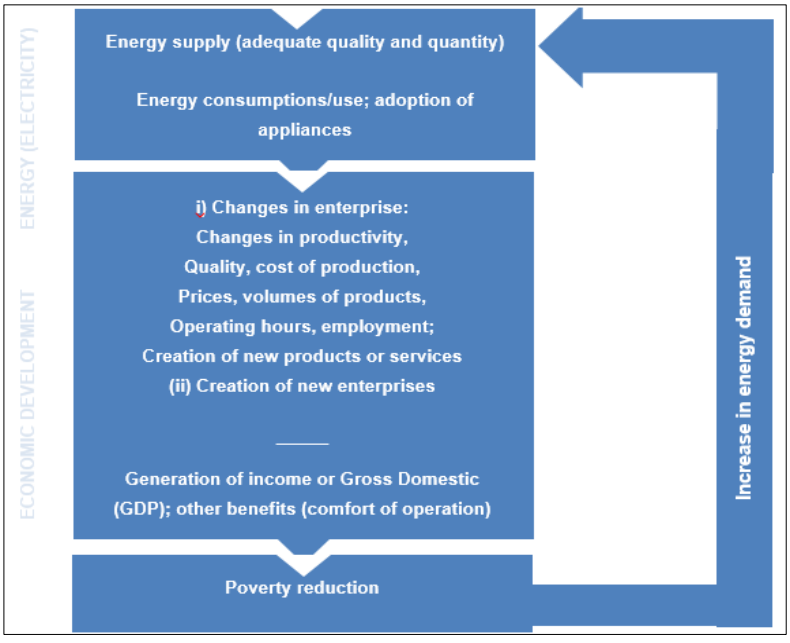


Figure 1 Steps from electricity supply to poverty reduction

Source Kooijman-van Dijk 2008

Research shows the link between electrical energy and economic development by looking at the casual relationship between energy consumption and economic growth or Infrastructure development which often includes electricity infrastructure as a variable of interest, (Attigah & Mayer-Tasch, 2013; Ayogu, 2007; Frontier Economics, 2007; Kraft & Kraft, 1978; Odalaru & Okonkwo, 2009; Saatci & Dumrul, 2013)

Emperical research this link have produced conflicting findings with regard to the existence and direction of causality as a result of the models used and the country analysed. Initial research into this relationship was first presented by Kraft and Kraft (1978) where he found proof supporting uni-directional relationship from GDP to energy consumption in the USA for the period between 1947 and 1974. The research by Frontier Economics (2007) concluded that the relationship between GDP growth and electricity volumes was one-for-one suggesting a strong link between the two variables. Both Ayogu (2007) and Odalaru & Okonkwo (2009) found a link between output and infrastractre variables which included electricity, in a panel test. Saatci & Dumrul, (2013), also found a positive relationship between economic growth and energy consumption in Turkey.

Literature on the domestic South African relationship between electricity and GDP is limited. Bayar & Özel, (2014) found that economic growth and electricity consumption affect each other. During the recent load shedding in 2015, the South African economy showed a sharp decline as the manufacturing and mining sectors where adversely impacted.Chris Yelland, estimates that load shedding had the potential to wipe out 1-2% of South Africa's GDP (Van-der-Nest, 2015).

2.2 The economics of renewable energy - The financing challenge

RE has been on the agenda of most policy makers for some time now, and although the need to increase RE in the energy mix has been acknowledged, investment into RE projects has not matched the enthusiasm muted by most policy makers. RE projects face a number of constraints that hamper their development and subsequent commercialization. The reasons most frequently cited for lack of RE development range from: financial, technical, regulatory and some country specific issues. This thesis aims to look at the financial constraints to RE development.

2.2.1 High upfront development costs

Most RE projects' economics fail to compete with fossil fuels as the cost per unit of energy is typically greater than those for fossil fuels projects. According to the World Bank (2012) the high costs can be attributed to the following:

- Projects are located in environmentally and socially sensitive areas, with large land requirements for large wind or solar plants;
- Location away electricity grids, ensuing in long negotiations to get the grind extended;
- In some instances, lengthy assessments are required as in the case of wind where one years' wind data is required to conduct an assessment on the viability of the project.

2.2.2 Distorted energy prices

Current energy prices do not reflect the environmental and social costs of production, thus causing RE projects to be more expensive than conventional technologies (World Bank, 2012). When costs include the social and environmental benefits, referred to as the "true costs" are used, RE is economically more attractive than traditions fossil fuels. Further many fossil fuel projects such as coal powered power stations are often subsidised by the government, further giving fossil fuel projects market advantage over RE technologies.

Energy prices do not reflect the true benefits of deploying RE projects, these technologies offer diversity in terms of the power mix which reduces reliance on fossil fuels and are often located close to where power is demanded, thus reducing the need for costly transmission infrastructure. RE projects are also better than alternative

power sources such as diesel, as diesel is subject to large price changes and suffers from supply risk issues.

2.2.3 Lack of equity

Lenders to projects often require a higher portion of equity compared to the debt, with debt to equity ratios of 60:40 often preferred. The lack of venture capital or start-up funding further impedes the development of RE in that, project developers are unable to secure the equity financing required by lenders.

2.2.4 Risk and return

RE projects also exhibit a higher level of risk and uncertainty due to the fact that their source of power comes from natural elements i.e. wind or sun and it is often difficult or impossible to control these elements, making it even more difficult to predict cash flows thus increasing the costs even more. RE projects show diminished returns with the project only turning cash positive in the later years of the projects' life cycle. Thus investors are exposed to more risk in RE projects but are often not compensated by any real form of acceptable Internal rate of return (IRR), making investment in RE even less attractive.

2.2.5 High transaction costs

RE technology is fairly new and there is often not enough data to conduct a due diligence, and thus most investors do not know how to analyse/valuate RE projects. The fact that the technology is new and unknown makes RE projects more complicated and it takes longer to analyse thus the transaction costs are often high.

2.2.6 Long term financing requirements

RE projects costs more in the initial stages and less once the plant is operational. This implies that these projects be funded on a long term basis. The long-time exposure is usually compensated for by higher interest rates and returns on equity, but such returns further make RE projects unattractive. Investors prefer to match their long term assets with long term liabilities, thus in-order to obtain long term financing, RE projects need investors that are looking for long term assets, often such investors are pension funds. However, these pension funds limit their risk and are unwilling to invest in risky RE projects. In most developing countries the lack of development of capital markets also acts as a constraint in accessing long term funding.

Another potential source of funding would be equity finance but in developing countries there are only a limited number of large-scale project sponsors with pockets deep enough to participate in RE financing.

2.2.7 Regulatory frameworks and policies that don't support investment

Almost all projects are subjected to regulatory risks in one way or the other, however this risk is particularly more important for RE. The fact that these projects are more costly that conventional fossil fuel type projects means these projects often require regulatory framework support in the form of: commitments from off-takers to pay premium prices, priority access to electricity grids and guaranteed offtake agreement (World bank, 2012).

Some researchers cite a report by the European Commission that emphasised that apart from characteristics such as effectiveness and efficiency of policy, a stable policy environment has been shown to be a key driver in the successful implementation of RE projects (Wagner, 2009). Wagner (2009) further reiterates that policy makers need to ensure the following three elements are conveyed in their communication to potential investors; Transparency longevity, and certainty which are explained as follows;

"Transparency – How easy is it to navigate through the policy structure, understand and execute?"

"Longevity – Does the policy match the investment horizon and create a stable environment for public policy support?"

"Certainty – Does the policy deliver measurable revenues to support a reasonable rate of return?"(Wagner, 2009)"

To get the project to financial closure proves to be quite a challenge and some of the hurdles encountered are outlined below;

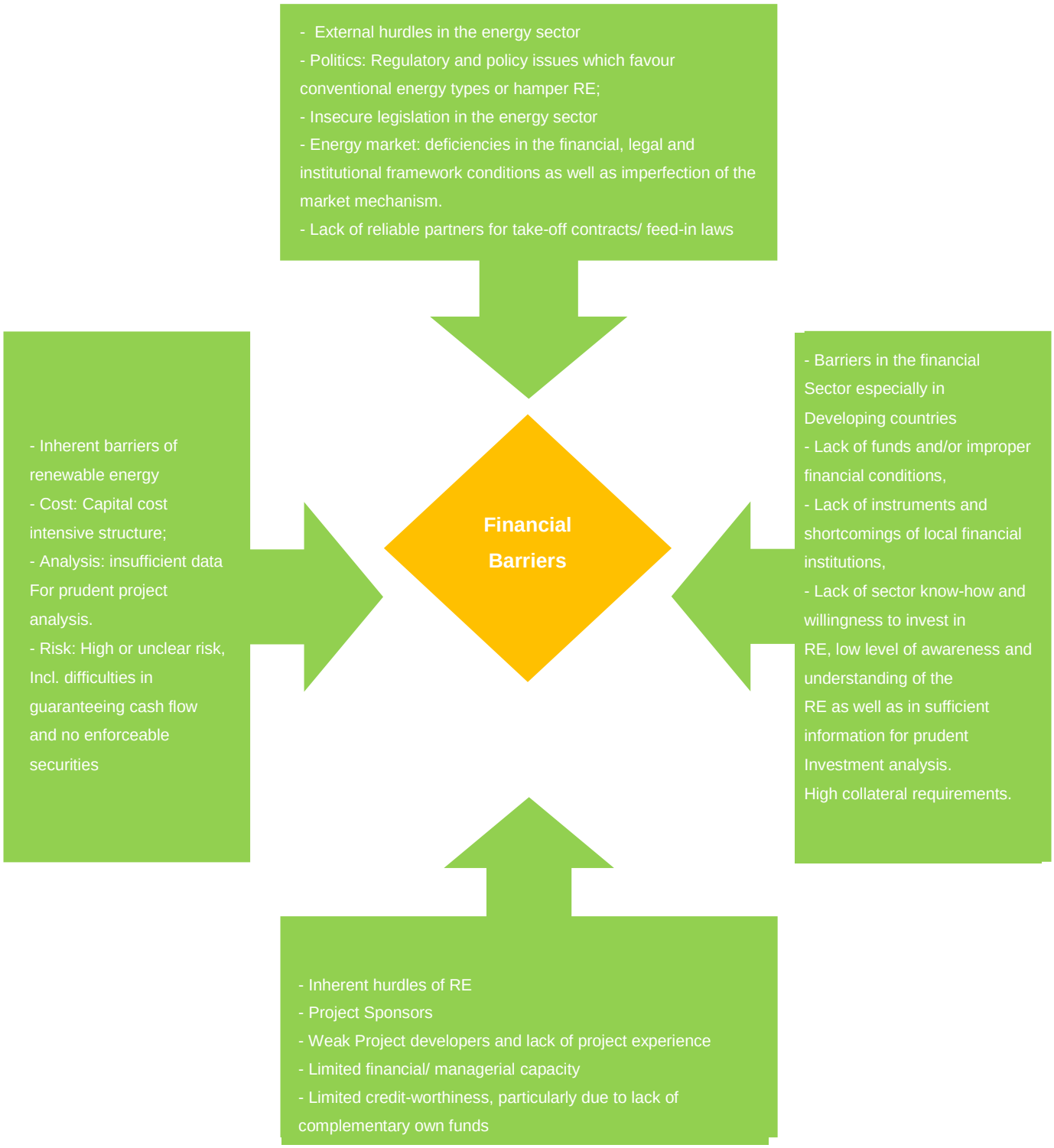


Figure 2 Financing challenges

Source KFW, 2005

2.2.8 Valley of death

Another common challenge in RE development is what is referred to as “the valley of Death” where projects are too advanced for venture capital but not advanced enough for commercialization. Those projects require high capital investment from venture capital but are too risky for private equity. Both financiers are not able to take on the risks associated with the technology and scale up costs. This phenomenon is often resolved by utilising public funding, but in most developing countries, such funding is often unavailable (Wagner, 2009).

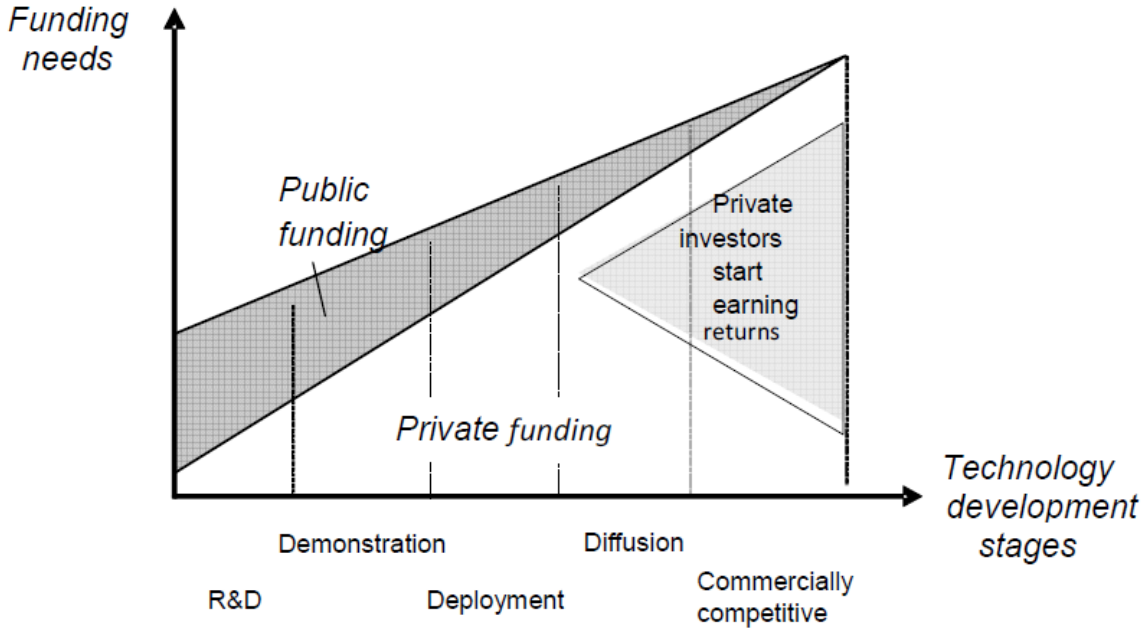


Figure 3 Role of public finance in the "valley of death"
Source: (Wagner, 2009)

2.3 Sub-Saharan Africa (SSA) specific challenges to investment in RE projects

Some SSA policy makers have alluded to targets aimed at increasing power generated from RE sources, as they recognise the role it plays in economic development and poverty reduction. Despite the commitments made, access to electricity in SSA remains one of the lowest in the world (IEA, 2014).The report by (UNEP,2012) conducted amongst 38 financial institutions with experience in developing projects in developing countries, found a number of challenges and some of these are discussed in the section that follows.

2.3.1 Issues that make the playing field uneven

Electricity generated from renewable sources is not competitively priced with electricity generated from conventional sources for reasons already stated above. However this issue is compounded in SSA where the cost of electricity is increased by the small inefficient electricity markets that do not enjoy the economies of scale that their counter parts in the developed world enjoy. This situation is made worse by the high reliance on oil/diesel imports for electricity generation via generators as well a heavy reliance on hydroelectricity.

Additionally, the electricity infrastructure is poorly maintained due to lack of funds, thus prone to higher losses in generation and distribution (UNEP, 2012). In the survey conducted by UNDEP, almost 70% of the respondents found that fossil fuel subsidies where a barrier to RE project deployment. The average electricity generation cost in SSA is estimated at around $ 0.18 per kilowatt-hour (AFDB, 2010).Whilst the survey found that 80% of respondents found high transaction costs adversely affected the promotion of RE projects.

Fossil Fuel

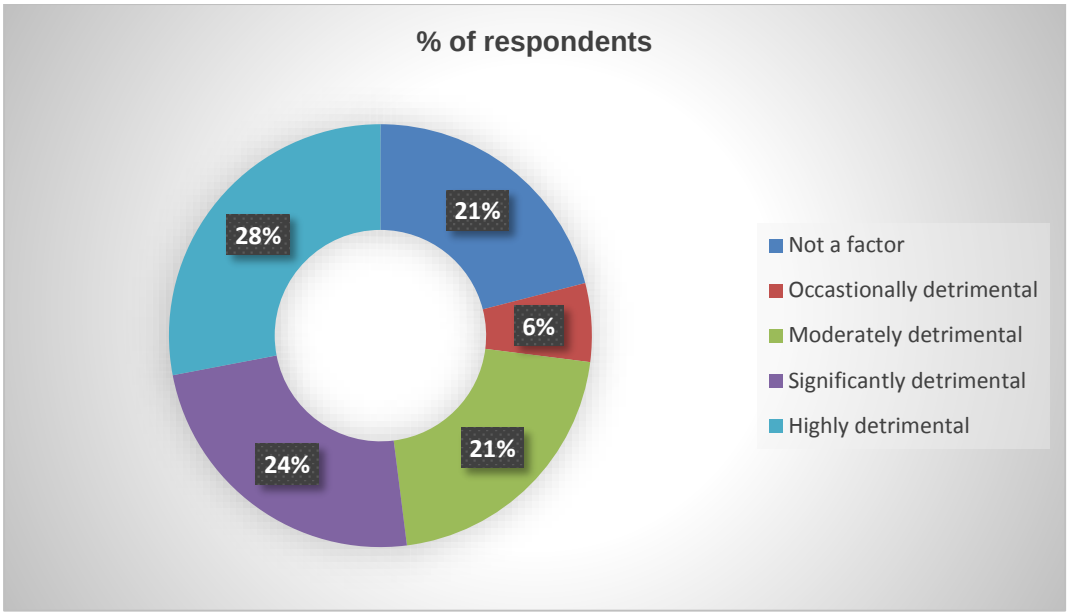


Figure 4 Effects of fossil fuel subsidies

Source UNEP, 2012

Transaction costs

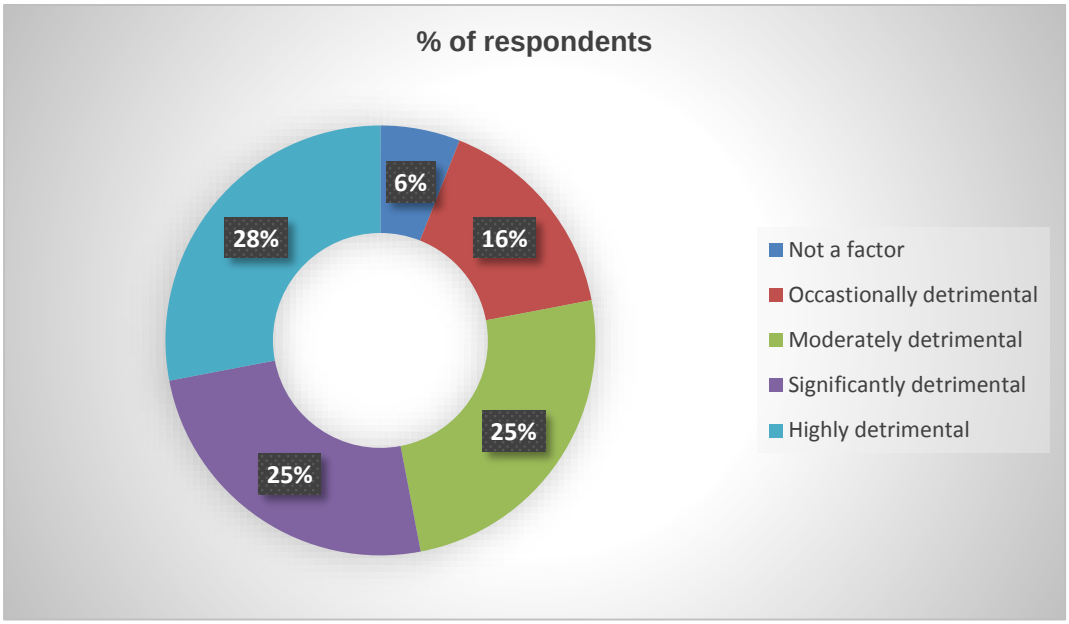


Figure 5 Effects of high transaction costs

Source UNEP, 2012

2.3.2 Power sector in sub-Saharan Africa

In addition to the general challenges outlined in the previous section, SSA's power sector presents peculiar challenges in that the electricity infrastructure is limited. The electricity infrastructure is underdeveloped and often getting access to the grid is a

problem. Additionally, the lack of grid operators that have the capability to manage the connections required from RE exacerbates the problem .Further issues around lack of knowledge on operating, maintaining and monitoring grid connections from RE sources also play a role in deterring RE project development (UNEP, 2012).

Countries in SSA are characterised by state-owned national power utilities, who often enjoy a monopoly in the power sector. These state-owned utilities lack the incentive to provide grid and market access and are often vulnerable to political meddling intended to keep the price of energy below market value in order to gain votes.

Respondents in the survey agree that both politically-motivated low prices, and uncompetitive policies deter investment and development in RE technologies.

Low energy prices

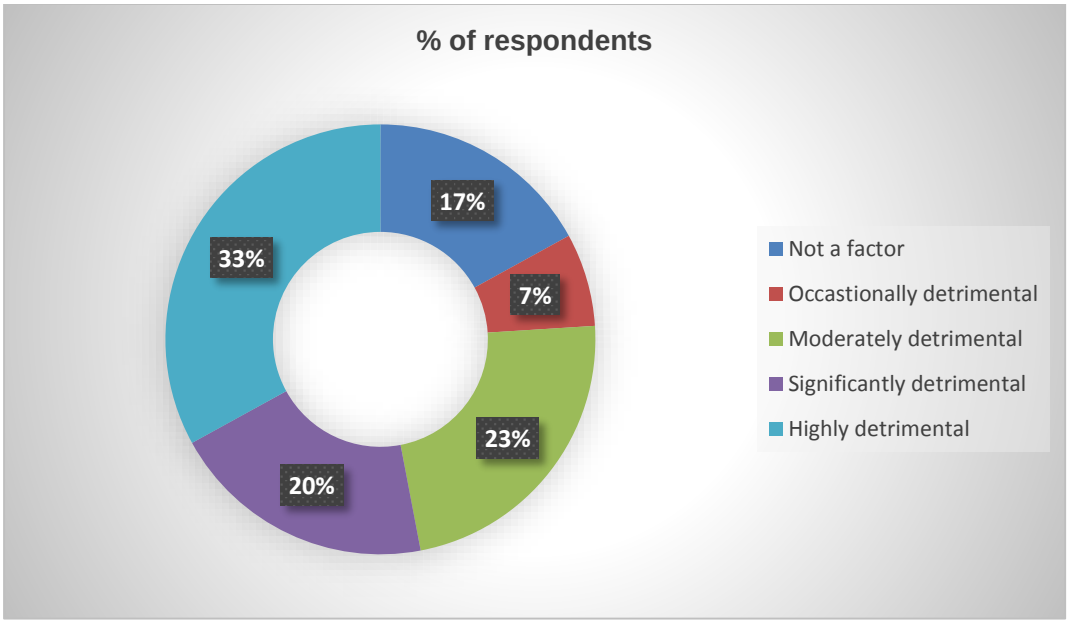


Figure 6 Unsustainably low energy prices

Source UNEP, 2012

Energy sector policies

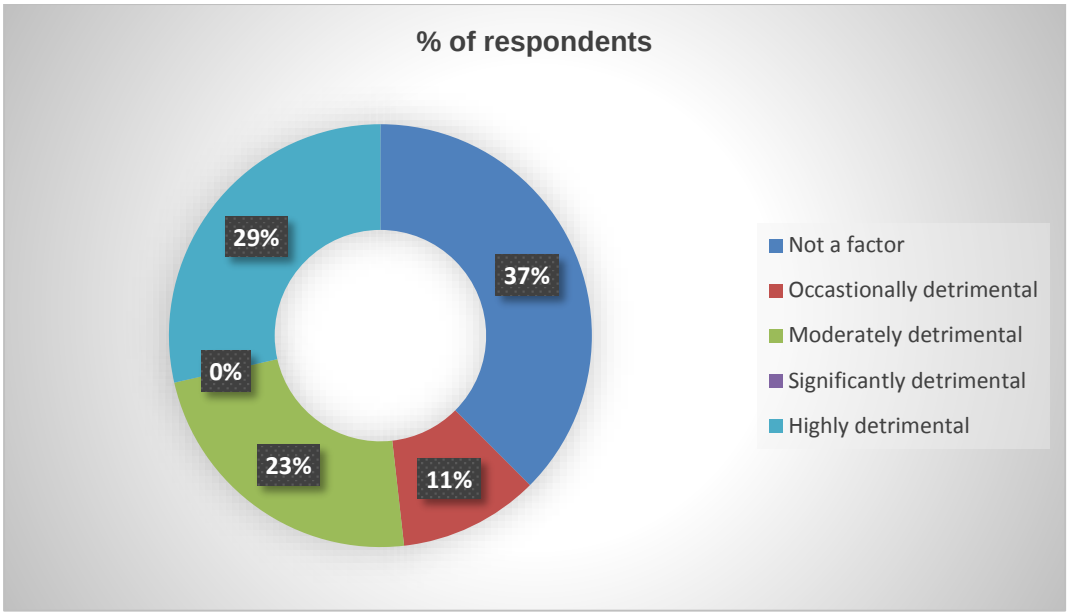


Figure 7 Effects of energy sector policies

Source UNEP, 2012

2.3.3 Other SSA specific financial risks

RE technologies are generally associated with novelty risks, however these risks are exacerbated in most countries in SSA as these countries; often have no track record in RE project development, lack the business and professional expertise required to develop such projects. Additionally, SSA specific investment concerns pertaining to the political, currency, and commercial risk as a result of the poor creditworthiness of state owned utilities are obligors under the power purchase agreements (PPAs) (AFDB, 2010).

Country risks

Country risk encompasses risks such as; breach of contract, civil war and the risk of expropriation. This risk is very relevant to SSA and is often an important consideration for investors and financial institutions. In deciding to invest in SSA, many investors look at indicators such as ease of doing business, enforceability of contracts to name a few as indicators of country risk.

Currency Risk

Further, projects with high costs of Re projects necessitates easy access to capital and in most SSA countries the capital markets are not well developed, making it even more difficult to fund large RE projects. The underdeveloped capital markets imply that most countries in SSA are reliant of foreign financing for infrastructure spend. In

addition, local markets are often not liquid or well developed enough to facilitate currency risk hedging instruments. Cash generated by the project is denominated in local currency whilst the debt incurred is serviced in a foreign currency. Respondents in the survey also perceive political legal and economic instability as a threat to investment RE technologies and projects.

Legal, political and economic stability

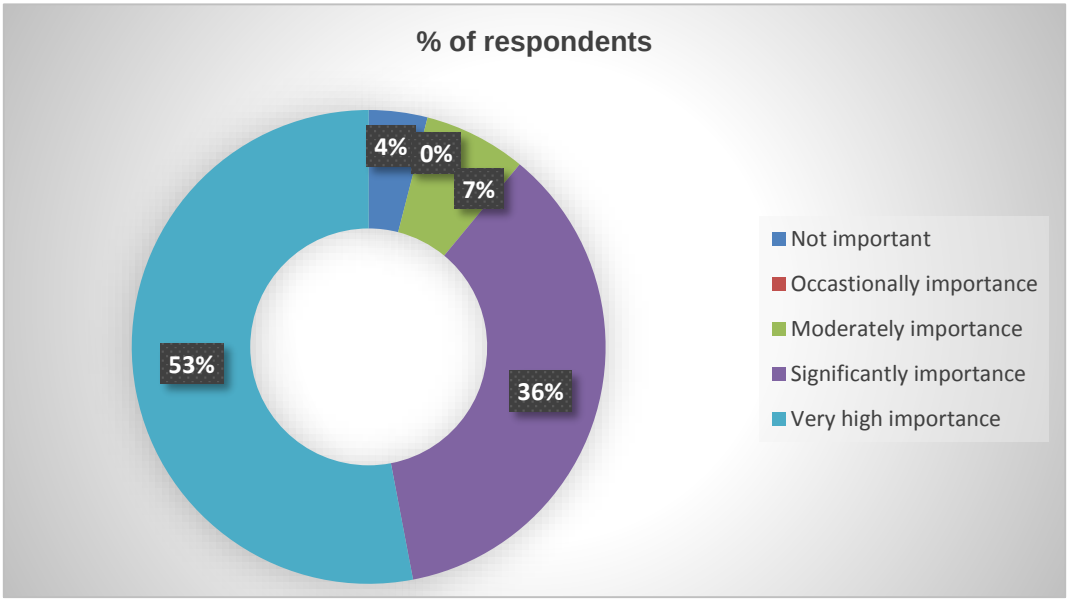


Figure 8 Effects of political, legal and economic stability

Source UNEP, 2012

Law enforcement

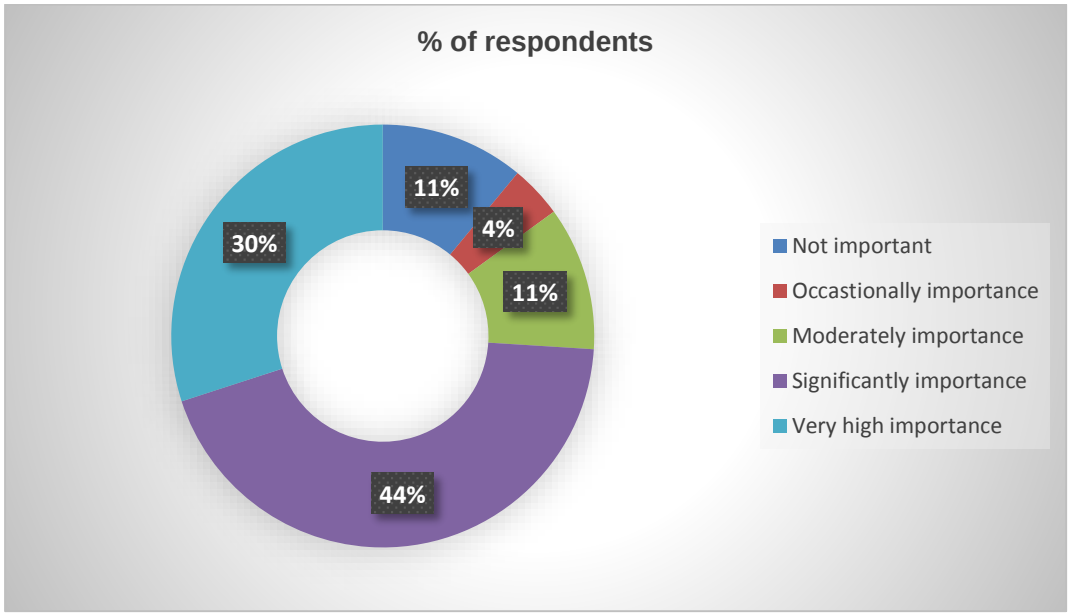


Figure 9 Effect of the effectiveness of law enforcement

Source UNEP, 2012

Currency risk

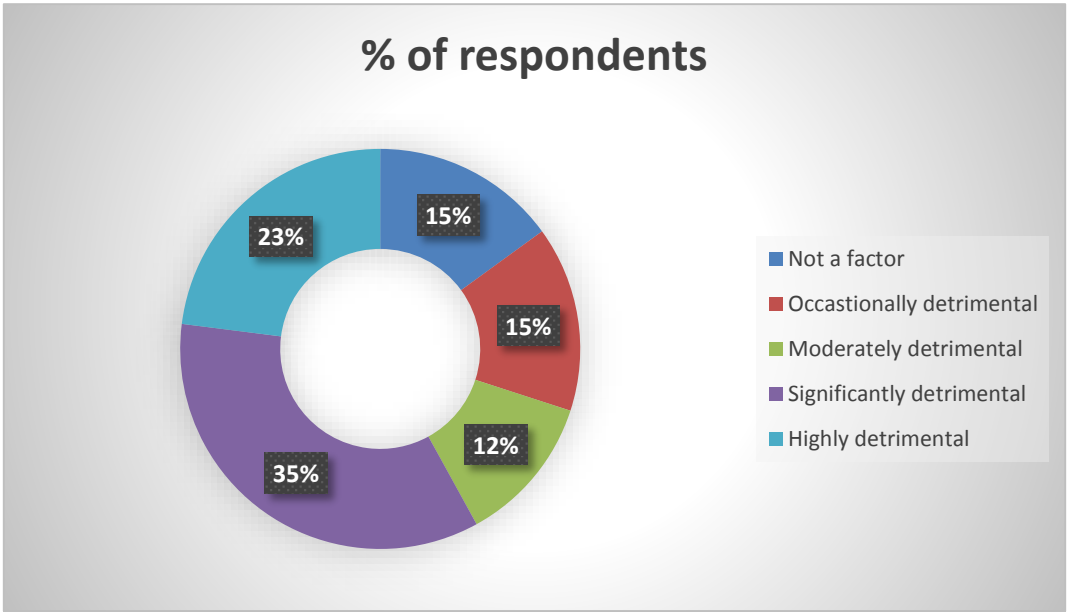


Figure 10 Effect of currency risk

Source UNEP, 2012

2.4 Current state of investment into renewable power

2.4.1 Investment overview

This section summarises the report entitled “Global Trends in Renewable Energy Investment 2015”, prepared by the Frankfurt School–UNEP and Bloomberg New Energy Finance (BNEF). Despite the challenges highlighted above global investment in renewable power (excluding hydropower less than 50 MW) increased to $270.2 billion in 2014 which is 17% higher than the previous year according to BNEF, (2015). If Investments in large hydropower projects is included, total investments totalled $301 billion in 2014 (The investment in renewable power and fuels stated above exclude heating and cooling technologies).

This increase came after a decline in the previous two years, and was influenced by large growth in solar installations in Asia totalling $ 74.9 billion as well as offshore wind projects that came online in Europe. Total generating power capacity increased by 103GW 2014 which takes the percentage of power generated by renewable sources to 9.1% of the world’s electricity generation(BNEF, 2015). RE technologies made up 48% of the power added in 2014, which makes 2014 the third uninterrupted year in which power of RE sources has been above the 40% mark. (BNEF, 2015) .

Global trends in investment, 2014

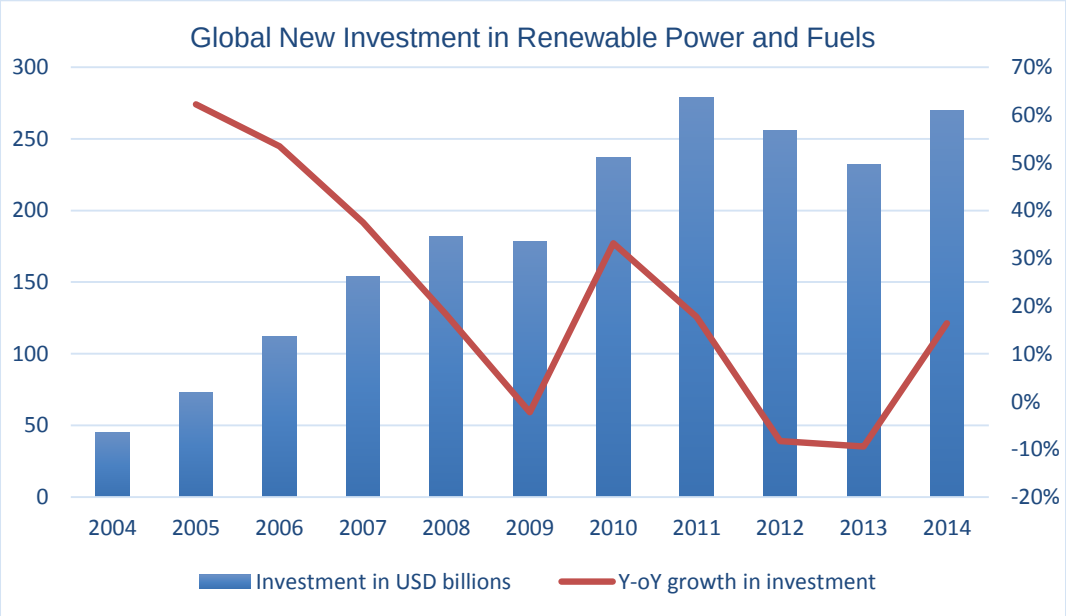


Figure 11 Investment flow

Source:(BNEF, 2015)

2.4.2 Investment by region

Investment in RE grew in both developing and developed economies. The developed economies saw a small growth in investment of 3% to $138.9 billion, whilst developing countries witnessed record growth of 36% to $131.3 billion of investment. Developing countries share of the global total investment increased by 6% to a record high of 49% in 2014.The top 10 countries by investments included six developed nations plus four developing ones that are all part of BRICS. China continued to lead, with total investments worth $83.3 billion, followed by the United States (USA) at $38.3billion, up 7% from 2013.Third came Japan, with a record $35.7 billion worth of investments, 10% higher than in 2013. The other countries in the top 10 included; Germany, UK, Brazil, Canada, Netherlands, India, and South Africa.

The Chinese economy continues to benefit from supportive government policies that encourage investment. Other developing countries that played a key role include India ($7.4 billion), South Africa ($5.5 billion) and Brazil ($7.6 billion).Brazil's 7.6 billion investments were mainly in wind, with a record 2.7GW commissioned in 2014(BNEF, 2015). The main driver of renewable energy investment, in both Brazil and South Africa Brazil remains the federal generation auctions and the tender programme , which help set fair pricing for RE projects (BNEF, 2015)

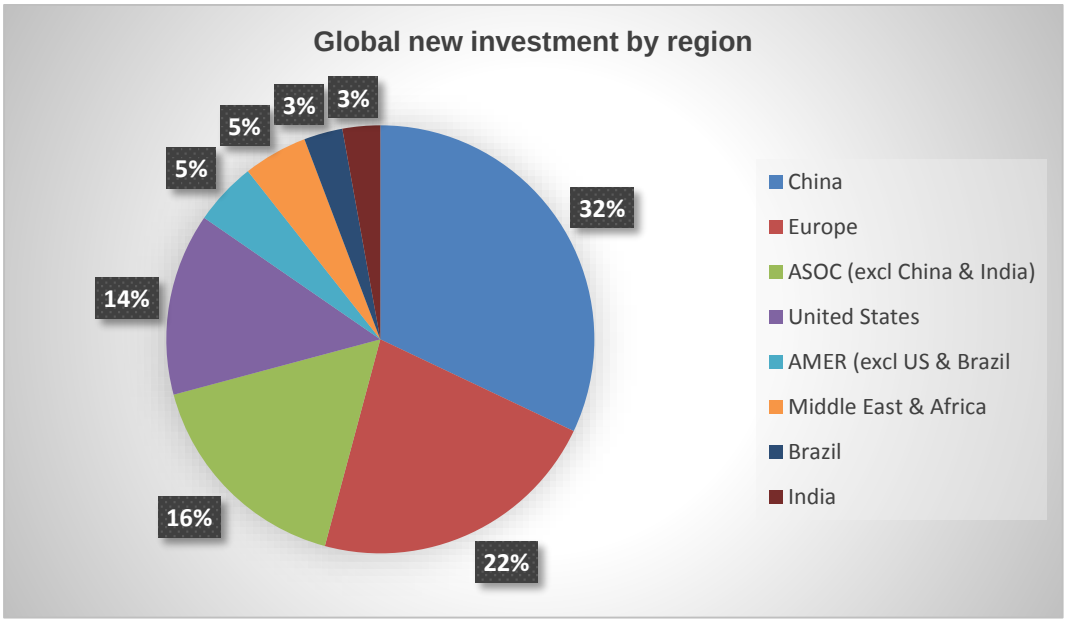


Figure 12 Investment by region

Source:(BNEF, 2015)

2.4.3 Investment by technology

Solar remained the leading technology in terms of investment in 2014 with around $149.6 billion (>55%) of total new investment dedicated to this technology. Wind followed with $99.5 billion worth of investment flow which makes up 36.8% of the global investments in renewable power as a whole. The outstanding 8% was made up of waste-to-energy, biofuels, biomass, small-scale hydropower (<50 MW),geothermal power and ocean energy (BNEF, 2015)(BNEF, 2015).

A huge portion (90%) of the investment in solar went to solar PV, followed by CSP and the remainder was mainly other unspecified solar. China established a new record for wind installations in 2014, at 21GW as “developers rushed to beat anticipated reductions in the feed in tariff” BNEF (2015). In addition China also constructed 13GW of solar power; of which 10GW were utility-scale plants (BNEF, 2015).

95GW of wind and solar photovoltaic power was installed as technology costs in solar fell during 2014. These two technologies were clear leaders in terms of renewable energy investment, the main drivers of growth in these technologies were;

1) The large investments made by China and Japan who together invested $74.9 billion between them in solar in 2014,

2) The large investments in offshore wind projects in Europe with a total value of $18.6 billion invested in this technology.

The cost of RE, specifically wind and solar continues to fall. With costs for crystalline silicon PV projects dropping from $315 to $129 per MWh, which is a reduction of 59% over a 5 year period. The costs for onshore wind have decreased by 12.9% over the same 5 year period.

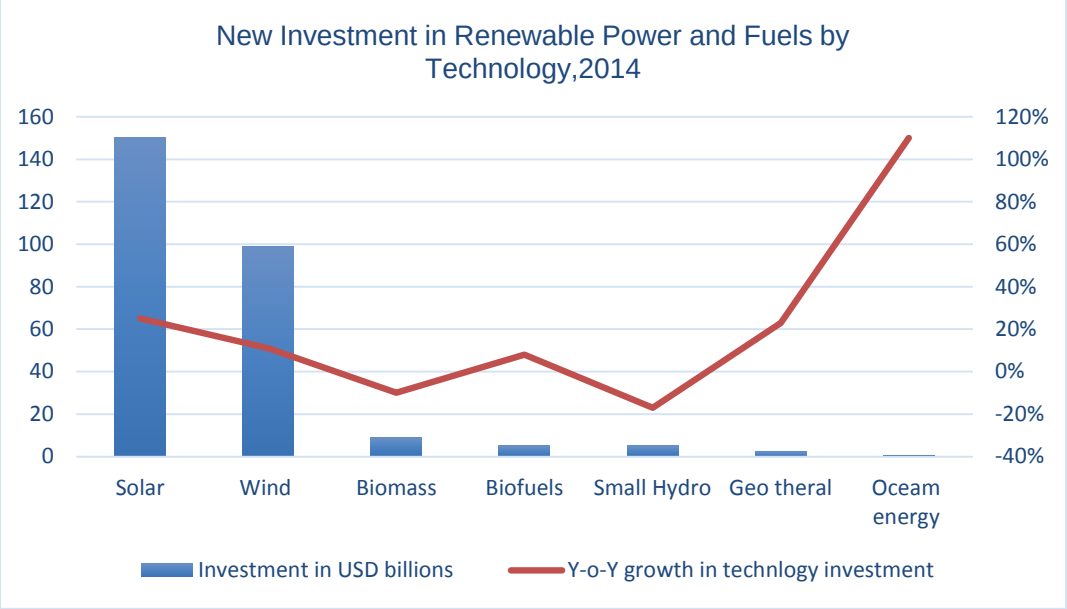


Figure 13 Investment by technology, 2014

Source:(BNEF, 2015)

2.4.4 Investment by type and source

Financing for *Research and Development* increased by a modest 2% in 2014 representing 4.3% of the global investment, split between corporates (60%) and government (40%) led investments. *Asset finance of utility-scale* projects increased by 10%, representing the vast majority of investments accounting for 62% of global investment in renewable power and fuels. whilst *small scale distributed capacity* increased by 34% to $73.5 billion representing 27% of the global total investment (BNEF, 2015) .

Public market investment in RE companies grew by 42% to $15.1 billion representing around 5.6% of the global total. Additionally, the WilderHill New Energy Global Innovation Index (NEX) declined 3% over the year as a result of the low oil prices. *Venture capital and private equity* investment increased to $2.8 billion in 2014 representing just over 1% of the global investment.

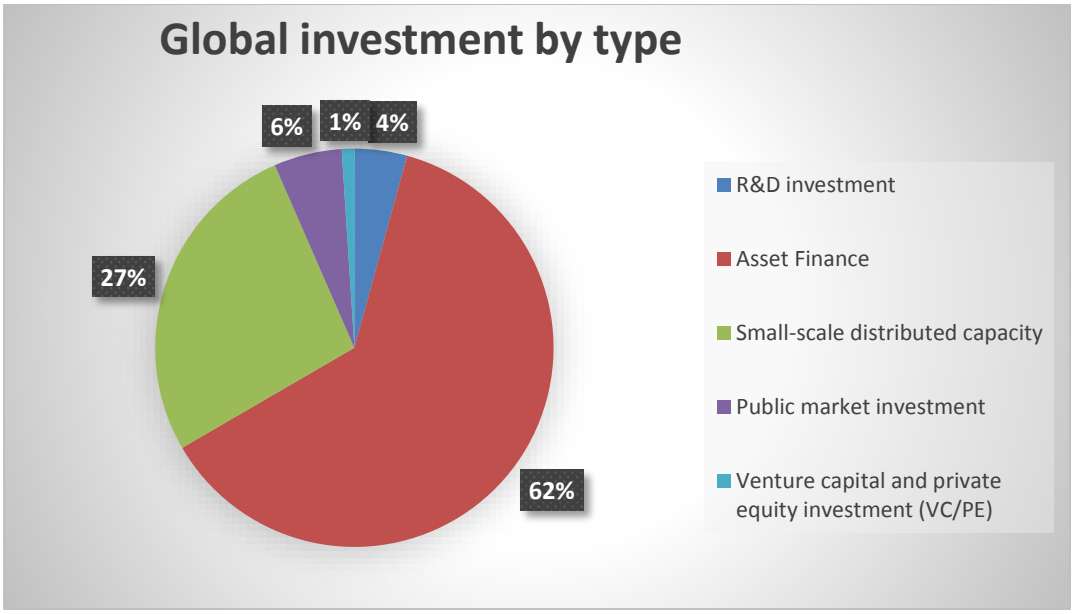


Figure 14 Investment by type, 2014

Source:(BNEF, 2015)

Funds: Sector share prices decreases over the year influenced partly by the declining oil price. Despite the decline in share prices, new innovative financing vehicles such as yield cos in the US, listed project funds in the UK and crowd funding continued to attract interest from investors.

Institutional investors—Investment from institutional investors continued to increase in 2014, mainly driven by the issuance of green bonds, new yield cos listing and quoted equity products. Direct investments in projects increased by 56% to $2.8 billion in 2014(BNEF, 2015).

Development banks— development banks continued to invest in RE, with Brazil's BNES leading the other banks with investments in utility scale asset finance increasing by over 55% in 2014 to $2.7 billion. The European Investment Bank (EIB) came in second with investment increasing by 2015 to $1.5 billion in 2014 .(BNEF, 2015).

2.5 Financing renewable energy power projects

Introduction

This section focuses on instruments and mechanisms generally used in large sized RE projects, not on instruments for small scale/rural RE projects although they are not totally excluded. This chapter looks and draws from the various literature surveys on financing RE development. Literature reviewed in this section covers work done in both the area of financing medium to large RE projects and financing small rural off grid RE in both the developed and developing world.

Most studies conducted in this area start by citing the work done by (IEA, 2008) which tries to estimate on a macro level the financing requirements and flow for per region and technology. Studies by (Bhattacharyya, 2013; Bobinaite & Tarvydas, 2014; IRENA, 2012; KFW, 2005; UNDP, 2008; Wagner, 2009; World Bank, 2012) looked at the funding needs and financing options, instruments and mechanisms. Whilst other authors looked at policies that promote RE integration (Abolhosseini & Heshmati, 2014; Menanteau, Finon, & Lamy, 2003).(CPI, 2014a) identified ways to lower the cost of RE in developing countries. Studies focused on Financing RE in developing countries include (UNEP, 2012; CPI, 2014a; Griffith-Jones, Ocampo, & Spratt, 2012; World Bank, 2012)

The discussion outlines RE development classified under two main heading; government led mechanisms and instruments and private sector mechanism, channels and instruments

2.5.1 Government led mechanisms and instruments

This sections covers the role of governments, Multilateral and regional DFIs, UN, World Banks institutions, bilateral aid agencies and export credit agency.

1. Public sector instruments

i. <u>Grants and Guarantees</u>

These instruments are not direct financing however they play a big role in mobilizing financing by mitigating some of the risks that potential investors might be worried about. Grants are essentially monies that are advanced with no expectation of repayment. Grants are offered by Governments or Development agencies that want to promote environmental and development policies such as the Global Environment

Fund (GEF), bilateral funding organizations, the World Bank (WB), or through government owned Funds dedicated to RE. Grants may be used to lower capital expenditure associated with setting up RE plants, this way the often high upfront costs are minimised. An example is the use of funds from the Renewable Energy and Energy Efficiency Fund (REEF) to invest in private sector RE projects in developing countries provides seed capital to entrepreneurs in renewable energy in the form of a grant or subsidised loan.

Guarantees represent a promise to make payment if the obligor defaults. Guarantees are made by well-capitalized organizations that are able to step in and make payments should the original obligor be unable to make payments when they are due. In RE project development, developer might look for guarantees from a government or its agencies and if the project is unable to make payments, the government or related agencies would cover the payments in the project's place. The availability of a guarantees enhances the creditworthiness of the borrower thus enabling the borrower to borrow at lower rates than those dictated by their credit rating (UNDP, 2008).

ii. *Concessional rates*

The cost of debt in most developing countries is higher due to the fact that the developing economies are plagued with higher inflation, lack of infrastructure development, high government borrowings and often poorly developed capital markets. This results in high cost of debt for RE projects. Concessional loans offer a solution in that they are characterised by features such low interest rates(lower than prevailing market rate), extended repayment terms, variable interest rate over the life of the loan.

According to (CPI, 2014a), because debt is expensive in developing economies it makes economic sense to reduce the cost of debt, rather than focussing of supporting the price of RE power. The reasons for this are;

- Initiatives aimed at bringing down the cost of debt result in overall less total support required to attract investors that when these initiatives are aimed at increasing the tariff received by the project
- A government can raise foreign denominated money at a lower cost than project developers thus making it cheaper for the government to on lend that money at a

concessional rate than giving out support mechanisms that increase the price. In India (CPI, 2014b) found that the use of lower priced had the ability to reduce the cost of RE by 10 to 40 %.

2. Mechanisms that promote Investment in RE

i. Tax incentives

There are different types of taxes that play a role in promoting RE projects and facilitating investment into the RE sector. The effect of tax initiatives can be summarised in three main points; firstly tax rules can be applied as an instrument to reduce reliance on fossil fuel and associated energy sources. An example of this instrument is the carbon tax that imposes a cost for burning fossil fuels. The second way tax policy can be instrumental in driving RE development is through policies that allow project developers to benefit from tax credit on the purchase and installation of RE machinery thus stimulating the development of a local manufacturing capacity. The third way is for revenues generated by RE technologies to be subjected to lower or no tax for an agreed period. The last two methods mentioned act as a subsidy ensuring the overall cost associated with RE is lower and enhancing the returns to prospective investors.

ii. Environmental policy instruments

This thesis aims to address financing models for renewable energy but in looking at renewable energy financing, support mechanism play a role in supporting investment in RET. This thesis will look at support policies that are focused on grid connected RE technologies. There are three main mechanisms that support RE projects from a power purchase point of view; namely Feed-In Tariffs (FIT), competitive bidding and tradable green certificates schemes arrangements.

FIT

FIT is a policy instrument that offers a fixed purchase price over a long term purchase agreement. FITs are considered to be the most effective policies in encouraging the fast distribution of RE and providing enduring financial stability for RE investors. According to the (REN21, 2015) at least 108 countries had enacted feed-in policies at the end of 2015.

There are two remuneration pricing models for FIT; the first is the fixed price model where the off-taker guarantees a minimum price over the life of the power purchase

agreement. Whilst the second model which is called the premium price model is linked to the electricity market price, whereby RE producers are offered a premium above the average retail price (Wagner, 2009)

When FIT systems are used by house households, farms and businesses rather than larger Independent Power Producer (IPP) they are known as a Net Metering program. In this arrangement, the individual households generate electricity from RE sources, and feed this power back into their grid to offset their electricity consumption.

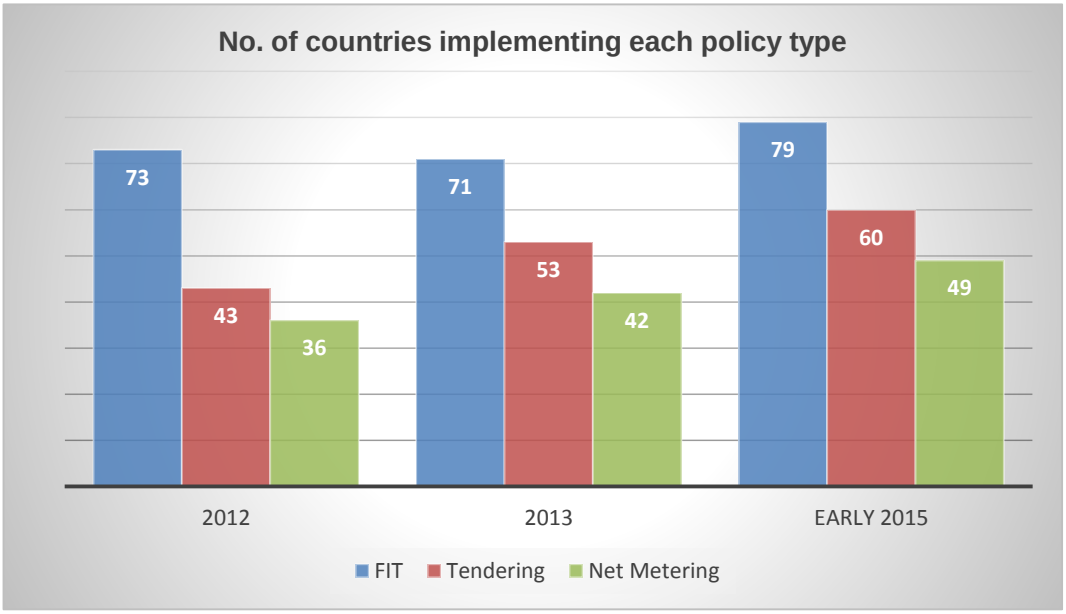


Figure 15 Countries implementing mechanisms to support RE development

Source Ren21 (2015).

Most policy makers have moved towards deploying FITs and competitive bidding at the same time. In some countries, competitive bidding and FITs have been used at the same time to support diverse market sections. An example is the use of FIT to support small scale solar PV in France and Taiwan, whilst the larger scale systems are supported by bidding policies (REN21, 2015).

Competitive bidding

Competitive bidding is based on a tender process where the quantity of power is known but the awarding of the bid is based on a wide range of options such as price, number of winning projects per bid winners and award of a negotiated PPA.

This system supports certain RE technologies at different stages of development as the tendering system encourages renewable stages of development. Competitive bidding, is used to acquire and incentivise RE generation and according to the

Renewables Global Status Report (2015) as of early 2015, 60 countries had held both technology-neutral and single-technology renewable energy tenders.

Competitive bidding has gained popularity in emerging countries with increased use in Latin America. Countries such as Chile, Argentina and Brazil, have awarded contracts for over 13,000 MW of capacity through tendering. The increased trend towards the use of bidding system has been a notable decline in RE contract prices, more so in solar PV. This decline in prices has been evidenced in actions such as the 890 MW contract that was awarded a bid price of USD 0.087 per kWh in Brazil (REN21, 2015).

Tradable Green certificates

This involves a fixed pre agreed quantity of electricity sold on the market to be produced from RE sources. This mechanisms is not common in the developing world but is popular in some developed countries. In this mechanisms certificates are allotted by generators, who sell electricity on the network at the market price.

CDM

The Clean Development Mechanism (CDM) promotes the reduction of emissions generated by developing countries by issuing Certified Emissions Reduction Credits (CERs) each equivalent to one tonne of CO2, which are tradable instruments that can be bought and sold in the CER market. Sales of CERs help mobilize financing by offering project developers a way to manage the CER sale risk as well as assist developing countries to meet their targets under the Kyoto Protocol.

The availability of carbon credits projects to access upfront financing secured against carbon revenues however, the market for CERs is illiquid and characterised by few buyers, risk is transferred to the public financing agencies who often have no control of such risks and additionally there are high transaction costs associated with the process of realizing carbon revenues

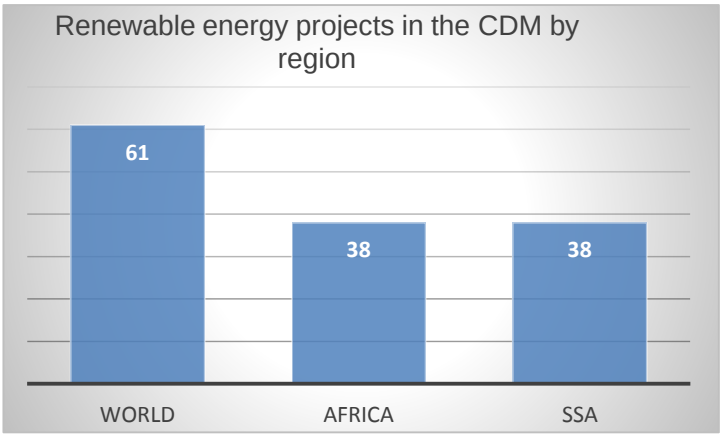


Figure 16 RE projects in the CDM programme, 2012

Source UNEP, 2012

Respondents in the UNEP FI survey consider the role of CDM as secondary in SSA. With 41% of participants saying they view CDM's to play an important role whilst the larger percentage (58%) did not see the importance of CDM.

3. Financial channels that increase supply of long term finance

i. Multilateral development banks (MDB)

MDB are defined by the World Bank as institutions that offer financial aid and professional advice for economic and social development. The institutions often provide guarantees to mitigate project start up risk and facilitate loans from other sources. The World Bank is a good example of a MDB and within the World Bank there are different organisations that each contribute to financing the RE sector in developing countries (Bobinaite & Tarvydas, 2014). Examples of these organisations include; The International Bank for Reconstruction and Development (IBRD), The International Development Association (IDA) , The Global Environment Facility (GEF), The International Finance Corporation (IFC)

ii. Regional Development Banks (RDB)

RDB act in a similar way to MDB described above, however these banks focus on a specific region. Examples of regional banks include; Development Bank of South Africa (DBSA), Asian Development Bank (ADB), the African Development Bank (AfDB), and the European Investment Bank. RDB's offer access to long term finance, they mitigate start up risks thus leveraging finance by making RE projects more attractive, and most importantly because of their development mandates these institutions leverage finance counter-cyclically often proving financing during an economic downturn. DB committed to funding $2 billion worth of investments in the RE sector up to the end of 2013,this target was met and exceeded by 2011, when $2.1 billion was invested(Bobinaite & Tarvydas, 2014).

iii. Clean energy funds

The funds mentioned below are joint ventures between the private and government. These funds have two main benefits; firstly they allow the private sector to build and set up projects that are later transferred to the public sector, and secondly the risk is shared between the public and private sector at each stage of the project. Examples of such funds include; The Global Energy Efficiency and Renewable Energy Fund (GEEREF), The Renewable Energy and Energy Efficiency Partnership (REEEP), The Global Village Energy Partnership (GVEP) (Bobinaite & Tarvydas, 2014).

In many countries dedicated funds have been established to promote RE development such as the India Renewable Energy Development Agency (IREDA) which has played and key role in bringing about substantial investments in various RE projects in India. Other examples include Malaysia which has set up MESITA, Cambodia with the Rural Electrification Fund (REF), Nepal‘s Power Development Fund (PDF); Biogas Credit Fund (BCF) and Thailand‘s ENCON fund. All of these funds aim at promoting and developing rural electrification, energy conservation and renewable energy (Ohiare, 2014)

2.5.2 **Private sector and instruments mechanism and channels**

1. Financing instruments

i. Debt

Debt financing is characterised by (fixed) interest rates and repayment schedules. Senior debt can be in the form of a project loan or credit line, and will rank senior than all other liabilities. This type of debt reduces the overall cost of the project, by generally being cheaper than other available funding. The debt contract is a fixed obligation and the lender does not profit beyond a certain level from project success thus the lender is more risk averse and seeks to minimise loss in the event of a default. In addition the availability of senior debt is used as a form of long term liability that is matched to the project being developed.

However in many developing countries banks are hesitant to extend long-term loans, and instead offer a mid-term loan with a potential follow-up finance at the end of the term. This creates a refinancing problem and a third party liquidity guarantee for the refinancing allows the extension of maturities to match the term of the RE project.

Pros

- The debt liability incentivises project sponsors to make the project work as they have to repay the debt
- Once the debt is paid, excess cash is available to invest further in the project
- It increases commercial financing institutions (CFIs) involvement in RE projects

Cons

- Transaction costs are usually high as a detailed due diligence process is required to establish economic viability of project
- Low leverage levels as the provision of debt replaces private financing
- Developing countries often lack long term loans, as most local banks find it difficult to provide debt financing with the required long tenors

ii. Mezzanine debt

In an effort to overcome the tenor problem faced by the provision of senior debt, lenders often propose Mezzanine debt. The term “Mezzanine debt” refers to the financing where by the mezzanine instrument is considered equity like in terms of priority of payment or in liquidation. This type of debt is a mix of debt and equity where

the repayment is subordinate to providers of senior debt and although no direct shareholding is obtained, the instrument acts “equity” like in that it is patient and repaid when cash flows permit.

Pros

- High level of leverage
- Encourages senior debt providers to participate by reducing the risk to the senior lenders.

Cons

- Often required custom structuring and analysis thus increasing the transaction costs
- Risk is transferred to the mezzanine debt provider, but with only limited ability to control risk

iii. Green Bonds

Green bonds appeal to Socially Responsible Investors (SRIs) that are concerned about climate change. These instruments trade on the exchange like normal bonds and can be bought and sold like normal bonds. One of the key attractive featured of these bonds is their sponsorship by a credible institution which is often backed by a sovereign. The involvement of the credible institution sends a clear signal to the market about the long term viability of RE projects. Their involvement further reduces the overall risk associated with the project, thus these types of bonds can be marketed to institutional investors as they have very little risk (IRENA, 2012).

Additionally the backing by a credible institution mitigates the fact that the market for these types of bonds is often illiquid. Demand for green bond has been on the increase with credible international institutions underwriting their issuance. The coupons on these bonds are compatible with AAA rating, and the presence of large institutional fixed income investors in this space has allowed green bonds the ability to raise considerable amounts of long term debt. Despite their attractiveness, Green bonds remain a niche product, with issuance reordered at $39 billion in 2014 (BNEF, 2015)

iv. Asset-backed finance/Project Finance

Asset-backed securities are backed by the cash flows generated by the RE project, where the lender has no recourse to the corporate but is secured instead by the cash flows generated by the project. This financing is characterised by the use of a special purpose entity (SPE), where the funds flow to a project itself.

This type of financing is often used to refinance projects that are generating positive cash flows, although they can also be issued in the form of project bonds ahead of construction (World Bank, 2012). Asset backed securities are useful in that they free up cash that would otherwise have been tied up in the project.

Pros

- Asset backed securities provide a longer tenor at lower cost that than senior debt
- It frees up development funds for further investments
- Potential to bundle projects together in a single security can reduce risks and, therefore, financing costs
- Can be used to expand capital market capabilities

Cons

- Sophisticated analysis required to price the risk associated with this type of security
- greater range of restrictive loan covenants

v. Sales-lease-back arrangements for RE-finance

In this type of lending arrangement the lender maintains ownership of the financed assets, and thus no collateral is required.

Pros

- Offers flexibility to the project developer

Cons

- Banks willing to finance on a lease basis may not be available in developing countries

vi. Equity

Equity investors offer investment in a project in return for a shareholding project equity. This type of investments is often riskier and therefore requires high returns. Investors

need to be compensated for risk and often the level of risk for capital is reflected in the expected 'Internal Rate of Return' (IRR).Being an equity investor means investors are shareholders together with the project sponsor through ordinary or preferential shareholding, which means they have voting rights on key issues in the project which makes it easier to protect their investment. The different funds provide equity finance at different stages of RE projects thus requiring different returns.

Table 1 Returns required by equity investors

Venture Capital	Private Equity	Infrastructure Funds	Pension Funds	Bank Mezzanine Debt	Bank Senior Debt
Start ups, new technology, prototypes	pre IPO compa-nies, demonstrator technology	Proven technology, Private companies,	Proven technology	Demonstrator / Proven technology, New Companies	Proven technology, established companies
>50% IRR	35% IRR	15% IRR	15% IRR	LIBOR + 700 bps	LIBOR + 300bps

Source: (Wagner, 2009)

Pros

- Pays for itself
- Players in the equity space are highly incentivised to make the project work as this is their only source of repayment and gains

Cons

- High returns are required to reward the risk
- Developed financial markets required for exit through an IPO or a direct sale of shares

2. Financial channels that play a role in the supply of finance

i. Banks

Banks provide three types of financing; corporate finance, project finance and mezzanine debt finance. Most RE projects cannot be funded using corporate financing and thus the use of project finance has gained popularity. The availability of the loan capital markets to provide the quantum required by RE projects is often a problem in developing countries.

ii. Sovereign Fund and institutional funds

Other asset classes that are commonly used to supply finance to RE projects include Sovereign Wealth Funds (SWF), these funds play an important role in that they not only supply long term finance but the scale of assets under management means that large scale investments in RE.

The sheer size of assets under management means that SWF should be a potential game changer in RE investments, however these funds often require returns higher than what a typical RE project would give. According to Griffith-Jones et al., (2012) a possible solution to this problem would be a "blended finance" approach in conjunction with DFI. Under this approach grants and loans would be mixed, resulting in market returns.

iii. PE ,Venture and infrastructure funds

The choice of financial channels depends on the development of the RE sector.

Table 2 PE, Venture and infrastructure funds

	Venture capital funds	Private equity	Infrastructure funds
Source of fund	Insurance companies, pension funds, mutual funds and high net worth individuals	Institutional investors and high net worth individuals	Institutional investors and pension funds
Target	New technology new market and early stage companies	Opportunities with possibility for enhanced returns, mature technology including those preparing to raise capital	Infrastructure projects/companies, interested in railways, roads and power generating facilities
Risk profile	High risk of failure in every venture	Lower risk of failure than venture capital	Low risk appetite
Investment horizon	4-7 years	3-5 years	7-10 years
Return requirement	50-500%	25%	15%

Source Bobinaite & Tarvydas, 2014

2.5.3 Conclusion on financing

A mix of financing sources is often used in driving investments into RE, this mix uses both public instruments and channels combined with private instruments and channels based on the lifecycle of development of the RE sector.The technology research stage employs more public financing aimed at reducing risk for RE technology researchers. This stage is mainly financed by the government/public finance grants and subsidies that are non-refundable. Post this stage, the amount of public financing should reduce and more venture capital or private equity type funding should take its place. RE financing channels analysis indicated the many varied financing channels available to fund projects Financing channels vary between countries; depending on the countries; level of economic development and the stage of developments of the RE sector.

Further the analysis on financing also highlights the important role that governments, MDB, RDB and commercial banks play in financing RE, these key channels are particularly important in developing countries. The analysis further showed a direct link between policy and RE financing, as policy plays a key role in attracting investors by providing stability, thus reducing risk perceptions that lenders may have. Therefore any financial model proposed should be supported by the correct policies.

Further any assessment on the effectiveness of policy should consider the following; The model's ability to to stimulate renewable electricity generation from renewable sources; the ability to lower associated financing costs and the ability to deliver electric power at the lowest possible cost.

Chapter 3

Methodology

The barriers to financing RE in developing countries is well documented and this research will be used to analyse and infer the relationship that exists between financing models employed and the growth of the RE market in that particular country. Sources of data will come from studies and papers presented by Development Finance Institutions (DFI's) such as the World Bank, International Energy Agency (IEA), and The United Nations Environment Programme Finance Initiative (UNEPFI).

Further the research will look to answer the question on whether the current financing model used to finance RE projects in South Africa is the most effective, if not, alternative financing solutions will be proposed. This assessment will be based financing model's ability to:

1) **Diversify the source of finance away from commercial banks,**

   This measure is based on a comparison analysis of the financial models in the 3 developing countries discussed in this chapter.

2) **Lower associated financing costs**

   A proxy for different financial instruments is used. Assuming that equity is more expensive that debt for instance. The cost of each instrument is mainly based on the perceived risk.

3) **Increase installed renewable power capacity**

   Looking at the percentage of power generated from renewable sources as a portion of total power generated in that country. And the growth of RE power sources relative to their starting base and the size of the economy

4) **Practical implementation**

   This measure looks at whether the model has been used elsewhere (precedents), the availability of financial intermediaries to facilitate the model, the state and sophistication of the financial capital markets and any relevant regulations. This assessment is made in comparison to the developing countries discussed in this thesis.

Evaluation Matrix **(subjective based on comparable analysis)**

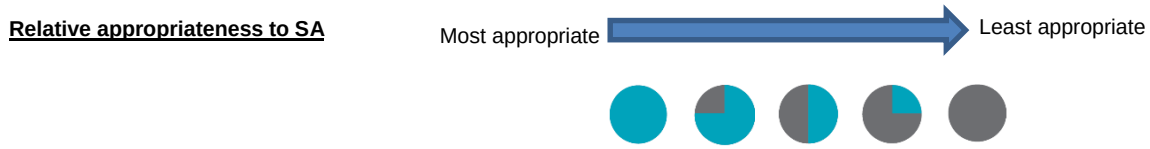


Table 3 Financing model assessment matrix

Financing Model	Diversify funding from project finance financing led by commercial banks	Lower associated financing costs	Increase installed renewable power capacity renewable sources	Practical implementation /feasibility
Model 1				
Model 2				

The thesis will show how the alternative financing model proposed is better than the current model and in so doing demonstrate how the proposed financing model can help grow the RE market in South Africa and achieve the government's goal as set out in the white paper on energy.

Chapter 4

Financing Models in Brazil, China, India and South Africa

4.1 Brazil

4.1.1 Overview of the electricity sector

Brazil is Latin America's largest economy with installed generating capacity of 134 GW in 2014 (EIA, 2015). Hydro power accounts for 66.87% of the installed capacity at 89.2 GW, fossil fuels represented 19% of generating capacity at 25.5 GW with biomass contributing 9% at 12.3GW. Wind, nuclear and solar make up the remainder (EIA, 2015).

The power sector has undergone a number of reforms since the 1990s, prior to this period the power sector was government owned and controlled. In the early 1990s the power sector was privatised and control rested with the private sector. This privatisation phase resulted in the formation of an independent system operator and a new energy trading model. The new model is based on two markets for the negotiation of electricity purchase agreements.

The first market is the so called "regulated market" where energy is purchased by distribution companies at public energy auctions, here the prices are set by National Agency of Electric Energy (ANEEL). In the second market is the so called "free market" where, energy is bought by non-regulated agents (with demand exceeding 500kW) at prices agreed upon through negotiations. The power generators involved in the auctions take up agree to an electricity purchase and sale agreement with the distributors based on the amount of power required.

The government plays a huge role in the energy market through National Council of Energetic Policy (CNPE), which is part of the Ministry of Mines and Energy (MME). CNPE plays the role of advisor to government on issues of national energy policies and is in charge in charge of setting energy policy in Brazil. ANEEL, is responsible for fixing the electricity rates, the rates set should be fair and take into the energy, transmission and distribution costs as well as energy sector charges and taxes (Silva, Neto, & Seifert, 2016).

Additionally the auctions outlined above are the responsibility of ANEEL. The price of electricity comprises fixed costs determined in auctions and variable costs dependent on the cost of generation. The Fixed costs are set by ANEEL, whilst the variable costs largely depend on operational needs of power plants as assessed by the Brazilian Operator for Electricity Systems (ONS) on a monthly basis (Silva et al., 2016)

4.1.2 Overview of the renewable energy market

Brazil is amongst the world leaders in terms of its commitment to cleaner energy and has one of the world's cleanest energy mixes. In 2014, RE accounted for 42.1% of the primary energy supply, with the energy mix characterised by high diversification. Brazil's RE power generating capacity is dominated by hydro power, with an estimated 140 GW of total hydropower potential (IRENA, 2015)

Brazil's RE targets are entrenched in its ten-year energy expansion plans (PDEE). The PDEE aims for RE to make up 42.5% of the country's total primary energy supply by 2023. Specific technology targets include;

- Wind energy: 11.5 GW by 2020.
- Small hydro: 6.4 GW in 2020.
- Biomass: 9.2 GW (2020) (IRENA, 2012)

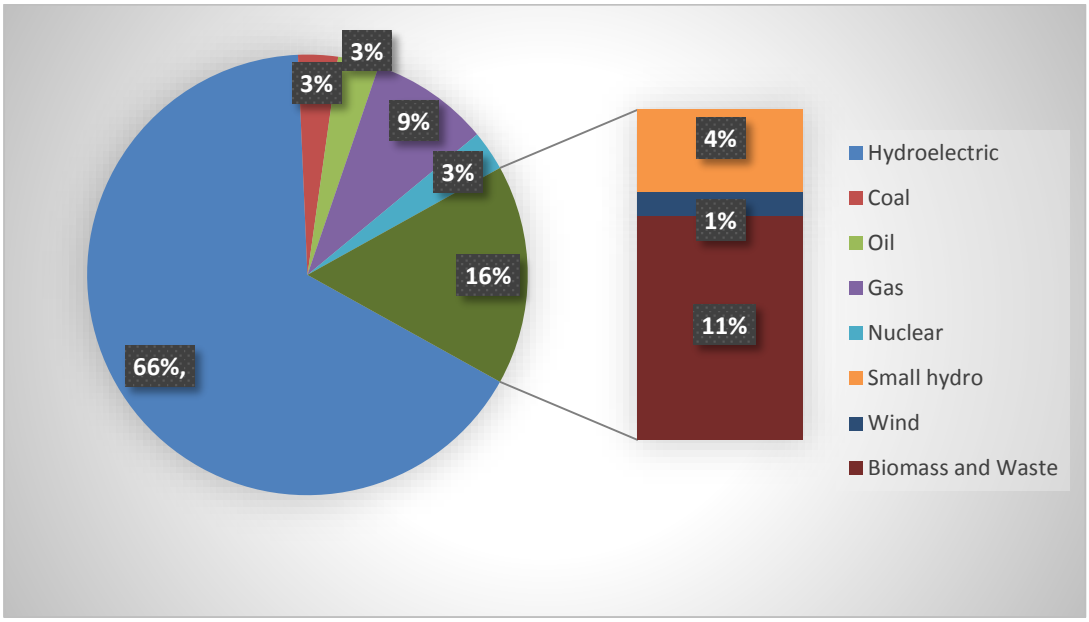


Figure 17 Installed power capacity in Brazil by source

Source EIA, 2015

4.1.3 Financing Model

The Brazilian model is a centralised financing model led by the national development bank Banco Nacional do Desenvolvimento Econômico e Social (BNDES). The bank provides preferential financing for RE projects in the form of stable low-interest financing to projects that meet local content requirements. The development bank made available loans through a dedicated credit line that finances up to 80% of total projects costs, with tenors going up to 16 years. The credit line offered a moratorium of up to six months after commissioning. Interests range between 7-12.5% per year.

In 2012 the bank created a new credit line funded from the proceed of oil exploration, that offers rates starting at 2.5% per year (iadb, 2014)

i. Environmental Policy Support for RE financing

FIT: Brazil established a FIT programme to support RE development, however on launching, the programme faced a number of difficulties such as ; delays in getting environmental licenses, disputes over land, problems with access to the grid further the FIT original programme proposes a 1100MW cap which made it unattractive ti investors (Bobinaite & Tarvydas, 2014) .

Thereafter the government launched Programa de Incentivo a Fontes Alternativas de Energia Elétrica (PROINFA), where the government set a target of 3.3 GW of renewable power generation by 2009. This deadline was later moved to 2012. Thus far the scheme has been successful with installed capacity reaching 2,888 MW from 132 projects by 2013.The costs of the scheme are levied from customers on electricity bills.

Auctions - An additional response to the failure of the original FIT schemes was the introduction of an auction system. This system together with preferential financing from BNDES has driven rapid growth of wind power installation to an expected total of 5300MW in 2013 (Abdmouleh, RashidA.M.Alammari, & Gastli, 2015)

Larger strategic projects mostly large hydro power , are regulated by a different type of auctions, where a long-term PPA for the development of the project is auctioned (REN21, 2015).

ii. Government support

The government provides incentives in the form tax relief for renewable energy generators and import duty exemptions for renewable energy equipment (iadb, 2014).

4.2 China

4.2.1 Overview of the electricity sector

China is the world's most populated country and the world's biggest energy consumer, with power generation capacity of 1,260 gigawatts (GW) at the beginning of 2014 (EIA, 2015).A majority of the power (63%) is supplied by coal, followed by hydro (22%).The country has made efforts to diversify its energy mix however wind (6 %), natural gas (4 %), nuclear power (1 %), and other renewables still account for a small share of the electricity generated (EIA, 2015)

As is the case with Brazil, the power sector is controlled by state-owned companies, effectively giving the government a monopoly in the electricity sector. Some reforms have been initiated to try open up the sector to private investors an example of such reforms would be the breaking up of the State Power Corporation (SPC) which was the monopolistic electricity provider into separate units. The sector is controlled by five state-owned generation companies being;China Huaneng Group, China Guodian Corporation, China Datang Corporation, China Huadian Corporation, and China Power Investment Corporation (EIA, 2015).

The regulatory responsibility as well as facilitation of investments use to lie with the Electricity Regulatory Commission (SERC) however in 2013, the government eliminated SERC and moved all its responsibilities to the National Energy Administration NEA. The NEA is responsible for approving new energy projects, establishing energy prices and implementing energy policies as set out by the central government (ESCAP, 2013). Electricity prices are set by the National Development and Reform Commission (NDRC).

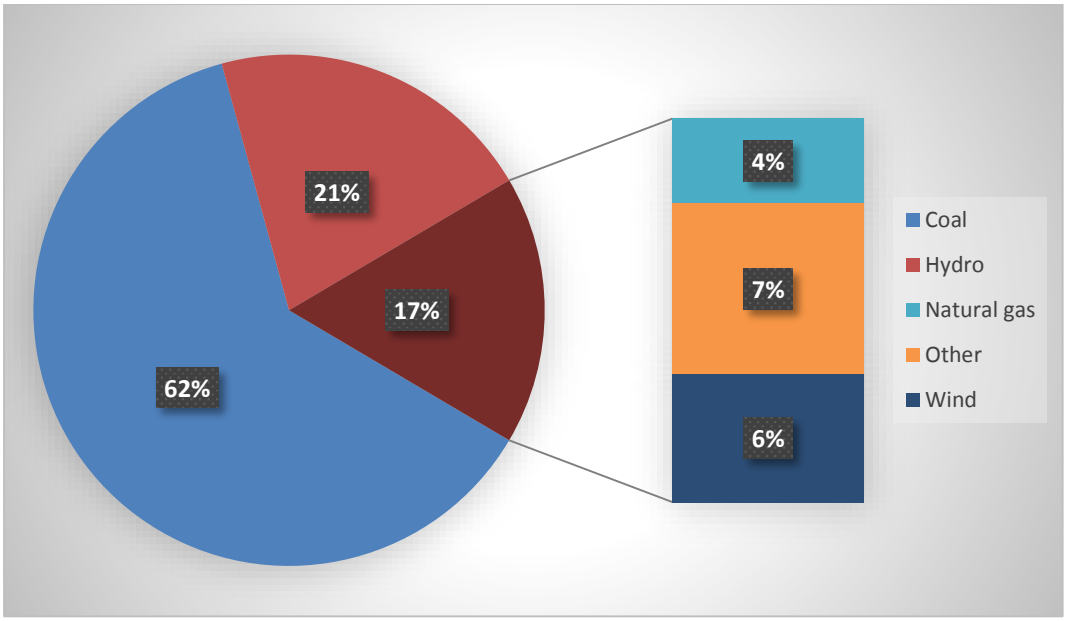


Figure 18 China installed capacity by fuel type, 2014

Source (EIA, 2015)

4.2.2 Overview of the renewable electricity market

China's share of electricity generated by renewables remains relatively low compared to the portion generated by coal. However, strong growth and investment in both wind and solar plants has seen this country growing to become a market leader in terms of RE investment. This is shown in figure 21 which shows the growth in RE generation for the 9 years from 2005 to 2013

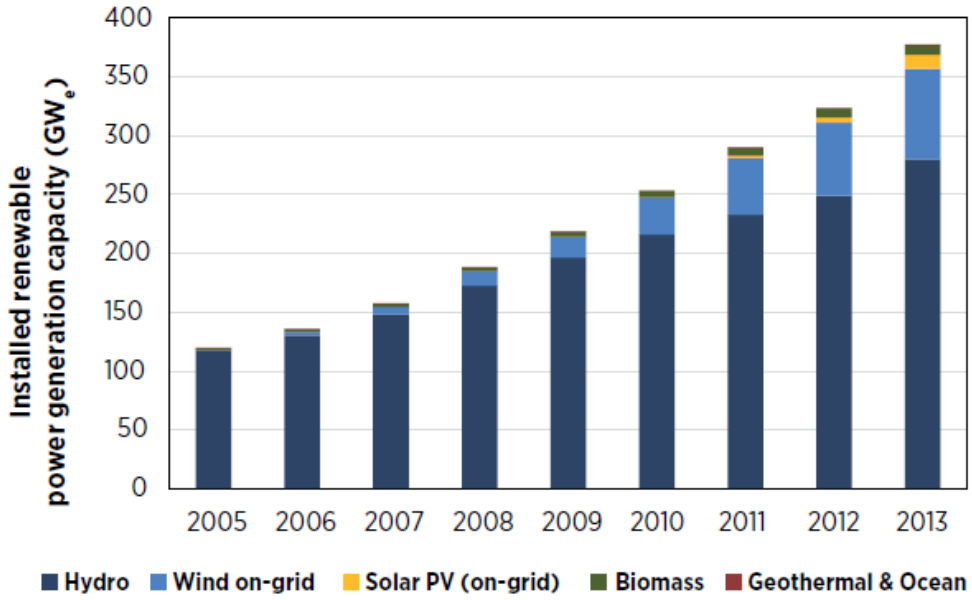


Figure 19 Cumulative renewable power capacity over a 9 year period

Source IRENA, 2014

In addition to the increase in power from RE sources, the manufacturing industry in China has seen phenomenal as a result of their ability to manufacture components competitively. Today china can boast relatively complete wind power and photovoltaic manufacturing industry that supplies components all over the world. The world's top wind turbine manufacturers are from China (Ming, Ximei, Yulong, & Lilin, 2014).China has set a RE targets as set out in its 12th FYP document, the target aims to meet 11.4% of its primary energy requirements from non-fossil sources by 2015 whilst decreasing the use of coal from 67% to 60% by 2020 (IRENA, 2014) . The targets aim for the installed capacity of RE to reach 600 GW by 2020, from 250 GW. Specific technology goals include;

- Hydroelectricity generation capacity is targeted to reach 350 GW, by 2020
- On grid wind power is expected to be 200 GW onshore and 30 GW offshore by 2020.
- Solar PV will total 100 GW in 2020 (70 GW by 2017) & CSP will be 3 GW by 2020

4.2.3 Financing model

China's financing model is a centralised model and is typically government-oriented, with the main stakeholders consisting of mainly state-owned developers and development bank. Most of the projects funded to date have been financed on the balance sheet of one of the big five-generation companies (state owned). This model relies mainly on the state owned development China Development Bank (CDB) which provides low interest debt. This model has used very little non-re-course /project finance funding instruments. This is in contrast to the other countries discussed in this paper namely; Brazil, India and South Africa who has used project financing primarily as the preferred financing method.

The main financing channel is through banks, and this is largely due to the role that CDB plays in RE financing. According to (Ming et al., 2014) banks had issued loans amounting 300 billion RMB, of which the largest share was CBD, the development bank had funded more than 1/3 of total installed capacity. New financing instruments such as stock financing are growing in popularity evidenced by 32.77 billion RMB raised by the listed enterprises by the end of June 28, 2012 (Ming et al., 2014).

Bond issuance is also another key financing channel, with 2 of the state owned companies raising 17.63 billion RMB through bond issuances from 2010 to 2011 (Ming et al., 2014).

i. Environmental Policy Support for RE financing

FIT: This was the main policy used between the periods from 2006 to July 2009 with prices for grid-connected projects pre-determined in accordance with the FIT price.

Tenders established by reverse auction procedure: competitive bidding process is used for large RE projects. The government facilitates the connection to the grid and purchases power from the selected projects.

ii. Government support

Installation Subsidy: where capital subsidies are provided for solar PV installation. Off-grid (stand-alone) installations received 70% subsidies while grid-connected installations received 50% subsidies (IRENA, 2014).

Tax: In addition the government supports the RE sector through import tax exemptions equipment manufactured by foreign companies which are thought essential for project development. The government exempts RE projects from local (provincial) income taxation.

China also received $40.22 million from the Global Environmental Facility (GEF) grant. The grant is aimed at increasing cost effective renewables and increasing their share in the energy mix and reducing GHG emissions.

4.3 India

4.3.1 Overview of the electricity sector

India is one of the largest energy consumers with installed electricity generation capacity of 249 GW in 2014(EIA, 2015). As is the case of china, India's energy mix is greatly reliant on fossil fuels, with, with 59% of energy supplied from coal, followed by hydro (16%). Installed renewables account for 13% of the energy mix.

RE policy is headed up by the Ministry of New and Renewable Energy (MNRE), whilst the enforcement of regulation is overseen by the Central Electricity Regulatory Commission (CERC). (IRENA, 2012).

The vertically integrated utilities in each state were unbundled according to the electricity Act of 2003 into separate entities responsible for transmission, generation and distribution. This reform in the electricity sector gave access to the transmission system, giving access to consumers with a load larger than 1 MW to purchase electricity from any generator (IRENA, 2012). Private investors have recently entered the previously state run sector with companies such as Reliance Power, Tata Power, and Essar Power now active in the country's power sector. The grid is constantly under pressure as a result of the growing economy and increasing population thus the country suffers a severe shortages of electricity.

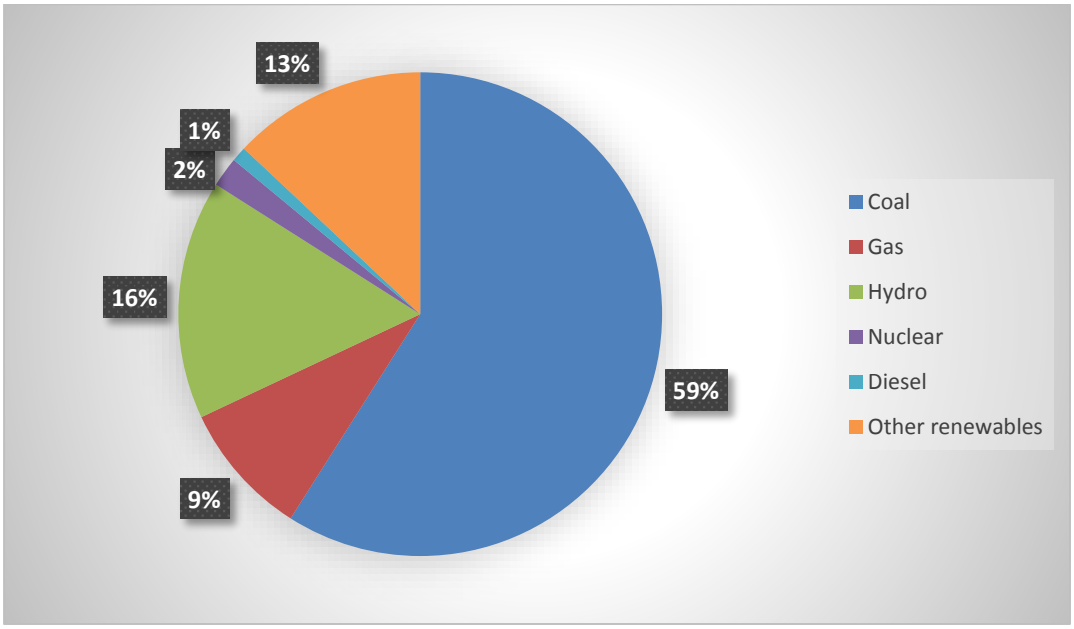


Figure 20 Installed power capacity by sources, 2014

Source EIA, 2015

4.3.2 Overview of the renewable electricity market

Renewable energy sources accounted for only 13% of India's overall power generation capacity in 2014 (excluding hydro).MNRE estimates an additional 90,000 MW can be generated from the available RE sources in India (IRENA, 2012)

India's policy on RE is set out in its national action plan on climate change. The plan contains mini milestones in the form of 8 national "missions" (IRENA, 2012). In the 11th Five-Year Plan which was effective between 2007 and 2012, India made a commitment to add 12.23 GW of renewables. The 12th five year plan which covers the period from 2012 to 2017 lays out plans to install 29.8 GW of renewable energy capacity, technology specific targets include;

- Grid-connected solar PV and CSP: 20 GW by 2022
- Off-grid Solar: 2 GW by 2022
- Wind power: 15 GW added in the 12th five year plan period
- Small hydro: 2 GW added in the 12th five year plan period
- Biomass: 2 GW added in the 12th five year plan period
- Waste-to-energy: 0.7 GW in the 12th five year plan period

4.3.3 Financing model

The Indian RE financing model includes decentralised public and private financial institutions that provide finance on commercial terms. The favoured channel for RE financing has been both private and public sector banks, followed closely by state-owned or bilateral institutional investors.

The Indian Renewable Energy Development Agency (IREDA), has historically played the role of proving the bulk of credit for RE and EE projects. IREDA provides loans to project developers as well as other financing products for securitisation and refinancing. IREDA's loans cover up to 70% of projects costs at an interest rate of 11.5 to 13.75% with repayments up to 15 years (IRENA, 2012). However IREDA is inhibited by its capital base and resources thus limiting its ability to lend to RE projects on a similar scale to Brazil's BNDES and China's CDB.

Table 4 Renewable energy investors in India, 2012

Type of investor		Registered in India	Involved in RE
Commercial banks	Private bank	26	9
	Public sector bank	30	6
	Foreign bank	37	0
Equity	Private equity	51	16
	Venture capital	180	21
Institutional funds			84
Development banks*			3

*Development banks include national-level institutions IREDA, IFCI, and SIDBI source:(Shrimali, Nelson, Goel, CharithKonda, & Kumar, 2013)

Source: Shrimali, Nelson, Goel, CharithKonda, & Kumar, 2013

i. Environmental Policy Support for RE financing

FIT: FITs are worked out in a cost plus basis and are based on long term PPA's of 20 to 25 years. The feed-in tariff period ranges from 13 to 35 years, depending on the technology. Post 2009, CERC introduced new annually reviewed feed-in tariffs for solar that, the tariffs for solar PV was 18.44 INR/kWh and for solar thermal at 13.45 INR/kWh (IRENA, 2012)

Renewable energy certificates (RECs) – RECs are market based instruments introduced in 2011 to address the mismatch between the availability and requirements of the off-takers to meet the renewable purchase obligation (RPO)

Generation Based Incentives (GBI) – This incentive was introduced in 2018. The incentive is funded by the MNRE and pays rates over and above the approved tariffs. (IRENA, 2012)

ii. Government support

Tax

- 5% import duty on itemised wind turbine and solar power parts
- Exemption from the excise levy for domestic solar and wind energy equipment
- 100% tax waiver on profits for any single 10-year period during the first 15 years in the life of the project (CPI, 2014b)
- The Government allows renewable (including wind and solar) projects to depreciate 80% in the first year (CPI, 2014b)

4.4 South Africa

4.4.1 South Africa's electricity sector overview

The South African power sector is categorised by large coal powered stations. South Africa's has installed electricity capacity of about 45645 MW (EIA, 2015). The current installed capacity is mostly generated from coal (85%), 10% hydroelectric, 4% a nuclear, and 1% other (EIA, 2015).

The power sector is dominated by state owned power utility, Eskom, which generates 95% of the country's electricity (EIA, 2015).Eskom is responsible for generation, transmission and it distributes an estimated 60 % of electricity directly to customers. The balance of the distribution is undertaken by local authorities, who purchase power from Eskom and then on sell to customers. Mines and heavy industry account for more than 40% of Eskom's power sales (Eberhard et al., 2014).

Electricity planning is outlined in the Integrated Resource Plan (IRP), which is the power road map, based on the IRP, the minister of Energy determines how much new power is needed and from which sources. The regulation of the power sector is rests with the National Energy Regulator of South Africa (NERSA), who licences new capacity and approved tariffs.

During the apartheid period Eskom overestimated demand and made capital investments in plants that resulted in overcapacity. This was mainly due to the fact that the majority of the population did not have access to electricity only 36 per cent of South African households had access to electricity in 1994 (Eberhard et al., 2014) as the apartheid government did not consider black African townships as part of South Africa. The newly elected democratic government embarked on a mass electrification programme and by 2004, 72% of households were electrified. The government had stated its intention to achieve universal access by 2012, this has not happened for numerous reasons (Pegels, 2010).

Things quickly changed post the first democratic elections and by 2004 the reserve margins started falling and it became clear that an investment in power plants was required(Eberhard et al., 2014).

The required investment did not happen within the required time frames and this resulted in South Africa suffering power shortages in 2008, with the effect on the economy estimated at between USD 253 and 282 million (EIA, 2008). To combat the power challenge, the then Department of Minerals and Energy and now DoE and Eskom releases a policy document outlining several interventions to combat the power outages, one such intervention was the proposed capacity expansion plan that would add an additional 19,000MWof power to the grid(DoE, 2008).

The power sector in South Africa currently faces three main challenges (Pegels, 2010);

- First is the inadequacy of power supply, which has resulted in power outages in 2008 and 2015
- Second is the dominance of Eskom in the power sector, which implies that in order to increase capacity Eskom needs to build new plants, Eskom's balance sheet cannot sustain the power expansion required
- Thirdly is environmental damage caused by high emissions from the coal fired power plants

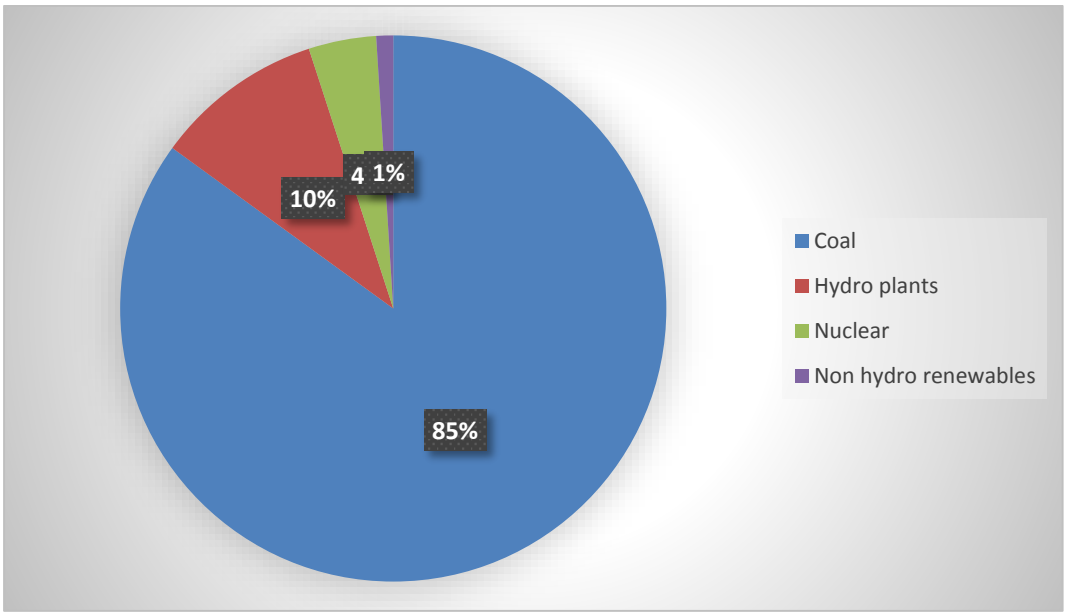


Figure 21 Installed power capacity by sources, 2014

Source EIA, 2015

4.4.2 South Africa's renewable power sector overview

The South African Department of Minerals and Energy (DME) in 2003 (now called DoE), published a White Paper on renewable energy. This document outlines the countries policies, goals and strategies in promoting RE (DoE, 2003). The DoE set out a RE target of 10,000 GWh of RE power by 2013, although these targets were not met by the agreed time frame (DoE, 2003).

Although South Africa is not obliged to reduce greenhouse emissions under the Kyoto protocol, the country volunteered at the Copenhagen conference of parties (COP) to reduce emissions 34% below a business as usual scenario by 2020. In 2011 at the COP 17 in Durban this commitment was reiterated and further public and private sector stakeholders agreed to "12 commitments" and committed to creating 300 000 jobs in the green economy by 2020 (Eberhard et al., 2014).Post the commitment in Copenhagen South Africa designed a RE deployment strategy to reduce its emissions. The initial strategy was designed around a renewable energy feed-in tariffs (REFITs) which was approved in 2009 by NERSA.

The implementation of the foresaid strategy proved challenging with issues around the uncertainty around the procurement and licensing process as well as the legally of the system in South public procurement framework. The initial tariffs set were thought to be generous and in 2011, NERSA threw a spanner in the works when they released a paper proposing lower feed-in tariffs. The lower tariffs were based on adjusted input parameters that now reflected a change in the cost of debt and the exchange rate (Eberhard et al., 2014).The proposed new tariffs were 25 % lower for wind, 13 % lower for concentrated solar, and 41 % lower for photovoltaic.

Table 5 REFIT and REIPP prices

	REFIT (ZAR / kWh)		REIPPPP (ZAR/kWh)		REIPPPP (US c/kWh)
Technology	2009 Tariff	2011 Tariff	Bid Cap	Round 1	Round 1
Wind	1.25	0.94	1.15	1.14	14.3
Photovoltaic	3.94	2.31	2.85	2.76	34.5
Concentrated solar trough with storage	3.14	1.84	2.85	2.69	33.6

Source Eberhard et al., 2014

Post the release of the consultation paper, the Department of Energy and National Treasury commissioned a legal opinion whose findings concluded that the FIT was resulted in uncompetitive procurement and not legal. The government then reconsidered the REFIT system, the end results was REIPPP and the termination of the REFIT. The main difference would be that in the terminated REFIT prices were fixed and tariffs were set at higher than market tariffs in order to incentivise project developers.

The newly formed REIPPPP would be based on tender system that is based on competitive bidding. The project developers would be invited to bid for a RE contract below a certain cap. Bids were evaluated based on price below a certain cap (70%), creation of jobs, BEE participation, Local content of the project, development of rural areas, ownership by the community and skills development (30%) (Baker, 2015). Under REIPPPP projects that are successful would sell electrical power to Eskom's grid under a 20 year, rand denominated, government-backed PPA (Eberhard et al., 2014).

The new REIPPP was led by the DoE, together with the assistance of national treasury's Public-Private Partnership unit. The new REIPPP has been successful in channelling expertise from the private sector into grid connected RE projects at competitive prices. By June 2015 92 projects had been approved with the potential to add 6327 MW of power to the grid and 37 projects totalling 1827 MW had been connected to the grid (Baker, 2015). The REIPPP has resulted in competitive pricing as evidenced by the 68% drop in PV solar tariffs and the 42% drop in wind tariff over the three bidding rounds (Eberhard et al., 2014).

4.4.3 Financing Model

What the main barriers to financing RE projects?

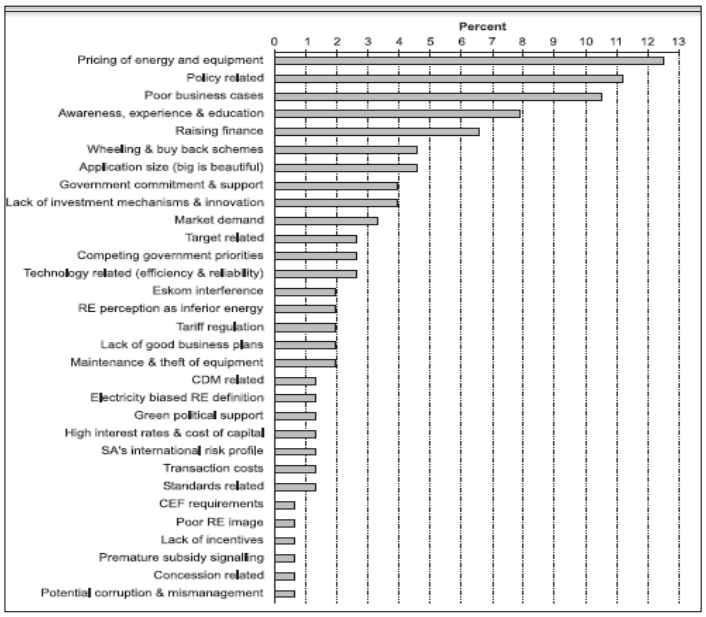


Figure 22 Barriers to finance

According to an survey conducted by (Foster-Pedley & Hertzog, 2006) Poor business cases and pricing were mentioned as the biggest risk to investments in RE projects. Other issues mentioned include poor policy development, lack of project awareness, ,lack of experience and skills related to RE projects, lack of finance, lack of innovation in financing scheme, market demand and tariff regulation

Source:(Foster-Pedley & Hertzog, 2006)

Where will finance for RE projects come from?

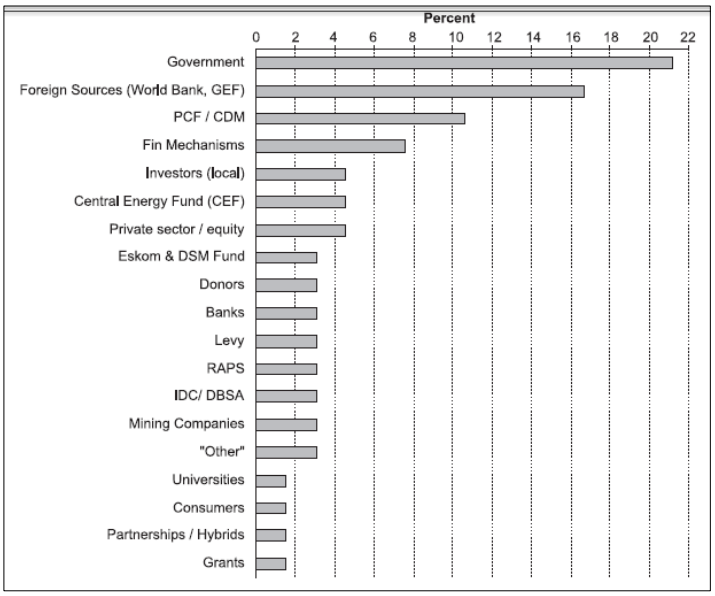


Figure 23 Sources of finance

Whilst the same survey found that most of the respondent's expected the government to be the main source of finance for RE projects. Followed by MDB and CDM revenue

Source:(Foster-Pedley & Hertzog, 2006)

4.4.4 Project finance in South Africa's REIPPP

The financing model in South Africa is a decentralised model where project finance is used extensively by local banks. 56 out of the 64 projects in round 1,2 and 3 were funded through project finance (Eberhard et al., 2014).The big local commercial banks being Absa, Nedbank, Standard bank, RMB, and Investec have dominated lending to the RE projects. Followed closely by the local DFI's being Industrial development Corporation (IDC) and Development Bank of South Africa (DBSA).The role of these DFIs has been mostly Black Economic Empowerment (BEE) financing. In addition institutional investors have also played a role with the participation of local insurance and pension funds on the equity side.

Project finance is widely used worldwide to finance power projects due to the limited/non-recourse nature of this financing structure. The increased use of project finance in energy has been driven by the global trends in the state owned utility unbundling and privatisation of such utilities(Baker, 2015). In project finance, the lender provides debt to a specific project, and the amount of debt made available depends on the specific project revenue. These revenues are often the only source of repayments for the debt and in case of default the senior bank is repaid first from the project company.

In project finance Special Purpose Vehicle (SPV) is created and it is this entity applies for a loan to finance the project. The financing provided is off balance sheet and is on the books of the SPV. In addition banks take as security the financed assets, the cede contracts such as the PPA and the construction contract. They also put restrictive covenants relating to the structure of the shareholders and any subsequent dividends to be paid to these shareholders (UNCTAD, 2005). Another key component of the project finance structure is the Engineering, Procurement and Construction (EPC) contract which is a turnkey contract, under which a contractor, ensures that the plant is built on time. The SPV enters into a long term PPA with an off taker usually a public sector utility, which makes a commitment to purchase a fixed minimum amount of power for a period between 20- 25 years.

One of the disadvantages of project finance is that it attracts high transactional costs as the due diligence required is often time consuming and very detailed. The transaction costs are usually fixed, thus making smaller projects unattractive vs bigger projects as they both have the same transaction costs. The REIPPP programme financial, technical and legal reports before the bid(WWF SA, 2014).Going over these documents is often a time consuming and often projects are nearly bid-ready well before the actual bid submission

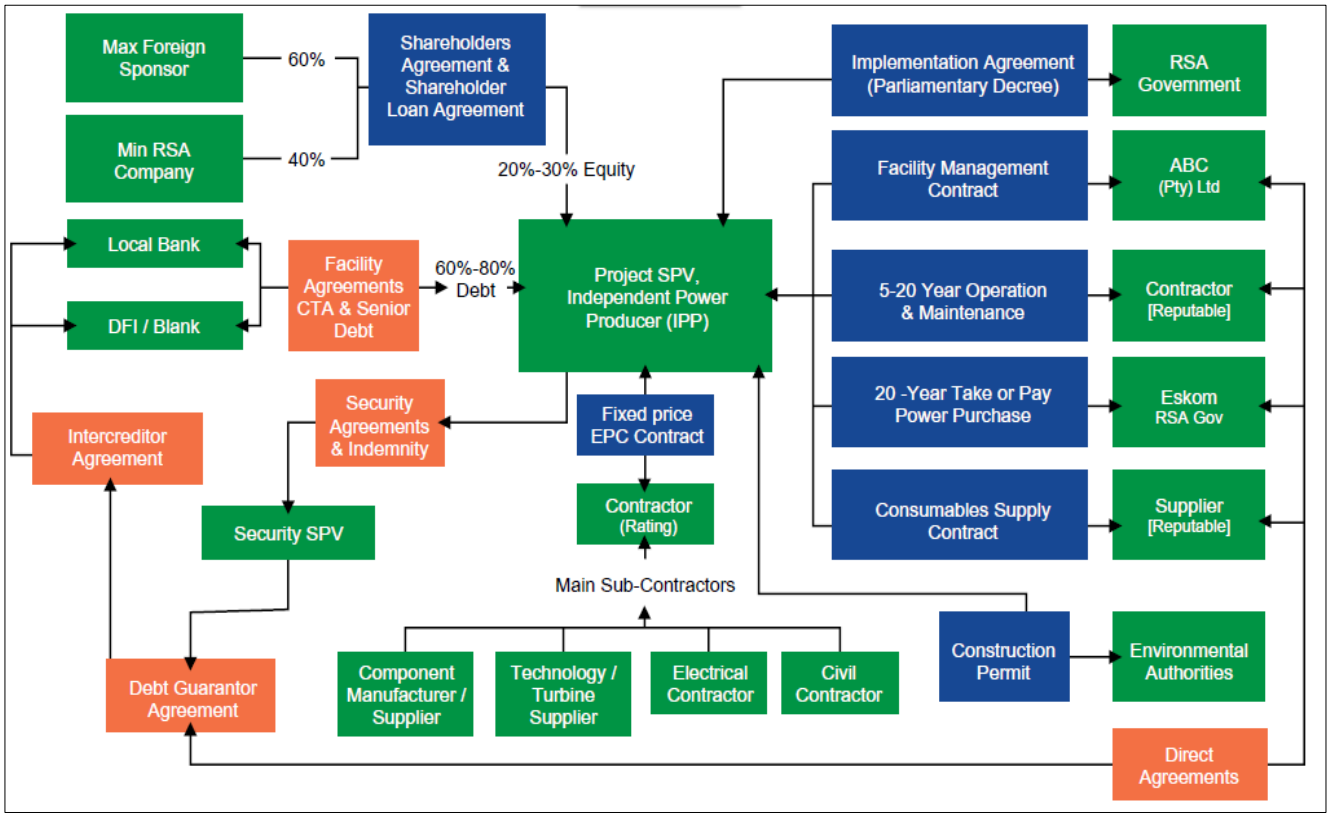


Figure 24 Project finance model in REIPP

Source WWF SA, 2014

4.4.4.1 The project sponsors

Project sponsors, developers and equity holders include institutional investors, local banks, specialist funds and development banks as well as international power utility companies. Majority equity stakes are held by foreign utilities as well as EPC contractors. The IRR achieved in round one and two are assumed to have been in the “late teens to mid-twenties” which is much higher than comparable projects in the developed world. The returns have since dropped in line with the reduction in tariff.

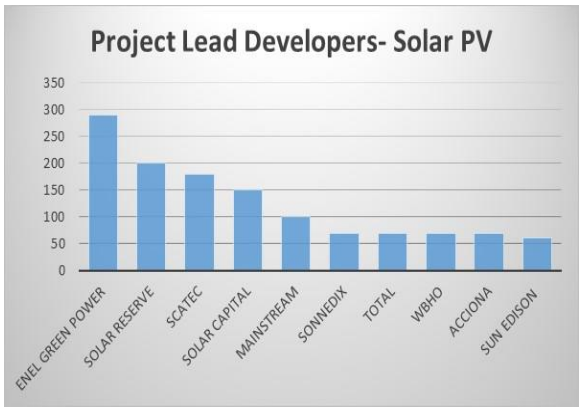


Figure 26 Approved capacity- Solar



Figure 25 Approved capacity - Wind

Source: Eberhard et al., 2014

4.4.4.2 Debt

The local commercial banks were majority funders in round one and two of the REIPPP (Eberhard et al., 2014). Followed closely by DFI's and insurance companies. For large projects bank syndication is usually used to get around the funding limitations of each individual bank. Round three was a bit different in that corporate financing emerged as the favoured financing tool and the local banks role as debt provider was reduced. International banks have not shown much interest in providing debt often citing currency volatility as a major barrier.

The debt provided was locally denominated debt, thus pricing was referenced to the Johannesburg Interbank Average Rate (JIBAR). Debt provided to the projects range in tenures from 15 to 17 years with spreads between 310 to 400 over JIBAR (Eberhard et al., 2014).The debt providers typically fund projects that range from R500 -1500 million, the commercial banks are unlikely to fund anything smaller that R500 million given the cost and time associated with funding due diligence (WWF SA, 2014).

A majority of the projects were club funded, where a number of commercial banks provide the funding together. This is partly done to mitigate single party exposure risk and to spread the due diligence work load.in addition another key feature of the REIPPP financing is the hedging of interest rate and currency exchange risk. Lenders require the projects to be adequately hedged against any financial risks. Most commercial banks provide debt on a floating rate basis which exposes the project to adverse interest rate movements. Thus most sponsors involved in the REIPPP entered into swaps where they exchanged floating rate debt for fixed rate debt.

Given the increasingly stringent capital and liquidity requirements of Basel III, most of the commercial banks are looking to reduce their long tenor loans by selling down to institutional investors (WWF SA, 2014).this selling down or syndication has been successful in the REIPPP market, mainly as a result of the appetite from institutional investors for RE projects.

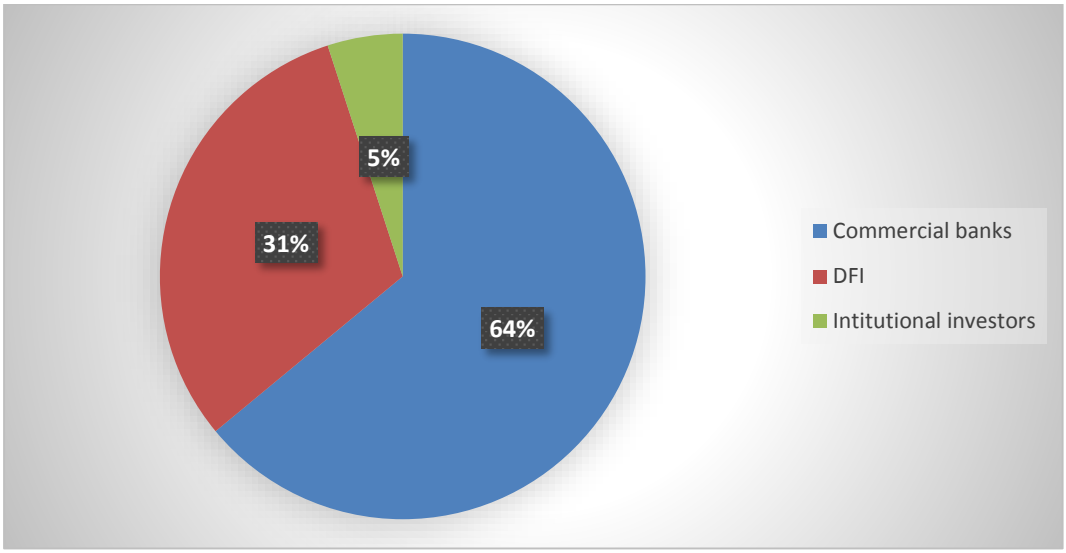


Figure 27 Split of debt providers

Source Eberhard et al., 2014

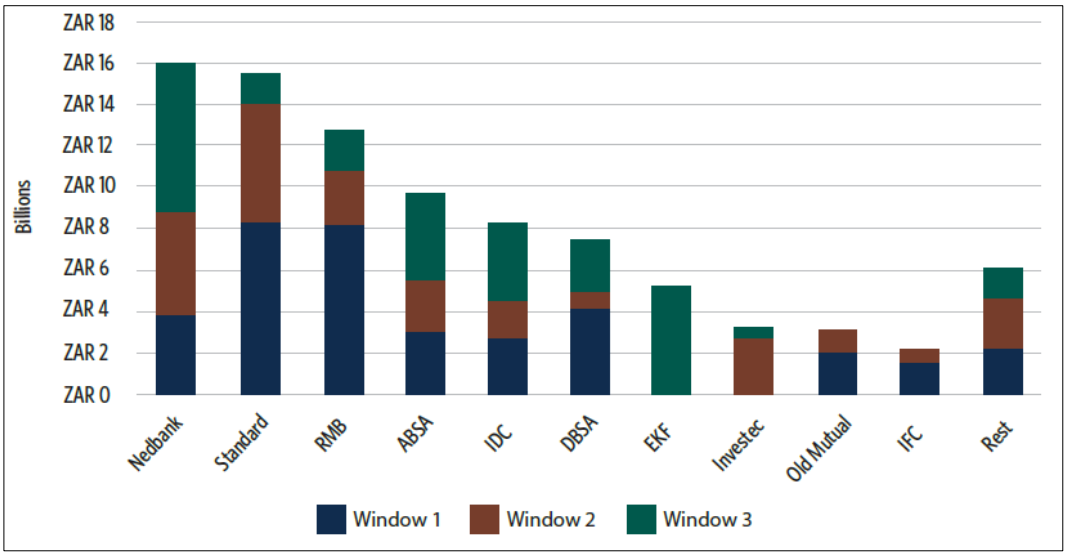


Figure 28 Debt providers in Round 1, 2 & 3

Source Eberhard et al., 2014

4.4.4.3 BEE, community ownership and economic development

An important differentiator of the REIPPPP is that it was designed to ensure sustainable benefits for the country, given that a majority of the population was excluded from participating in economic building under the apartheid system The

programme has several mechanisms aimed at achieving community development and socio economic benefits these mechanisms include;

- The REIPPP programme called for a minimum of 40% local entity participation, meaning that at least 40% of the project was to be owned by South Africans with Level 5 contributor status (DoE, 2015). Local equity shareholding across the four bids stand R30 billion which is 47% of all the equity provided to all the projects (DoE, 2015)
- BEE ownership of the project company of 12% with a target of 20%. IDC and DBSA have provided the majority of financing for BEE
- In addition the programme required the local community to have 2.5% shareholding in the project (mostly structured through community trusts). Foreign developers have struggled with the BEE and local community requirements and thus have partnered with a local company when submitting bids.

4.5 Challenges with the current financing model in South Africa

There are a number of challenges that finance providers financing projects face in South Africa. The challenges cited by the report by the WWF-SA are outlined below (WWF SA, 2014);

Possible delays in adding additional megawatt to the grid – DoE sets a date for financial close for each projects, however due to the funding model employed where commercial banks dominate the financing. Most of the developers need to fix their floating rate debt on a certain date, this has the undesired consequence that all the projects attempt to enter into hedging contracts on the same day and this can have an effect on the FX and swap markets.

Foreign exchange volatility – Given that most of the equipment for RE projects is imported the vitality of the exchange rate can often be detrimental to a project as it can cause project costs to escalate unexpectedly. This is mitigated by incorporating into the bid a tariff price adjustment that is the sole responsibility of the government at DoE signing. However, any movements from DoE signing until financial close are borne by the project.

Interest rate volatility – Developers typically wait anything from a couple of months to a full year between submitting their bids and reaching DoE financial close. During this time an adverse move in interest rates could prove to be detrimental to the project. South Africa's reserve bank operates an inflation targeting policy and thus inflation and interest rates are linked.

Dominance of commercial with a funding mismatch as debt providers – the dominance of the commercial banks in RE financing can be attributed to the fact that South Africa has a well-established, sophisticated banking sector that has shown an interest in financing RE projects. However funding by commercial banks presents an asset liability mismatch as these banks take in short term deposits and therefore need to match their loans with the deposits received. The Basel III requirements could further increase the costs associated with non-recourse project finance .Under Basel III RE projects are not considered a liquid assets, thus the loans provided to such projects will have a negative impact on the banks liquidity ratios. Diversified sources of funds are required to reduce financing costs and ultimately to bring down the electricity tariff

Further the RE sector is relatively new in South Africa but it is positioned to grow, Financing bigger transaction could become an issue as the banks might not have the capacity to fund the growth in the sector.

The high costs associated with BEE financing – Debt for most BEE transactions is serviced by the dividends from the project's equity cash flows**.** with REIPPP , BEE financiers have set inflexible terms that include, vesting periods, trickle dividends and IRR of >18% is required for the instrument to vest. Such terms may lead to an increase in the tariff bid in order to meet the high returns required by BEE shareholders.

4.6 Comparative analysis

This section starts by comparing the financing models in Brazil, China, India and South Africa, a qualitative approach is used that looks at the key features of the financing model used in each country. Thereafter the advantages and disadvantages of each model is presented.

Brazil, China and India face similar challenges in financing RE and although these economies have seen rapid growth in the RE sector as a whole, these advances have not been without their fair share of challenges. Brazil has seen significant growth in the non-hydro RE technologies since 1990. Brazil's share of Renewables excluding Hydro is the smallest followed by India and then China. China′s growth is quite recent but it is the most outstanding, with the country having started investment and deployment of wind technologies in 2008, resulting in China beating USA for the top spot for country with the highest investments in RE. These countries have taken different approaches for growing their RE sector as outlined below.

The table below outlines some of the major differences between the financial models used to fund RE projects in Brazil, China, India and South Africa. The size of the installed power capacity in China is much larger than the other countries, this is due to the larger size of the Chinese economy .However the Brazilian economy is the biggest participant in RE as shown by the share of installed power generated by renewable sources. Both the Brazilian and Chinese financing models can be considered as centralised government led models whilst the India and South African model are decentralised models where commercial banks and private financiers play a leading role in RE project development.

The model employed by both Brazil's BNDES and China's CDB together with the state owned entities reduces credit risks for project developers and reduces transaction costs as it benefits from economies of scale. In addition both models use concessional debt at rates below market rates to incentivise growth in the sector. This is achieved because both development institutions are able to raise money more cheaply than other banks could. The government led model is also able to facilitate government policies and strategies, this is evidenced by Brazil's ability to push its industrial policy

through the local content requirements that must be fulfilled by potential borrowers who wish to borrow from BNDES. This has helped Brazil develop a manufacturing base for wind components, as well as attract international manufacturers to set up plants in Brazil.

The decentralised bank led model used in India and South Africa has some similarities but is not exactly comparable. For one the banks involved in funding in India consists of state owned banks as well as commercial banks whilst in South Africa the dominating banks are private commercial banks and secondly the South African model uses mostly project finance to provide debt whilst the Indian model is mainly based on corporate finance . The models are similar in that financing is often done via a club of banks as opposed to one bank funding the whole transaction. Both countries are plagued by high interest rates, which increases the cost of debt for RE projects.

In India, the rapid growth of the RE sector coupled with the reliance of banks for long term debt has resulted in an asset liability mismatch. To prevent the asset liability mismatch gap from widening, Indian authorities have imposed prudential limits that are fixed and dependent on the performance and risks of the sector in question. Most banks in India are nearing their prudential cap limit for infrastructure lending (Umamaheswaran & Seth, 2015), meaning that these banks would have limited capital to commit to RE infrastructure projects. The participation of a number of financiers has the ability to introduce innovative financing models. In addition this model with a diversified lending group is less likely to have any political interference.

The table below shows the macro economic data of the countries analysed. Financing of RE projects in Brazil, China and to a lesser extent India is dominated by government led institutions, this is in sharp contrast to South Africa where private commercial banks dominate. Each model is suited for different stage of development of RE technologies.

The countries analysed for comparison purposes are very different as shown in the microeconomic data shown below. However all the countries below were chosen as they are all part of the BRICS which consists of five large developing countries? Further the high interest rate environment in India and South Africa is comparable. It is believed that these emerging economies will have the largest growing demographic and economic potential and thus energy and more specifically RE will play a major role in these countries' growth going forward.

Table 6 Macroeconomic data

Factors	**Brazil**	**China**	**India**	**South Africa**
Age of the RE sector	Mature Hydro New Wind & solar	Mature RE market	Mature RE market	Relatively new industry <8 years old
Population (in million)	206	1 364	1 295	54
GDP(in $bn)	2 346	10 355	2 049	350
Inflation (in %)	7	1	3	6
Lending rate (in %)	32.01	5.6	10.25	9.125
Size of Investment in 2014 (excludes large hydro)	$7.6bn	$83.3bn	$7.4bn	$6.9bn

Source World bank data

Table 7 Comparison Table

Factors	Brazil	China	India	South Africa
Total electrical capacity	134 GW	1,260 GW	249 GW	45.7 GW
Capacity generated by RE	108.5 GW including hydro 19.3GW excluding hydro	433 GW including hydro, 153 GW excluding hydro	76 GW including hydro, 31 GW excluding hydro	5 GW including hydro, 0.45 GW excluding hydro
RE targets	42,5%of primary energy by 2023 Wind energy: 11.5 GW by 2020. And small hydro: 6.4 GW in 2020.	Installed capacity of RE to reach 600 GW by 2020, from 250 GW	Add 29.8 GW of renewable energy installed capacity	3.7 GW by 2016, 3.2GW by 2020 and 6.3MW by 2025 excluding hydro
Financing Model	Centralised model led by the national development bank	Centralised corporate financing on the balance sheet of state owned utilities	De centralised corporate finance model through commercial banks	De centralised project finance model through commercial banks
Financing channels	Mainly through the development bank ,BNDES	Commercial banks and the development bank CDB	Commercial banks , institutional investors and DFI's such as IRENA	Mainly though commercial banks, DFI's and Institutional investors
Challenges posed by financing model	This model could result in crowding out of private investors. The reliance on the development bank might lead to lack of innovation in financial models and instruments. This model is also susceptible to political interference	The use of single financing channel, with most wind projects relying heavily on debt and not having enough equity, as equity financing is low	The involvement of many lenders can increase lending costs and can also lead to limited financing as debt financing relies on the strength of the bank's balance sheets.	The dominance of commercial banks in the provision of debt limits the growth of the industry and will be adversely affected in terms of the banks' ability to lend to projects by Basel III regulations

Chapter 5

Proposed financing model for South Africa

5.1 Overview

As already outlined the key challenges posed by the current financial model in South Africa are;

Foreign exchange volatility – Given that most of the equipment for RE projects is imported the vitality of the exchange rate can often be detrimental to a project as it can cause project costs to escalate unexpectedly.

Interest rate volatility – lags between submitting their bids and reaching DoE financial close expose the project to interest rate risk.

High transaction cost – due to the fact that there are often multiple lenders and the Due diligence process is quite rigorous given the limited knowledge and experience in dealing with RE projects.

Dominance of commercial with a funding mismatch as debt providers – Funding by commercial banks presents an asset liability mismatch as these banks take in short term deposits and therefore need to match their loans with the deposits received. The Basel III requirements could further increase the costs associated with non-recourse project finance which is the dominant financial instrument.

Thus the financing model proposed should look to find solutions to the problems outlined above. The model should have the following key features, it should;

- Diversify the source of finance away from commercial banks
- Increase the tenor of funding to match the projects tenor
- Offer debt on a fixed interest basis
- Stimulate renewable electricity generation from renewable sources
- Lower associated financing costs
- Deliver electric power at the lowest possible cost

The analysis done thus far in comparing the financing models used in the other BRICS countries revealed the following;

- Both Brazil and China's financing model is a centralised government led model which might not necessarily work in the South African context.

- The India decentralised model is similar to the South African model, with the exception that corporate finance is widely used in India and Project Finance in South Africa.
- Thus there are lessons to be learnt from each country, however no single country financing model was found to be more suitable for South Africa. The model derived below incorporates lessons from the emerging countries analysed above and best practices from other developing nations.

At the end the proposed solutions are assessed on their practical implementation feasibility which looks at if the model is used elsewhere (precedents), the availability of financial intermediaries to facilitate the model, the state and sophistication of the financial capital markets and any relevant regulations

5.2 Government issued bond/ concessionary funding

Lessons from Brazil and China - both CDB and BNDES raises money at low interest rates and on lends this money at concessionary rate to various high priority industries

The government in most countries has the highest credit rating in the country and therefore can issue a bind and raise money at an interest rate much lower than any other entity. The government can issue a domestic bond and then on-lend the proceeds at concessional rates to renewable power projects. In this way the government can pass on the low interest rate that it is able to get on its borrowings to projects and also provide a fixed interest rate.

5.2.1 Implementation assessments

1. Has the model been used elsewhere?

The South African government has not issued local currency infrastructure bonds but instead bonds have been issued by state owned companies on the back of a government guarantee. An example would be the R5 billion unlisted private placement green bond that the IDC placed with the Public Investment Corporation (PIC) to fund green businesses.

2. Financing channels available

The bond market in South Africa is developed bond and there is sufficient available capital outside of the banking system from institutional investors.

5.2.2 Advantages of the model

The model can work concurrently with the current project finance model where the banks provide bridge finance and thus their liquidity ratios are not affected under Basel III, and then be extended with the bond issuance

This solution diversifies the source of funding from commercial banks and offers long term debt on a fixed interest rate basis.

5.2.3 Disadvantages of the model

The proposed model has the disadvantage in that the availability of low cost debt from the government tends to crowd out investors as is the case in Brazil. Additionally South Africa's rating currently sits one notch above junk status, as the country struggles to reduce its debt, it is unlikely that the government would take this approach

5.3 Project bonds

Lessons from Brazil - Brazil recently made an announcement that they will be utilising the World Bank's project bond model to finance infrastructure

A project bond is essentially an addition to the project finance structure outlined above, where an additional SPV is created to issue bonds and on-lend the proceeds to the project SPV or the project vehicle. The vehicle that issues the bonds would typically have a long term off-take contract that ends when the debts is fully paid off. The issue would need to be rated and listed. The proposed model in the South African context is a blended model where the bond is used together with other sources of debt. These bonds are applicable to large projects where long term fixed rate debt is required.

Project bonds present an alternative means to access debt funding for RE projects. The importance of this alternative source of financing is even more relevant in South Africa where traditional bank finance has been the dominant source of financing. With the enactment of the Basel III requirements, banks will be required to adhere to more stringent regulations which ultimately will lead to higher capital requirements, higher liquidity rations and higher costs. The increased cost associated with financing will adversely impact on the project developer's return. The use of project bonds gives project developers access to over R3 trillion worth of assets under management by South African institutional investors and additionally will reduce the project funding costs and increase the returns to project developers.

5.3.1 Implementation assessments

1. Has the model been used elsewhere?

Project bonds have been well employed in some parts of America and Europe. Brazil recently made an announcement that they will be utilising the world bank's project bond model to finance infrastructure projects (World Bank, 2015). In 2013, CPV Power Plant No.1 Bond SPV (RF) successfully listed an investment grade rated infrastructure project bond. The proceeds were utilised in financing the construction of a 44 MW Concentrated Photo Voltaic Plant (Deloitte, undated)

2. Financing channels available

The bond market in South Africa is developed bond and there is sufficient available capital outside of the banking system from institutional investors. Further the market was able to handle the CPV issuance. The successful issuance of the CPV bond is testaments to the "sophistication of the South African bond market especially given technology is still untested on a utility-scale (Deloitte, undated)"

5.3.2 Advantages of the model

The model has the potential to reduce financing costs and it provides longer tenors which has the potential to increase returns for the developers

5.3.3 Disadvantages of the model

The model usually excludes construction risk as most investors are risk averse

The structure of REIPPP and time period makes this option challenging as the DoE requires as a pre-qualifying criteria that finance be committed upfront through letters of support for the full term of the project

5.4 A blend Project bonds and Project Finance

The proposed model in the South African context is a blended model where the bond is used together with other sources of debt. These bonds are applicable to large projects where long term fixed rate debt is required. This would reduce the reliance on bank financing.

5.4.1 Implementation assessments

1. Has the model been used elsewhere?

In Some projects in South Africa such as the CPV Power Plant have utilised both project bonds and traditional debt finance with much success.

2. Financing channels available

The bond market in South Africa is developed bond and there is sufficient available capital outside of the banking system from institutional investors. Some institutional investors are already very active in the RE financing space.

5.4.2 Advantages of the model

The model has the potential to reduce financing costs and it provides longer tenors which has the potential to increase returns for the developers

5.4.3 Disadvantages of the model

This blended model would meet the requirements by the DoE and provide a solution to the challenges currently faced in financing RE projects

5.5 Other Models

The models discussed below are used in developed economies as their capital markets are more liquid and the investor base is more sophisticated, these models are not considered appropriate for South Africa but are mentioned here for information purposes.

- Yield cos
- Crowd funding

5.6 Evaluation Matrix (subjective based on findings)

Relative appropriateness to SA

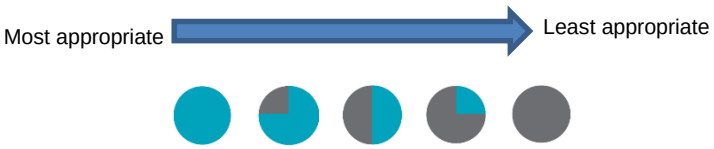


Table 8 Financing model assessment matrix

Financing Model	Diversify funding from project finance financing led by commercial banks	Lower associated financing costs	Increase installed renewable power capacity renewable sources	Practical implementation /feasibility
Comparative analysis of current financing model				
Brazil/ china government led model				
India bank led model				
South Africa current Financing model				
Proposed model For South Africa				
Project finance				
Corporate finance				
Government issued bond/ concessionary funding				
Blend of project finance and corporate bonds				

Chapter 6

6.1 Conclusions and Recommendations

This paper looked at financial models used to finance RE projects in Brazil, China, India and South Africa, and the key take away from our analysis of each financing model is as follows;

The model employed by both Brazil's BNDES and China's CDB reduces credit risks for project developers and reduces transaction costs as it benefits from economies of scale in addition both models use concessional debt at rates below market rates to incentivise growth in the sector. The government led model is also able to facilitate government policies and strategies. However the model has the undesired consequence that it result in crowding out of private investors as they are unable to match the low cost of debt provided by DFIs. Further ultimately leads to lack of innovation and is more susceptible to political interference.

Whilst the model used in India is more decentralised this model is more efficient and promotes innovation however, the dominance of banks as the main source of funding means there is an asset liability mismatch which will ultimately lead to limited funding from these institutions. The South African model faces challenges in terms of interest rate and exchange rate volatility as well as the dominance of private commercial banks in the provision of funding.

This paper therefore recommends that South Africa's model be altered to incorporate project bonds. The use of these bonds in conjunction with the current project finance model will ensure that banks are able to lend to projects in short term basis thus managing their liquidity ratios and their asset liability management. Some institutional investors have shown an interest in funding projects at the construction stage and the inclusion of project bonds would ensure that more of these investors play a role in financing projects.

6.2 Suggestions for further research

The research analysed financing models used in Brazil, China, India and South Africa. The models used in Brazil, India and China were found to be incomparable to South Africa although some similarities exist. It was further recommended that a blend of project bonds and project finance be used to fund RE projects. Further research, therefore, could be to find out how a blended approach would likely affect the cost of financing as well as the impact on the requirements from the DoE. The use of non-conventional financing models in the form of crowd funding and yield co's is growing and thus research could also be done on these financing model's suitability for South Africa RE projects.

References

Abdmouleh, Z., Rashid A.M Alammari, & Gastli, A. (2015). Review of policies encouraging renewable energy integration & best practices,. *Renewable and Sustainable Energy Reviews, 45*(2015), 249-262.

Abolhosseini, S., & Heshmati, A. (2014). The mainsupportmechanismsto finance renewable energy development. *Renewable and Sustainable Energy Review, 40*(2014), 876–885.

African Development Bank, AFDB, **.** (2010). *Committee of Ten Policy Brief: Financing of Sustainable Energy Solutions.* Paper presented at the Committee of Ten Policy Brief. 3.

Attigah, B., & Mayer-Tasch, L. (2013). The Impact of Electricity Access on Economic Development – A Literature Review. In: Mayer-Tasch, L. and Mukherjee, M. and Reiche, K. (eds.), . *Measuring Impacts of Electrification on Micro-Enterprises in Sub-Saharan Africa*. Retrieved from http://www.produse.org/imglib/downloads/PRODUSE_study/PRODUSE%20Study_Literature%20Review.pdf on 20/06/2015

Ayogu, M. (2007). Infrastructure and Economic Development in Africa. *Journal of African Economies,, 16*(1), 75–126.

Baker, L. (2015). The evolving role of finance in South Africa's renewable energy sector. *Geoforum, 64*(2015), 146–156.

Bayar, Y., & Özel, H. A. (2014). Electricity Consumption and Economic Growth in Emerging Economies. *Journal of Knowledge Management, Economics and Information Technology, IV*(2).

Bhattacharyya, C. S. (2013). Financing energy access and off-grid electrification :A review of status, options and challenges. *Journal of Knowledge Management, Renewable and Sustainable Energy Reviews, 20*, 462–472.

Bloomberg New Energy Finance BNEF, . (2015). Global Trends in Renewable Energy Investment 2015. In Bloomberg (Ed.). Frankfurt: Frankfurt School of Finance & Management GmbH

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, 40*(2014), 259–276.

Brunnschweiler, C. N. (2009). *Finance for Renewable Energy: An Empirical Analysis of Developing and Transition Economies*. Economics Working Paper Series. CER-ETH – Center of Economic Research. Zurich,Switzerland.

Castellano, A., Kendall, A., Nikomarov, M., & Swemmer, T. (2015). Brighter Africa : The growth potential of the sub-Saharan electricity sector. Retrieved 25/05/2015, from McKinsey & Company www.mckinsey.com/.../mckinsey/.../powering%20africa/brighter_africa_..

Clean energy Pipeline, C. E. (2014). Clean Energy Africa Finance Guide. Retrieved from www.cleanenergypipeline.com on 16/11/2015

Climate Policy Initiative CPI. (2014a). Finance Mechanisms for Lowering the Cost of Renewable Energy in Rapidly Developing Countries, San Francisco.

Climate Policy Initiative, CPI. (2014b). Solving India's Renewable Energy Financing Challenge: Instruments to Provide Low-cost, Long-term Debt. San Francisco.

Deichmann, U., Meisner, C., Murray, S., & Wheeler, D. (2010). The Economics of Renewable Energy Expansion in Rural Sub-Saharan Africa (D. R. Group & E. a. E. Team, Trans.) *Policy Research Working Paper,* World bank. Washington DC

Deloitte (undated). Project Bonds : An alternative source of financing infrastructure projects. South Africa.

Department of Energy DoE. (2003). *White Paper on Renewable Energy*. Pretoria.South Africa

Department of Energy DoE. (2008). National Response To South Africa's Electricity Shortage. Pretoria.South Africa

Department of Energy DoE, (2015). State of Renewable Energy in South Africa. Pretoria.South Africa:

Eberhard, A., Foster, V., Briceño-Garmendia, C., Ouedraogo, F., Camos, D., & Shkaratan, M. (2008). Underpowered: the state of the power sector in sub-Saharan Africa *Background Paper 6, Africa Infrastructure Country Diagnostic.* World Bank.. Washington, DC

Eberhard, A., Kolker, J., & Leigland, J. (2014). South Africa's Renewable Energy IPP Procurement Program: Success Factors and Lessons. Public-Private Infrastructure Advisory Facility. Washington, DC

Energy Information Administration EIA. (2015). Retrieved 20/11/2015 https://www.eia.gov/beta/international/analysis.cfm?iso=BRA

Foster-Pedley, J., & Hertzog, H. (2006). Financing strategies for growth in the renewable energy industry in South Africa. *Journal of Energy in Southern Africa, 17*(4), 57-64.

Frontier Economics. (2007). In F. Economics (Ed.), *The Association Between Unexpected Changes in Electricity Volume and GDP Growth for Residential Customers* (May 2007 ed.). Melbourne

Griffith-Jones, S., Ocampo, J. A., & Spratt, S. (2012). Financing Renewable Energy in Developing Countries: Mechanisms and Responsibilities. Institute of European Report on Development.

Inter-American Development Bank, iadb, I. (2014). Study on the Development of the Renewable Energy Market in Latin America and the Caribbean.

International Energy Agency, IEA,. (2014). Africa Energy Outlook: A focus on Energy Prospects in Sub-Sharan Africa *OECD/IEA*. Paris

International Energy Agency,IEA. (2008). World energy outlook (executive summary). Retrieved 20/12/2015 /http://www.worldenergyoutlook.org/docs/weo2008/WEO2008_es_english.pdf

Independent Evaluation Group, IEG, (2008). The Welfare Impact of Rural Electrification: A reassessment of the costs and benefits. An IEG Impact Evaluation,. In W. Bank (Ed.). Washington D.C

International Renewable Energy Agency , . (2012). Financial Mechanisms and Investment Frameworks for Renewables in Developing Countries. Abu Dhabi.

International Renewable Energy Agency ,IRENA. (2014). Renewable Energy Prospects: China, RE map 2030 analysis. Abu Dhabi.

International Renewable Energy Agency, IRENA, (2015). Renewable Energy Policy Brief: Brazil.Abu Dhabi

Jalilvand, D. R. (2012). Renewable energy for the Middle East and North Africa policies for a successful transition.

KFW. (2005). *Financing renewable energy : Instruments, Strategies, Practice Approaches*. KFW. Frankfurt Germany.

Kooijman-van Dijk , A. L. (2008). The Power to Produce - The Role of Energy in Poverty Reduction Through Small Scale Enterprises in the Indian Himalayas.

Kraft, J., & Kraft, A. (1978). In the Relationship between Energy and GNP. *The Journal of Energy and Development, 3*(2), 401-403.

Martinot, E., Chaurey, A., Lew, D., Moreira, J. R., & Wamukonya, N. (2002). Renewable Energy Markets in Developing Countries. Washington D.C

Meadows, K., Riley, C., Rao, G., & Harris, P. (2003). Modern Energy: Impacts on Micro-Enterprises - A Literature Review into the Linkages Between Modern Energy and Micro-Enterprise.

Menanteau, P., Finon, D., & Lamy, M.-L. (2003). Prices versus quantities: choosing policies for promoting the development of renewable energy. *Energy Policy, 31*(2003), 799–812.

Ming, Z., Ximei, L., Yulong, L., & Lilin, P. (2014). Review of renewable energy investment and financing in China: Status, mode, issues and countermeasures. *Renewable and Sustainable Energy Reviews, 31*(2014), 23–37.

Odalaru, G. O., & Okonkwo, C. (2009). Does energy consumption contribute to economic perfomance? impirical evidence from Nigeria. *East-West Journal of Economics and business, Vol. XII*(No.2), 43-79.

Ohiare, S. m. (2014). *Financing rural energy projects in developing countries: a case study of nigeria.* (Doctor of Philosophy in Rural Energy Development), De Montfort University, Leicester, United Kingdom.

Pegels, A. (2010). Renewable energy in South Africa: Potentials, barriers and options for support. *Renewable and Sustainable Energy Reviews, 38*(2014), 945–4954.

REN21. (2015). Global Status Report. Paris.

Saatci, M., & Dumrul, Y. (2013). The Relationship Between Energy Consumption and Economic Growth: Evidence From A Structural Break Analysis For Turkey. *Journal of Energy Economics and Development, 3*(1), 20-29.

Shrimali, G., Nelson, D., Goel, S., CharithKonda, & Kumar, R. (2013). Renewable deployment in India : Financing costs and implications for policy. *Energy Policy, 62*(2013), 28–43.

Silva, R. C., Neto, I. d.-M., & Seifert, S. S. (2016). Electricity supply security and the future role of renewable energy sources in Brazil. *Renewable and Sustainable Energy Reviews, 59(1)*, 328–341.

The United Nations Environment Programme Finance Initiative (UNEP). (2012).

Drivers and barriers for private finance in sub-Saharan Africa Financing renewable energy in developing countries.

Umamaheswaran, S., & Seth, R. (2015). Financing large scale wind and solar projects—A review of emerging experiences in the Indian context. *Renewable and Sustainable Energy Review, 48*(2015), 166–177.

United Nations Conference on Trade and Development, UNCTAD.(2005). *Potential uses of structured finance techniques for renewable energy projects in developing countries*. Paper presented at the United Nations Conference on Trade and Development

United Nations Development Programme,UNDP.(2008). Financing Options for Renewable Energy: Country Experiences. Bangkok,Thailand

United Nations Economic and Social Commission for Asia and the Pacific, ESCAP.(2013). Comparative Study of Polices and Related Best Practices in the Asia-Pacific Region for Promoting the Adoption and Utilization of Renewable Energy Technologies.

Van-der-Nest, G. (2015). The economic consequences of load shedding in South Africa and the state of the electrical grid. Retrieved from http://www.tralac.org/discussions/article/7000-the-economic-consequences-of-load-shedding-in-south-africa-and-the-state-of-the-electrical-grid.html on 16/10/2015

Wagner, D. (2009). *can feed-in tariffs close the investment gap for renewable energy in developing countries.* (Master of science by advanced study in energy policy and sustainability), Exeter, Exeter University.

World Bank. (2012). Financing renewable energy options for developing financing instruments using public funds. Washington D.C.

World Bank. (2015). Brazil Launches New Project Bond Model to Finance Infrastructure with world bank support [Press release]. Retrieved from http://www.worldbank.org/en/news/press-release/2015/10/09/brazil-launches-new-project-bond-model-to-finance-infrastructure-with-world-bank-support on 22/10/2015

WWF SA. (2014). Enabling Renewable Energy in South Africa: Assessing the Renewable Energy Independent Power Producer Procurement Programme. In L. Cahill (Ed.). South Africa