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Meeting India's Renewable Energy Targets: The Financing Challenge

Climate Policy Initiative

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Executive summary

India's power sector has two overlapping, historic challenges — one that has grabbed international headlines and another that has largely flown below the radar. The widespread blackouts that brought much of India to a sputtering halt in 2012 were a dramatic signal of a power sector that requires attention. But a challenge no less central to India's future, and arguably much more so, is that of the country's goals for renewable energy.

The national government's ambitious goals for solar energy, coupled with the country's rapid progress in developing wind energy, raise many questions regarding the sources and costs of the investment that will be needed to install and operate this infrastructure.

Under the Jawaharlal Nehru National Solar Mission (JNNSM), grid-connected solar PV capacity increased by 165% in 2011 to reach 427 MW. However, the ambitious targets for 4,000-10,000MW by 2017 and 20,000 MW by 2022 may be hard to achieve under current policies and programs, and financing may be the biggest obstacle. Likewise, with 16 GW installed, India had already become the world's fifth largest market for wind by 2011, but ambitious plans for a further expansion to 31 GW by 2017 will face similarly daunting policy and financing problems.

In this report, Climate Policy Initiative (CPI) analyzes the challenges for designing national policy that will attract the investment needed to spur rapid growth in wind and solar energy at a reasonable cost. CPI has conducted detailed financial modeling of actual Indian renewable projects; numerous interviews with developers, financiers, and policy makers; and examined, in depth, the idiosyncrasies of Indian financial markets. This report describes and analyzes the impact of national and state policies on various classes of renewable energy investors, as well as the overall relative costs or benefits of policies on the final cost of renewable energy projects. We focus particularly on the cost and availability of equity and debt, respectively, and the consequent implications for Indian renewable and financial policy.

Table ES-1 summarizes the main financing issues facing renewable energy policy currently and evaluates how these issues might grow or diminish in importance in the medium to long term. To summarize its findings:

In the short term:

- The high cost of debt — that is, high interest rates — is the most pressing problem currently facing the financing of renewable energy. Our financial modeling of actual renewable energy projects in India and elsewhere indicates that the higher cost and inferior terms of debt in India may raise the cost of renewable energy by 24-32% compared to similar projects financed in the U.S. or Europe.
- Interviews with investors and developers suggest that neither the cost nor availability of equity is currently a major problem. In fact, our analysis suggests that when adjusted for differences due to the less attractive nature of debt in India, expected returns on equity (ROE) India may actually be lower than in the U.S. or Europe, despite potentially higher country risks.
- General Indian financial market conditions are the main cause of high interest rates for renewable energy. Growth, high inflation, competing investment needs, and country risks all contribute. A shallow bond market and regulatory restrictions on foreign capital flows also adds to the problem, while the cost of currency swaps and country risk negate the advantages that could come from access to lower cost foreign debt.

In the medium to long term:

- A declining availability of debt for renewable energy projects, whether high cost or not, may become an impediment. Interviews with lenders and analysis of debt markets indicate that many lenders may be reaching the limit for the amount of money they will lend to the sector. Their withdrawal from the market may restrict project development.
- Continued high borrowing by the Government of India and related regulatory restrictions are likely to keep interest rates high.
- Even if the cost of debt goes down, our analysis suggests that loan terms – including short tenors and variable interest rates – will become more significant impediments, especially in lower interest rate environments.
- Finally, attractive, low cost equity may be less available in the future. First, as debt becomes less available, current equity investors may not

be able to recycle their investment capital into new projects by borrowing against the operating projects. Second, as the market matures, many investors may no longer be willing to invest at relatively low returns in order to establish a strategic foothold, as they currently appear to be doing in solar photovoltaic (PV) projects.

Beyond Debt and Equity:

- Regulation and the structure of the Indian power sector also raise significant issues. State-level policies – including the financial weakness of the state electricity boards that buy much of the output from renewable generators – increase project risk. National policies designed to weave state policies together, particularly the recently established Renewable Energy Certificate (REC) market, do not adequately reflect the realities of financial markets or state-level risks.
- Our analysis shows that renewable energy policy lessons from the U.S. and Europe may not apply to India's financial realities. The economy and financial markets in which renewable energy policies operate partly determine the effectiveness of these policies. The significant differences between India and developed world financial markets, including the high cost of debt and what that means for the impact of policy, means that policy levers used to decrease financing costs in the U.S. and Europe have a less impact in India.
- Other developing countries have bridged the financing gap in unorthodox but successful ways. The Brazilian Development Bank (BNDES) is an especially promising example that deserves further study and consideration by Indian policymakers.

As a next step, CPI proposes to investigate potential policy solutions to bring lower cost, long-term debt into the Indian renewable energy market. Given that renewable energy will require some financial support in the medium term, until renewable energy costs reach a degree of parity with conventional sources of electricity, we will ask the question: Within a portfolio of policies, is it more effective to close the gap between renewable energy costs and alternatives through subsidies, tax benefits, or other support mechanisms, or through concessional debt, or a mix of two or more?

As part of this investigation, we will explore the mechanisms used to finance renewable energy in other rapidly developing economies including China and Brazil. The BNDES example should be particularly instructive.

Table ES-1: Current and future impact of major issues in Indian renewable energy finance

		Issue	Negative Impact of Issue: Now	Negative Impact of Issue: Medium to Long Term
EQUITY	COST AND TERMS	**Equity returns required by investors are reasonable** for good projects	NONE	LOW
		Required returns depend on technology maturity and developer strategy	NONE	MEDIUM
	AVAILABILITY	**Equity is generally available** for good renewable energy projects	NONE	MEDIUM
		Equity is available from foreign investors but facing a shortage of attractive projects	LOW	MEDIUM
		Equity availability is heavily skewed towards a few states with good policy regimes and attractive business environments	MEDIUM	MEDIUM
		Lack of debt may reduce available equity in the medium term as equity investors cannot recycle investments from current projects to future investments	LOW	HIGH
DEBT	COST AND TERMS	**High general Indian interest rate** environment raises renewable project debt cost	VERY HIGH	VERY HIGH
		Longer tenor debt is generally unavailable	MEDIUM	HIGH
		Fixed interest rate debt is rare; market relies on variable rate debt	LOW	HIGH
		Debt is not strictly non-recourse as it is usually offered on a relationship basis	MEDIUM	MEDIUM
		Shortage of debt may raise its cost in the longer term	LOW	MEDIUM
	AVAILABILITY	**Banks limit lending to any one sector** for risk purposes	LOW	HIGH
		Renewable energy debt is often classified within power or energy sectors, which are already nearing sector limits	MEDIUM	HIGH
		Some banks are not lending to renewable projects due to unfamiliarity with renewable energy policy and markets	MEDIUM	HIGH
		Limits on foreign debt may restrict foreign lending	LOW	HIGH
		Technology risk is limiting debt to some technologies	MEDIUM	MEDIUM
		State-level policy, the poor financial condition of the State Electricity Boards, and unfavorable local business environments restrict lending to some states	MEDIUM	HIGH

Contents

1. Introduction

As India wrestles with the historic challenge of providing enough electricity for its huge population and booming economy, the national government is pursuing another equally difficult and impressive goal — markedly expanding the share of renewable sources in its energy supply mix.

The government has embarked upon an ambitious plan, Jawaharlal Nehru National Solar Mission, to build 20,000 MW of solar power nationwide by 2020. At the same time, India is already the fifth-largest market for wind turbines, with cumulative installations of 16GW at the end of 2011.[1]

This flurry of activity demonstrates the seriousness of India's intentions. But the scale of these ambitions, and the financial resources required, raise many questions regarding the sources and costs of the needed investment, about the adequacy of the investment to reach these goals, and the efficacy of that investment in reaching the most suitable projects.

The question of whether India's financial system is adequately financing the renewable energy sector — and if not, why — is especially poignant in light of the differences between India's financing system and those of Europe and North America as well as developing nations such as China and Brazil.

Of course, the challenges of the renewable energy sector cannot be completely divorced from India's overall infrastructure financing challenges. According to the Planning Commission of India, infrastructure investment will need to increase from about 8% of GDP in 2011-12 to approximately 10% of GDP by 2016-17. The total investment in infrastructure is required to be over INR 45 lakh crore (USD 1 trillion) during the 12th Five Year Plan period (2012-17).[2] However, the Indian government estimates a 30%, or USD 300 billion, gap in the targeted infrastructure investments by 2017, largely due to the lack of long-term finance.[3]

Given the emerging nature of renewable energy technologies and business models, financial and regulatory sectors must adapt quickly — a task they have carried out somewhat unevenly. For this reason, the renewable energy sector's current challenges are especially acute.

In India, the role of development financial institutions (DFIs), a major source of long-term funding for energy infrastructure prior to the 1991 financial reforms, has markedly diminished in recent years. Because of the deregulation of financial markets, DFIs have been obliged to compete with commercial banks to raise funds at market rates. This undermined the business model of the DFIs; many were forced to convert themselves into commercial banks. This change, combined with the shallowness of the corporate bond market, has left a gap in funding for renewable energy.

In Brazil, by contrast, the Brazilian Development Bank (BNDES) plays a major role in almost every renewable project in the country, often by offering long-term loans at below market rates. BNDES's role in financing renewable energy has led to lower prices and, arguably, enhanced the performance of other policies such as wind energy auctions designed to create competition amongst potential wind park developers.

In this paper we analyze the impact of Indian policies on the attractiveness of renewable energy investments to various classes of investors, and we assess the overall relative costs or benefits of polices on the fully financed cost of renewable projects. We have used detailed financial modeling of actual Indian renewable projects as a key element of this analysis.

This study does not address the subject of off-grid renewable energy projects, which present different financing challenges and require different policy solutions than on-grid renewable energy projects. Nor does it discuss in depth the overlap between the financing of renewable energy and conventional power generation. CPI will address these topics in future research.

1 BP Statistical Review of World Energy, 2012

2 An Approach to the Twelfth Five Year Plan, Government of India, Planning Commission, October 2011

3 India estimates a USD 300 billion infrastructure funding gap, Infrastructure Investor, October 2010

2. Renewable energy industry trends

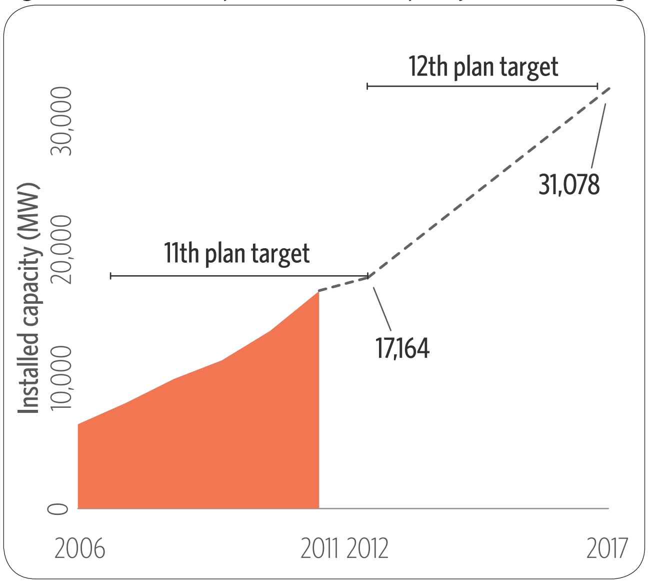
2.1 Renewable energy development in India

Historically, the growth of wind power in India was primarily driven by state-level incentives in conjunction with an accelerated depreciation benefit extended by the national Government of India beginning in 1995. Wind power installed capacity increased from 230 MW in 1994-95 to 16,078 MW by 2011, reaching approximately 94% of the 11th plan (2007-12) target.

In 2007-11, wind capacity installations increased at a compound annual growth rate of 19.7% as the Government of India introduced additional incentives such as the generation-based incentive (GBI) as well as accelerated depreciation. However, both the accelerated depreciation and the GBI, which comprised 10% of wind energy incentives,[4] expired in March 2012. Reaching India's ambitious target of total wind installed capacity of 31,078MW by 2017, will now depend upon new mechanisms, including the Renewable Energy Certificate (REC) market discussed in Section 7.

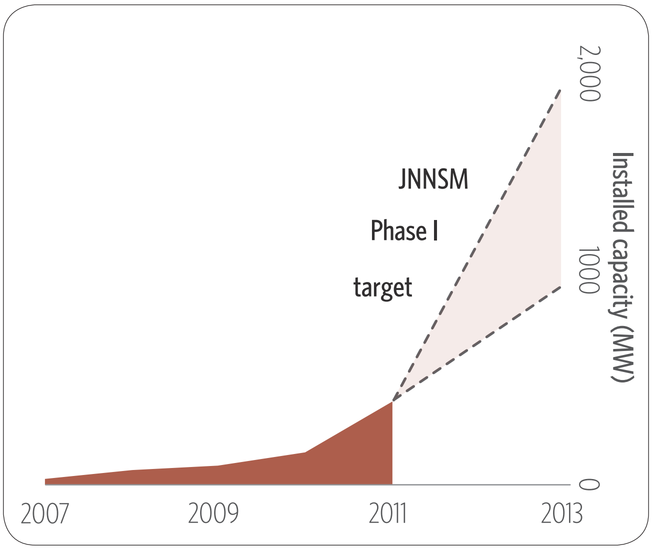
India's solar power industry began significant growth only in 2010, when the Jawaharlal Nehru National Solar Mission (JNNSM) was announced. After the announcement of JNNSM, grid-connected solar PV capacity increased by 165% in 2011 alone to reach 427MW. However, a failure to address the remaining financing challenges will make the targets set under JNNSM — Phase 2 (4,000-10,000MW by 2017) and Phase 3 (20,000MW by 2022) — difficult to achieve.

Figure 2-1: India wind power installed capacity and future targets



Source: BP Statistical Review, 2012; Central Electricity Authority; Ministry of New and Renewable Energy; India Infoline. Note: Yearly data is at the end of December every year.

Figure 2-2: India grid-connected solar PV installed capacity vs. Phase 1 target



Source: BP Statistical Review, 2012 Note: Yearly data is at the end of December every year.

4 See section 7.

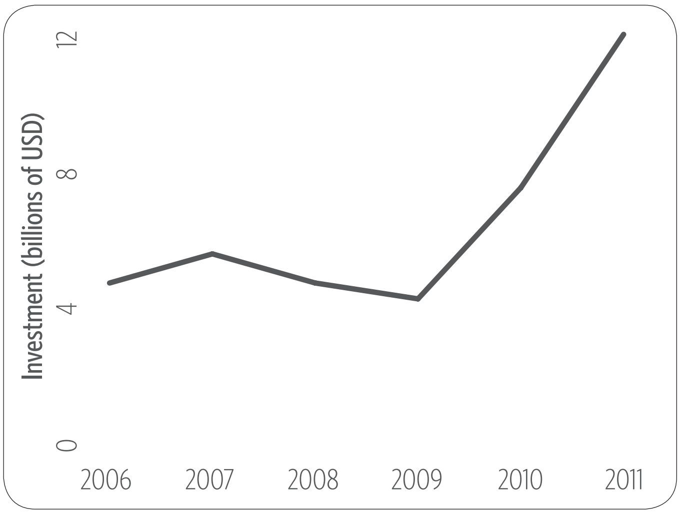
2.2 Sources of finance

A variety of investors finance renewable energy projects in India, including institutions, banks, and registered companies (Table 2-1). Institutional investors are either state-owned or bilateral and multilateral institutions. Among banks, both private sector and public sector banks are involved. In addition to registered companies, venture capital and private equity investors contribute equity investment. Return expectations of the investors vary according to the sources of their funds and the risk attached to specific projects.

During 2006-09, India's annual total renewable energy investment remained between USD 4 billion and USD 5 billion. Investment has risen rapidly since then, from USD 4.2 billion in 2009 to USD 12.3 billion in 2011 (Figure 2-3).

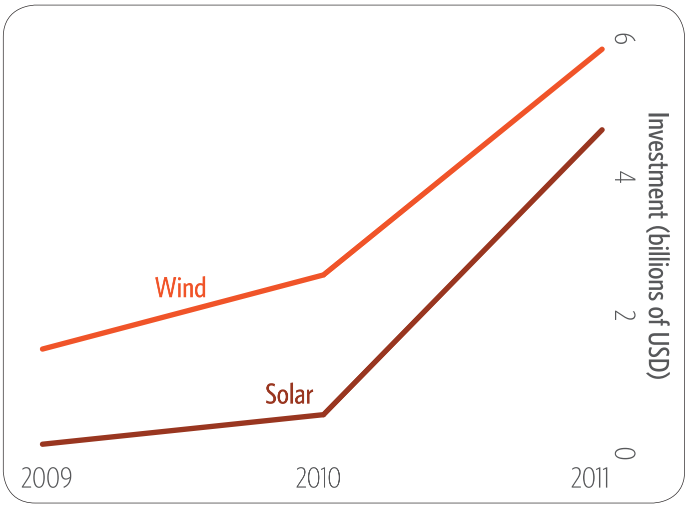
While wind continues to receive the majority of investment, solar has seen the highest growth, and the gap between the two is falling rapidly, as shown in Figure 2-4.

Figure 2-3: Renewable energy investment trends in India



Source: Global trends in renewable energy investment 2012

Figure 2-4: Renewable energy investment trends in India by technology



Source: Bloomberg NEF- UNEP Reports, (i) Global trends in sustainable energy investment 2010. (ii) Global trends in RE investment 2011 and (iii) Global trends in RE investment 2012

Table 2-1: Renewable energy investors (number of institutions)

TYPE OF INVESTOR	CATEGORY	TOTAL REGISTERED IN INDIA	ACTIVE IN RENEWABLE SECTOR
Commercial banks	Public sector banks	**26**	**9**
	Private sector banks	**30**	**6**
	Foreign banks	**37**	**-**
Equity investors	Private equity	**51**	**16**
	Venture capital	**180**	**21**
Institutional investors	Insurance funds	**24**	**11**
Development Banks	Development financial institutions*	**3**	**3**

*DFIs include national level institutions IREDA, IFCI, SIDBI

2.3 The cost of renewable energy in India

In some important ways, India has a cost advantage in renewable energy. Labor and construction costs, for instance, are significantly lower in India than in countries like the U.S. or Germany. Furthermore, India is blessed with renewable resources like wind and sun that are comparable to good locations in other countries. Yet, despite these advantages, the cost of renewable energy can be as high in India as in the U.S. or even significantly higher. The difference is often due to financing costs.

In comparison to conventional power generation sources such as coal or gas, renewable energy is characterized by a relatively high initial investment, followed by low variable costs. Since a much greater share of the cost of energy is determined by the initial investment, higher financing costs have a disproportionate impact on renewable energy. This puts renewable energy at a relative disadvantage in India.

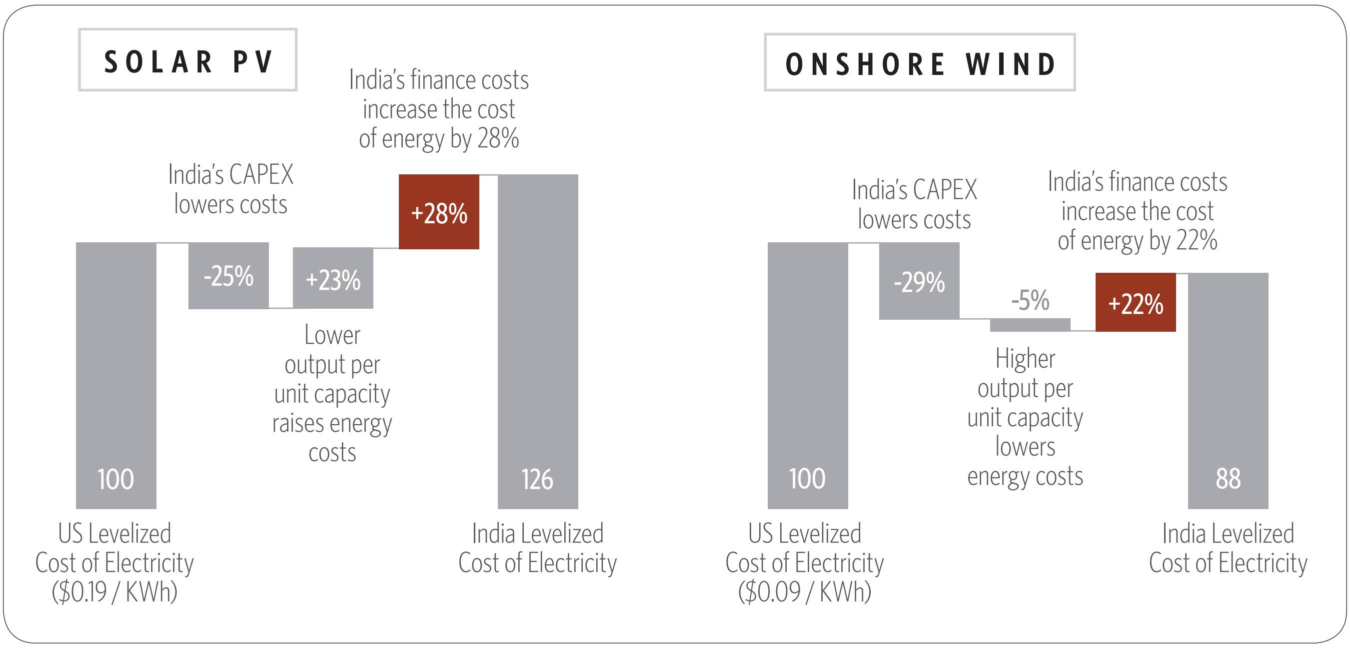
Figure 2-5 compares two typical large-scale installations in the U.S. against similar projects in India to quantify the sources of differences in the levelized cost of electricity (LCOE), defined as the average cost of electricity over the life of a project factoring in the return required on investments.

In the case of solar, capital costs in India were 25% lower than those in the U.S. However, most of this cost advantage was eliminated by the lower expected output per MW, which was likely the result of lower insolation and higher levels of dust in Rajasthan, where the Indian plant was built, or, possibly the use of less expensive, but less reliable, equipment. **With these two factors offsetting each other, the Indian solar PV facility was nevertheless 26% more expensive due entirely to the higher return requirements for investors in India, that is, the more expensive cost of financing the project.**

The two wind projects depict a similar story, although the wind project in India is still cheaper, despite the higher financing costs. While these projects do not represent all U.S. or Indian renewable projects, and rapid changes to cost and performance lead to constantly changing figures, the comparison itself is indicative of the substantial impact of financing costs on renewable energy in India.

The key takeaway is that the renewable projects could be much less expensive if not for the higher financing costs. For more details, see Appendix 4.

Figure 2-5: Finance raises the overall cost of renewable energy in India



Sources include discussions with developers.

Low cost financing of renewable energy projects usually requires both debt and equity investors. However, in India debt and equity investors face very different conditions. When compared to the financing of renewable energy projects in the developed world, in India the relatively high cost and low availability of debt may add 24-32% to the cost of renewable energy projects compared to similar projects in the US, while equity returns have a comparatively minor impact on relative costs.

In this section, we analyze the relative impact of the cost and terms of debt and equity on renewable energy project costs and identify a set of issues beyond debt and equity markets that may concern policy makers. This section paves the way for more detailed discussions of debt (section 4), equity (section 5) and other potential policymaker concerns (section 6).

3. Finding equity and raising debt – Two very different issues

Conditions for renewable finance can be very different depending on the technology employed, the developer, geography, or the requirements of the investors themselves. The most important distinction is between investors in the debt markets (lenders) and those in the equity markets (owners).

Generally speaking, debt investors are more conservative, accepting lower returns in exchange for lower risk. As such, their primary concern is that downsides are limited; that is, that the project does not fail. Equity investors are willing to take more risk in exchange for higher returns, and therefore focus equally on risk and the prospects of a project performing even better than expected. Under most circumstances, a project will be least expensive when it is funded by a mix of debt and equity, either at the project level, or through debt and equity secured at the corporate level.

Renewable energy financing can become costly when either debt or equity investors demand too high a return or when either is simply unavailable. Thus, for both debt and equity we pose two sets of questions:

- **Cost and terms:** Are the returns investors are demanding and the conditions they are placing on their investment so onerous as to make the project economically unattractive? or;
- **Availability:** Is debt or equity just not available? That is, are there enough investors willing to invest or lend to renewable projects in India?

Significantly, while policy can influence the returns required by equity and debt investors and the availability of either, different policies are likely to be important to different classes of investors.

In India, the differences between debt and equity are particularly striking. In general, we find that equity appears to be readily available at a reasonable cost, while renewable energy debt is both limited and expensive. Figure 3-1 highlights the differences between renewable energy debt and equity markets in India and developed markets. Note how equity returns in India are similar to those in the U.S. and Europe, but interest rates on debt are significantly higher.

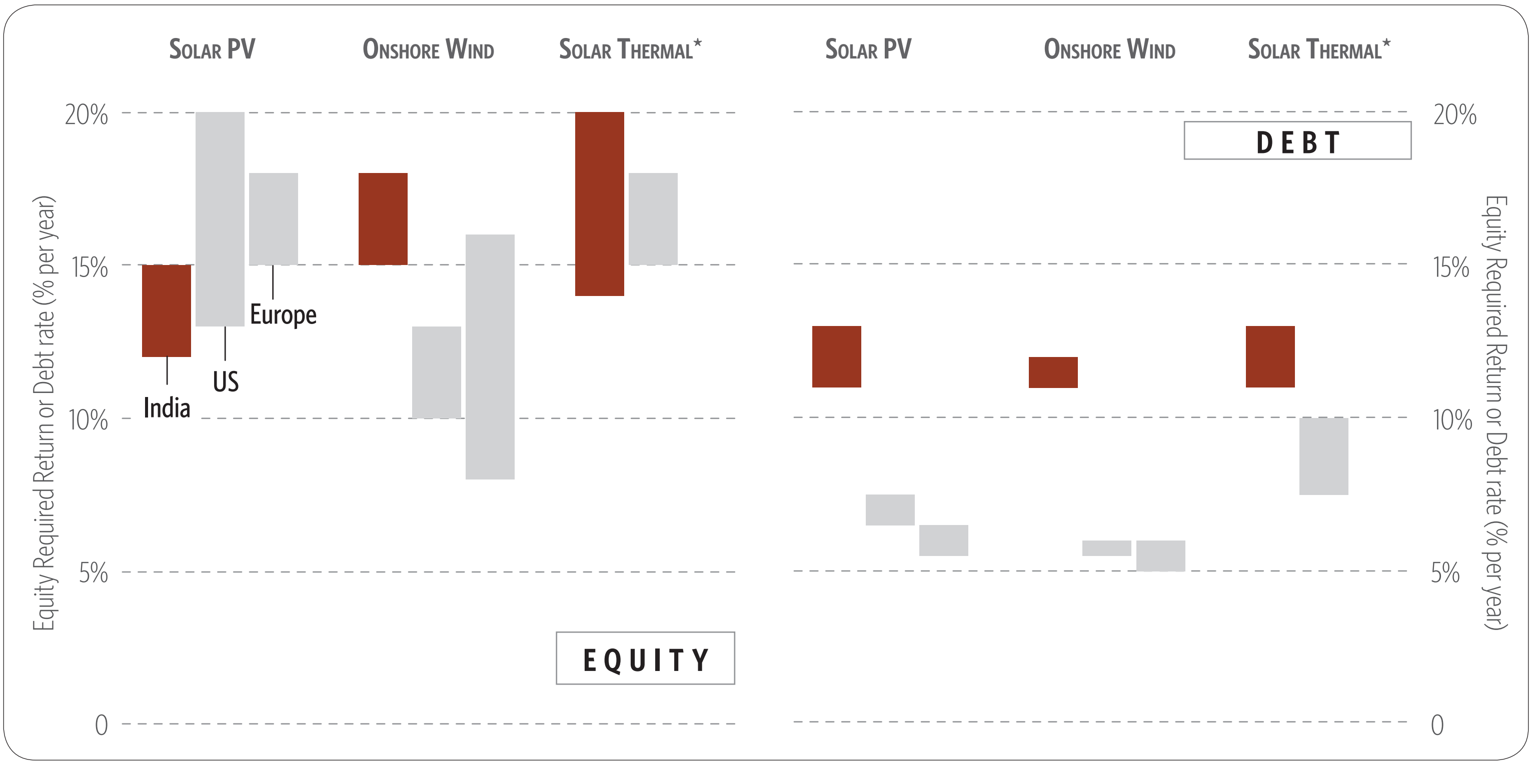
To compound the problem, access to potentially lower cost international debt is limited due to regulatory barriers, the cost and risks associated with long-term currency swaps, and perceived country risks (Section 5.6). As a result, the cost of debt to a renewable energy project in India will typically be in the 10-14% range, as compared to the 5-7% range typical in the United States. Despite the higher cost, debt in India also suffers from inferior terms, including shorter tenors and variable rather than fixed interest rates.

Figure 2-5 in Section 2 demonstrates that the financing costs added 28% and 22% to the cost of solar PV and wind projects, respectively, in India. In Figure 3-2, we take a closer look at the financing component. We begin by noting that there are many factors that influence the total finance cost. Here we highlight five:

- The cost of debt
- The tenor of debt — that is, the length of time over which the debt is repaid
- Whether the debt is variable or fixed
- Extra risk that will be taken on by equity in the event that debt rates are variable
- The cost of equity, or the required return on equity (ROE)

Using the same typical projects described in Figure 2-5, Figure 3-2 compares just the financing differences of

Figure 3-1: Range of returns on equity and debt costs for renewable energy projects – India versus U.S. and Europe



* No data for solar thermal in Europe. Note: Equity is levered equity. Source: Projects in India and US CPI finance paper.

the U.S. and Indian projects. To summarize, we find the following:

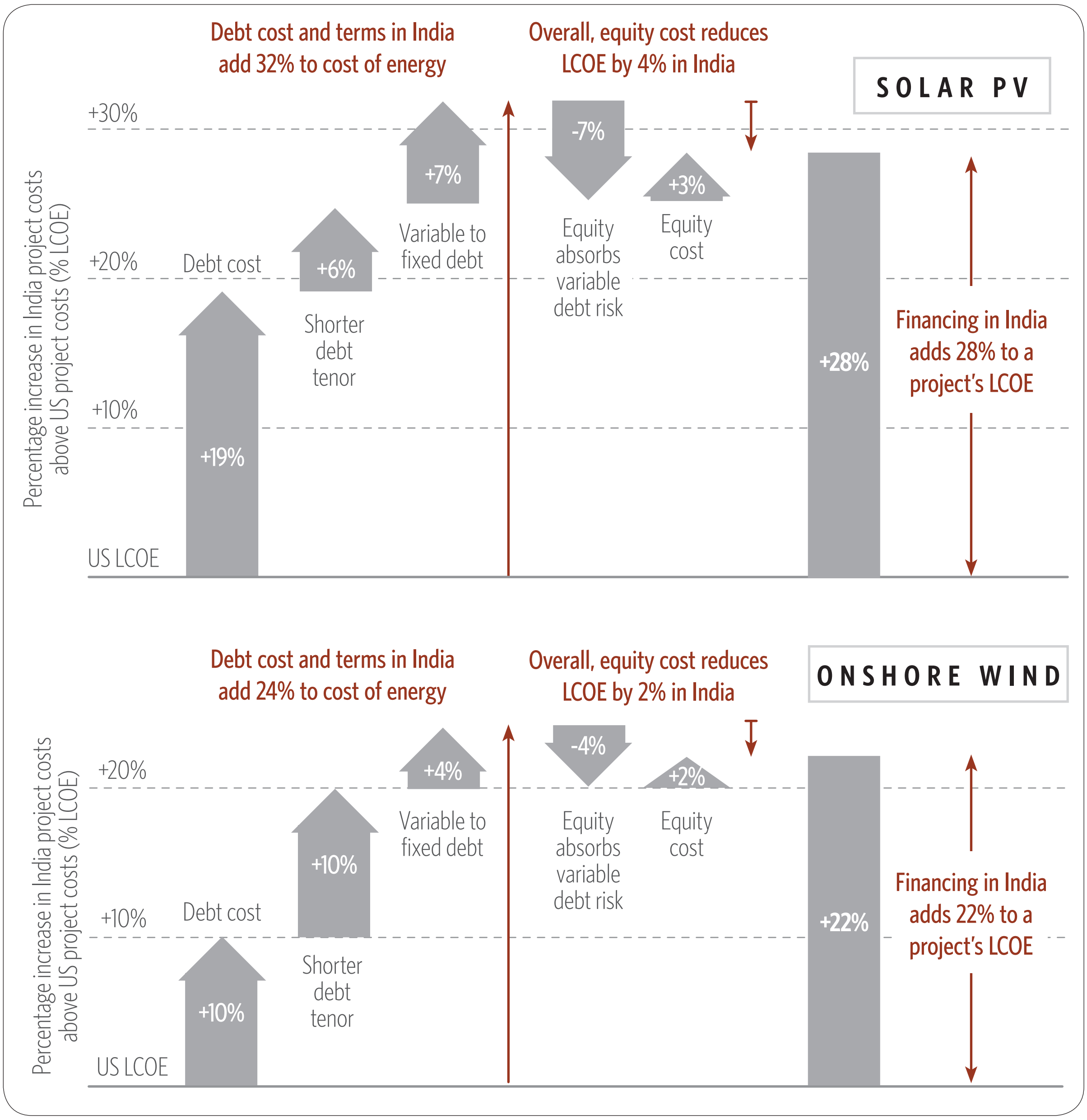
- In the case of the solar PV projects, the higher interest rate on the debt alone added 19% to the project cost, while it added 10% to the wind project.
- Indian debt tenors are typically much shorter than in the U.S. or Europe. Overall, we have found the shorter debt tenors add between 3% and 10% to the cost of the project, by forcing more rapid amortization of the loan, and therefore reducing the effective leverage over the life of the project.[5] Stated another way, with shorter-term debt, the average amount of debt over the project life goes down and project debt has a relatively smaller influence on bringing finance costs down over the life of the project. It is important to point out that debt tenors are relatively less important in India than they would be elsewhere given that the spread between the cost of debt and equity is smaller. Therefore, the value of maintaining a higher level of debt throughout the life of the project decreases. If the cost of debt was to decrease and the spread between debt and equity expand, we would expect the impact of shorter debt tenors to increase significantly.
- Despite being more costly, the debt terms in India are less attractive, particularly the variable interest rate of most debt in India. In more developed markets, project developers nearly always seek fixed interest debt. When combined with feed-in tariffs, or long-term power purchase agreements (PPAs) with a fixed price, a fixed interest rate leads to a high degree of certainty around future cash flows. An investment with well-defined cash flows is less risky, and therefore attracts lower cost finance. Developers will typically use interest rate swaps to convert variable rate debt into fixed rate debt. In India there is no liquid swap market. Therefore, to calculate the cost of the greater uncertainty, we have used the current interest swap rates in the U.S. and applied them to the debt. At 2%, 10 year swap rates are currently low by historical standards. Nevertheless, this cost adds approximately 7% to the finance cost of solar PV and 4% to the cost of wind on a comparable basis. Why do Indian developers accept variable rate debt? See section 4.3 for further discussion.

5 The solar project used for our analysis had an uncharacteristically long tenor. Therefore, we have adjusted the debt tenor down to 13 years, which would be much more typical of Indian PV projects. The result is to increase the impact of shorter debt tenors from 3% to 6%.

- The corollary to the lower value of the variable rate debt is that equity is actually taking on more risk. With a fixed price PPA, it is easy to see how an unexpected rise in the interest rates could consume all of the cash flow from a project and wipe out the equity investor. While we have no accurate way of measuring the cost of the additional risk assumed by the equity investor, we assume that the risk they take on is equal to the value of the swap used to compare India debt to U.S. debt. The result is an exact offset between debt and equity, moving expected return from the equity column to the debt column.
- Finally, as shown in figure 3-1, the cost of equity in India is only slightly higher than in the U.S. or Europe, depending on the technology, despite the higher underlying country risks. The slightly higher Returns on Equity add only 3% and 2% respectively to the total cost of financing the solar and wind project.

When all of the adjustments are made to account for the differences in terms and tenors, equity ends up being less expensive than in the U.S. or Europe, despite the higher country risks. Meanwhile, the total impact of debt, including terms and costs, is 24-32% added to the cost of the project.

Figure 3-2: The impact of debt and equity costs and terms in India on overall financing costs compared to a U.S. baseline



It is significant that, on an adjusted basis, project Returns on Equity (ROEs) in India are below those in the United States. This implies that equity investors are buying into the market and accepting below rational returns for strategic reasons — thus suggesting that ROEs may rise once the market matures.

Beyond the cost and availability of debt lie other distinctions with significant implications for policymakers:

- Are the cost and availability drivers for Indian renewable energy a function of Indian financial markets in general, or are they specific to renewable energy?
- Do the drivers affect all investors, or only foreign investors?
- Does the impact depend on the renewable technology, for instance affecting only wind, but not biomass or vice versa?
- Does the impact vary by state? That is, do state-level policies and business environments account for differences in cost or availability of investment capital?

Sections 4 and 5 focus on important issues that impact the financing of renewable energy in India now and in the future. Eleven of these issues relate to the cost and availability of debt (discussed further in section 4) and six relate to the cost and availability of equity (Section 5). In Section 6 we return to the other issues outlined here, including whether these issues are specific to renewable energy or characteristic of Indian Financial markets in general, whether foreign investors are specifically affected, and whether the impact is different depending upon the technology employed or the state in which a project is built.

4. India's Achilles heel – High cost of debt

4.1 The high general interest rate environment in India

India is a rapidly growing country. As is typical for rapidly developing countries, growth in India comes with a need for investment in new infrastructure, creating competition to raise debt; and general inflationary pressures that need to be controlled through higher interest rates. As a result, benchmark interest rates in India are significantly higher than in developed countries. Furthermore, uncertainty around the Government of India's future borrowing needs and the value of the Rupee create a longer-term uncertainty that constrains the development of longer-term debt markets.

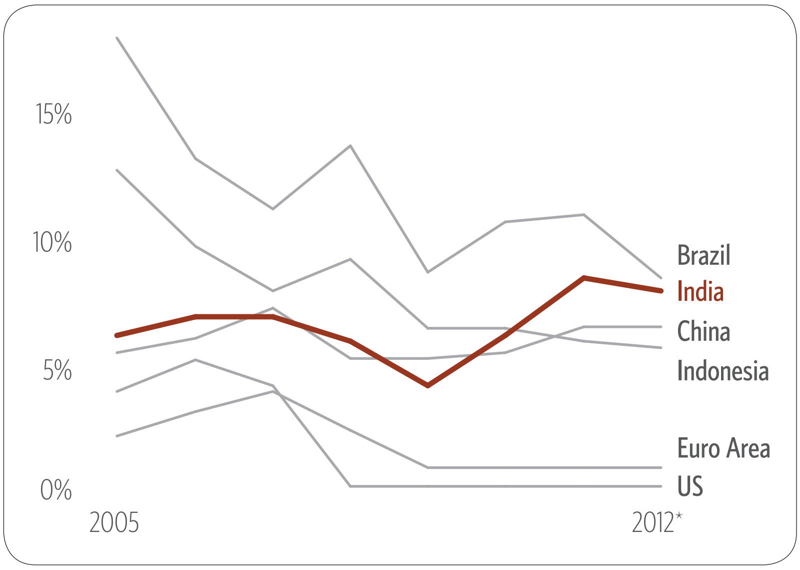
The starting point for our analysis is the underlying benchmark interest rates for India versus other countries. The impact of the financial crisis is clear. Since 2007, benchmark interest rates have fallen significantly in the developed world to stimulate the economy, but have stayed relatively flat in the rapidly developing economies. India is the only country whose benchmark interest rates are higher than they were in 2007. Indian interest rates are now higher than each of the countries in Figure 4-1 save Brazil and the gap with Brazil has fallen from 12% in 2005 to 0.5% today. The higher benchmark rates are, themselves, indicative of the fast growth in India and the multiple competing demands for borrowing to meet infrastructure needs and other government borrowing.

The roughly 7-8% difference between benchmark interest rates in India and the U.S. and Europe account for

Table 4-1: Summary of issues affecting debt cost and availability

		Negative Impact of Issue: Now	Negative Impact of Issue: Medium to Long Term	See Section
Cost and Terms	**High general Indian interest rate** environment raises renewable project debt cost	VERY HIGH	VERY HIGH	4.1
Cost and Terms	**Longer tenor debt is generally unavailable**	MEDIUM	HIGH	4.2
Cost and Terms	**Fixed interest rate debt is rare**; market relies on variable rate debt	LOW	HIGH	4.3
Cost and Terms	**Debt is not strictly non-recourse** as it is usually offered on a relationship basis	MEDIUM	MEDIUM	4.4
Cost and Terms	**Shortage of debt may raise its cost** in the longer term	LOW	MEDIUM	4.5-4.10
Availability	**Banks limit lending to any one sector** for risk purposes	LOW	HIGH	4.6
Availability	**Renewable energy debt is often classified within power or energy sectors**, which are already nearing sector limits	MEDIUM	HIGH	4.6
Availability	**Some banks are not lending to renewable projects** due to unfamiliarity with renewable energy policy and markets	MEDIUM	HIGH	4.6
Availability	**Limits on foreign debt** may restrict foreign lending	LOW	HIGH	4.7, 4.8
Availability	**Technology risk** is limiting debt to some technologies	MEDIUM	MEDIUM	4.9
Availability	**State-level policy**, the poor financial condition of the State Electricity Boards, and unfavorable local business environments restrict lending to some states	MEDIUM	HIGH	4.10, 7.2

Figure 4-1: Benchmark interest rates (%), 2005-12



*Until May 2012. Source: Trading Economics

nearly all of the 5-7% difference in debt costs between renewable energy projects, even when adjusted for the fixed rate premium (2%+) that the U.S. and European debt should be given. Note that, as we discuss in section 4.6, borrowing in the U.S. and European markets to exploit the lower interest rates is not a perfect, or even feasible option, as the cost of currency swaps over the life of the loan needed to reduce the exposure to potential rupee devaluation consumes nearly all of the interest rate differential. That is to say, much of the interest rate difference could be considered as risk that the Indian rupee will lose value, or country risk in general.

4.2 Longer tenor debt is generally unavailable

We observed that the short debt tenors in India play a significant part in keeping the costs high compared to developed nations such as the United States. Our analysis indicates that an increase of debt tenor by seven years would lead to a decrease of 6% in the LCOE of a generic solar power project. But long-term debt is not easily available in India for several reasons:

- **Asset-liability mismatch.** Banks dominate[6] infrastructure financing in India as the corporate bond market is under-developed, but face severe constraints in lending long-term debt due to the short-term nature of the funds they raise. According to the Reserve Bank of India (RBI) estimates, nearly 79% of 2009-10 bank deposits have an average maturity of below three years.[7] For this reason, banks in India are not comfortable lending for tenors longer than 5-7 years, while the infrastructure sector requires long-term debt of more than 10 years.
- **Weak bond markets.** In 2010, India's total outstanding bonds amounted to 53% as a percentage of GDP compared to other countries, such as Japan (247%), U.S. (176%), Malaysia (76%), and China (60%).[8] India is lagging far behind other countries in the corporate debt market, which accounted for around only 4% of the total debt market in 2011, a tiny amount when compared to other countries. The growth of the corporate bond market in India has been limited largely due to stringent regulations and under-developed financial markets. Government regulations restrict investments from banks and insurance companies in corporate bonds and also impose a ceiling on foreign investments in rupee-denominated government and corporate bonds. Under-developed financial markets in India do not offer adequate liquidity for corporate bonds and risk mitigation instruments, such as credit default swaps. Indian financial markets also appear to lack diversity of investors, which could limit the trading activity and instruments available.
- **Diminished role of Development Financial Institutions (DFI).** Several key DFIs were established in the 1950s, such as Industrial Development Bank of India and Industrial Finance Corporation of India, which had access to cheap funds from the government and the central bank, and from multilateral and bilateral international agencies. They were able to extend low-cost, long-term debt to infrastructure development companies during 1950-1990, and they were a major source of long-term funding. However, financial liberalization in 1991, aimed at deregulation of financial markets that resulted from the balance of payments crisis, reduced the role of DFIs as the

6 According to the Planning Commission banks are estimated to contribute nearly 51% of the total debt finance requirement of the infrastructure sector in India during the 11th plan period (2007-12)

7 RBI again warns banks on asset-liability mismatch, Business Standard, Jan 28, 2011

8 Asian Bond Markets Development and Regional Financial Corporation, The 21st Century Public Policy Institute, February 2011

government stopped supporting their fund-raising activities. After the liberalization, DFIs have had to compete with commercial banks to raise funds at market-determined rates. The financial market deregulation made the DFI business model unviable and many were forced to convert themselves into commercial banks. Given that the corporate bond market has remained shallow, the reduced role of DFIs has left a gap in infrastructure funding.

- One exception to this is the Indian Renewable Development Agency (IREDA). IREDA, the investment arm of the Ministry of New and Renewable Energy (MNRE) is a government agency that offers loans to renewable energy projects at favorable rates compared to commercial lending. IREDA was established in 1987 with objective of developing and financing renewable energy projects. IREDA has deployed over a billion U.S. dollars and has further commitments from the Asian Development Bank (ADB), Kreditanstalt für Wiederaufbau (KfW), and development banks from Japan and France for another billion dollars. However, the scale of IREDA is small compared to the challenge of financing Indian renewable energy ambitions.

4.3 Fixed interest rate debt is rare

In India, loans commonly have variable, rather than fixed, interest rates, primarily due to the issues outlined in section 3.2: short-term lending by the banks due to asset-liability mismatch and the near-absence of bond markets. Long-term hedging instruments — term-swaps and bonds — are typically unavailable due to immature financial markets and risks related to a growing economy. Variable rate debt makes cash flows to equity holders, which include project cash flows minus the interest payments to debt holders, less certain as they are subject to changing interest expenses.

While outside India, equity investors would not invest in a project with variable rate debt or, at least, would expect a premium equity return, it is not clear that this is the case in India. Interviews with developers and potential providers of fixed rate loans suggest that the demand in India for fixed rate loans is not high. Part of the reason may be a general expectation that interest rates in India will fall — presumably because they are so high already — however, unlike in Brazil, forward markets suggest that interest rates are far from certain to fall in the future. Indeed, long-term borrowing by the Indian government might be enough to ensure that interest rates do not fall for some time. Thus, there may be false expectations baked into the investment assumptions regarding renewable energy projects. The fear would be that if these expectations change, required ROEs would need to increase or equity might become otherwise scarcer or more expensive.

4.4 Debt is not strictly non-recourse

One area of controversy is the extent to which project finance exists for renewable energy in India. Project finance, or non-recourse finance, is where money is lent or bonds are sold solely on the basis of the project's cash flows. Typically, the project is set up as a separate company and the loan is made to that company. Since the lender only has recourse to that project, if the project company fails, the lender loses their investment. The project owner, meanwhile, loses only their investment in that specific project company. That is, there is no recourse to the parent company of the project developer. Developers often prefer this type of financing because it is less risky to their company and they can leverage the balance sheet of the parent company more aggressively. Developers typically pay a significant premium for project debt over recourse debt at the parent company level, because the lower risk to the parent enables them to take on additional projects.

We had extensive discussions with stakeholders on whether project finance exists in India. One extreme view is that pure project finance (i.e., non-recourse based financing) has not become popular in India.[9] On the other hand, many equity as well as debt investors claim that, though not common in the past, it is becoming more popular.[10] IREDA's lending practices support the view that non-recourse lending is becoming more common. In 2007 only 6% of IREDA lending was non-recourse, by 2011 this had grown to 55%.

Discussions with private-sector banks indicated that in most cases some guarantees are required. [11] However, these discussions also indicated that these guarantees are mostly given by promoters — in particular, for wind projects — that may not have large balance-sheets. It looks like projects get approved only when there is a good promoter. Once loans are approved, they are evaluated on their own strength with some further discount for a better promoter. This is no different from how project finance happens in the West and it is safe

9 Discussion with Global Environment Fund (GEF)

10 Discussion with Infrastructure Development Finance Company (IDFC) Project Finance as well as L&T Infra

11 Discussions with ADB, ICICI Bank, Deutsche Bank (DB), IDFC, and L&T Infra

to assume that project finance exists to some degree — at least in practice — in India.

Since relationships play a stronger role in Indian banking than in Western banking, exercising a "non-recourse" option could have a very strong impact on a company's ability to borrow money in the future and, maybe, even survive. However, again, this situation is not dissimilar to that in the U.S. or Europe. Therefore, although we believe that the Indian debt probably has more recourse and, therefore, is less valuable than in the U.S., we have not attempted to value this particular difference in Indian debt markets.

4.5 Availability of debt

We heard conflicting accounts regarding the availability of debt in India. In general, larger companies with good relationships with banks have access to debt. Superior projects also seem to have access. However, marginal projects with smaller, unconnected developers might find it more difficult. Likewise, some foreign developers without existing relationships might find it difficult to raise debt in local markets.

However, our conversations indicate that access to debt is becoming more difficult now and will very likely become even more difficult in the longer term for several reasons:

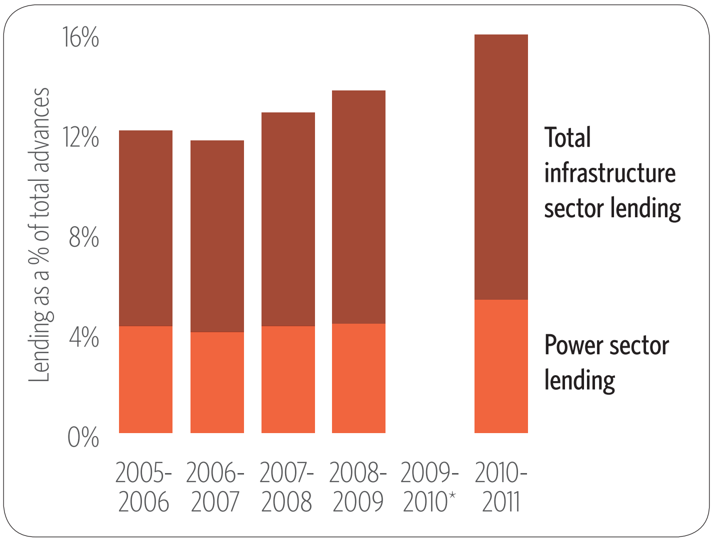
- Banks have sector limits to limit their exposure to any one market, sector, or technology. As renewable deployment increases, more banks are nearing their sector exposure limits. (Section 4.6)
- Further, most banks in India include renewable energy in their power, utility, or energy sector limits. These sectors have heavy borrowing demand, to the point that many banks may have been near their limits even before lending to renewable energy could begin. (Section 4.6)
- While many banks have sector limits, others will not lend to the renewable energy sector at all due to the novelty of the sector, immature technology, and uncertain regulation. (Section 4.6)
- Sourcing debt from foreign lenders is restricted by regulations that set caps on the amount of money that can flow in as well as the pricing of that debt, which in some cases may be too low for international lenders. (Sections 4.7 and 4.8)
- Finally, state-level issues, including the poor financial condition of many of the State Electricity Boards (SEBs) who are the counterparties to many of the contracts that pay the renewable energy projects, will restrict lending in those states. (Section 4.10)

4.6 Many banks do not lend, or limit lending, to renewable energy projects

Domestic banks restrict lending flows to renewable power projects which limits the availability of debt for renewable energy projects. Our analysis reveals that less than one third of public sector banks lend to renewable energy projects. The situation is worse for private sector banks where less than one fifth lend to renewable projects (Table 2-1). Banks cite non-familiarity with the renewable energy sector as well as the perceived riskiness as the major reason for not lending to renewable energy projects. Even among banks that lend to these projects, the amount is restricted due the reasons discussed below.

Commercial banks in India cap investments in infrastructure at 10-15% of their total domestic advances based on the Reserve Bank of India (RBI) prudential lending norms. At present, the renewable energy sector is coupled with the power sector, which is governed by (implicit and self-enforced) sub-sector limits in the range of 4.5-5.0%. During the last few years, due to large capacity additions — primarily of coal based power projects — commercial banks in India almost reached their lending limits for the power sector (Figure

Figure 4-2: Gross bank credit of scheduled commercial banks



*2009-10 data is not available. Source: Reserve Bank of India. Data are provisional and relate to select scheduled commercial banks which account for more than 95 per cent of bank credit of all scheduled commercial banks. Power sector lending includes lending to generation, transmission, and distribution projects.

4-2), potentially leaving limited funds for renewable power projects.

Conversations with banks and developers confirmed that they are worried not only about banks not lending to renewable power due to power sector lending limits but also about the (resulting) increased cost of debt. In February 2011, Andhra Bank noted that "many banks are close to exhausting their internal limits set for infrastructure firms." In April 2012, SBI Capital added that there is a need to categorize the solar power sector as a priority sector to increase funds available for solar power development. Further, Solarsis noted that "shortage of debt capital in the country is adding 50-100 basis points to the variable component of the interest rate."

4.7 Limits on foreign lending - Capital controls on foreign debt

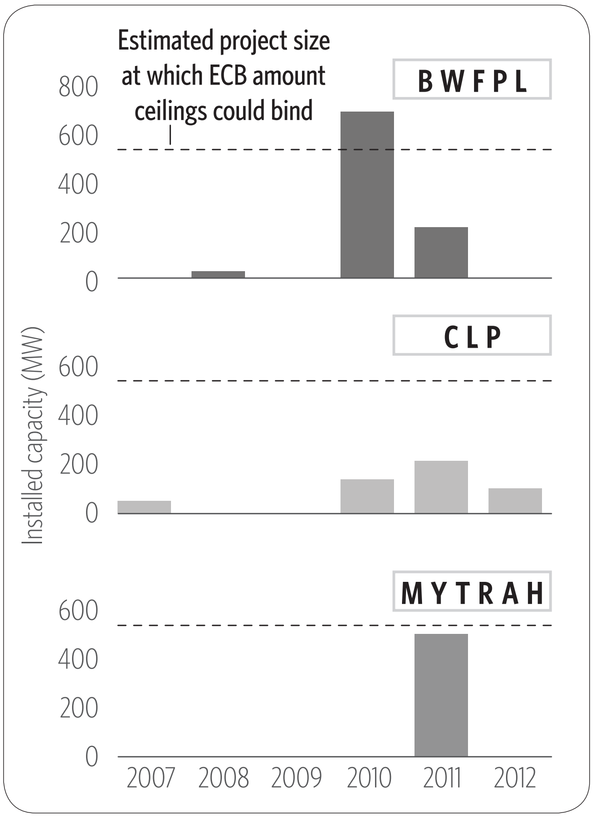
Companies operating in the infrastructure sector — and hence the renewable energy sector — can obtain long-term ECB loans of up to USD 500 million per year. Infrastructure companies can raise an additional USD 250 million per year with government approval. Our analysis shows that the limit on ECB may not be impacting renewable energy projects at the moment, but they may bind in the future, and the ECB ceiling may become a barrier for renewable investments.

At the project level, assuming a typical debt-equity ratio of 70:30, Indian wind and solar renewable projects have reached only 55% and 63%, respectively, of the USD 500 million ECB limit.[12] The largest wind project in India so far (until March 2012) has been 300MW. At an average cost of USD 1.3 million per MW, a 550MW wind project would surpass the ECB limit. Similarly, the largest solar PV power project in India so far has been 125MW. At an average cost of USD 3.6 million per MW, a project size of approximately 200MW would exceed the ECB limit.

However, the situation is different at the holding company level. In at least one case — Beta Wind Farms in 2010 — the financing requirement could have hit the ECB limit if the company had tried to obtain cheaper foreign debt (Figure 4-3). Similarly, in 2011, Mytrah Energy got very close to the ECB limit. To the best of our knowledge, neither of these companies has attempted to obtain foreign loans yet.

12 Bloomberg New Energy Finance

Figure 4-3: Sample of large wind power investors in India versus ECB ceiling, 2007-12



Note: Installed capacity is all projects combined (that attained financial closure) undertaken by a company in a specific year. BWFPL: Beta Wind Farms Pvt. Ltd. (a subsidiary of Orient Green Power Company Ltd.). CLP: CLP Power India Ltd. (a subsidiary of CLP Holdings). Mytrah: Mytrah Energy Ltd. Source: Bloomberg New Energy Finance.

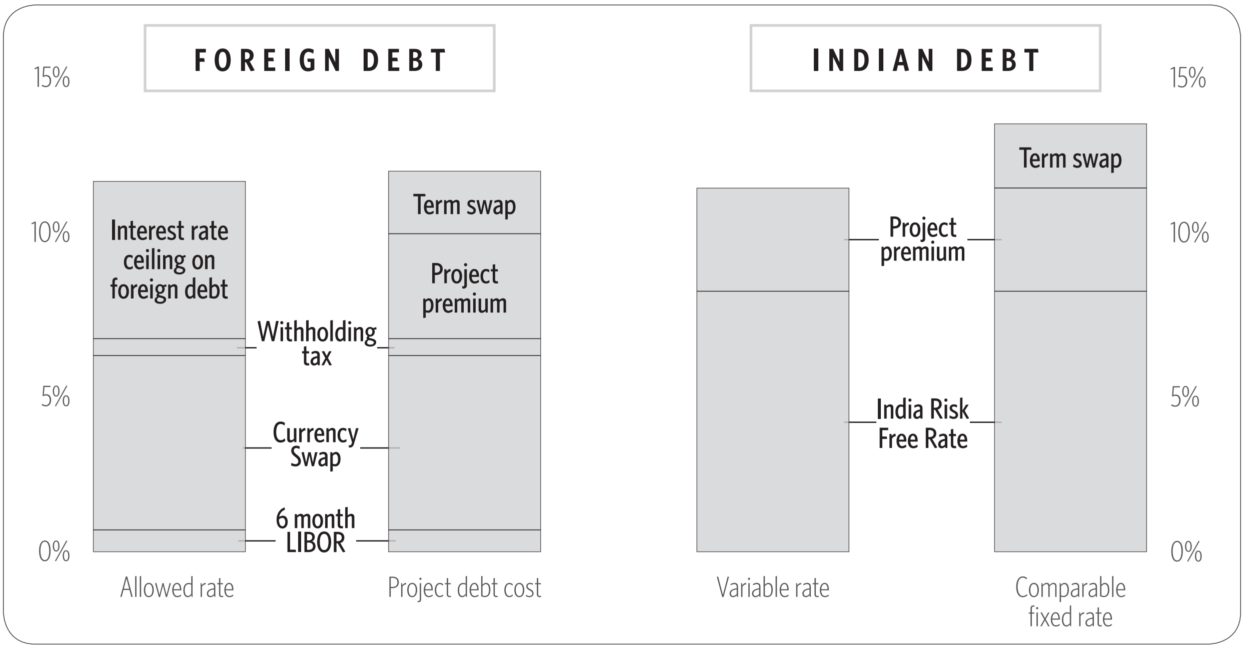
4.8 Limits on foreign lending - Interest rate ceilings

The flow of foreign funds may be constrained due to interest rate ceilings imposed by the government of India on foreign loans. The ECB interest rate (all-in-cost ceiling) is capped at six-month LIBOR + 300 bps[13] for three to five year loans and six-month LIBOR + 500bps for loans longer than five years. Our analysis indicates the ceiling for typical renewable project loans to be approximately 11.8% (Figure 4-4). For many investors, these conditions may be so stringent as to make investing in Indian renewable energy unattractive.

Against this effective 11.8% limit for the interest rate that could be charged by foreign lenders, we compare the cost of the foreign investor making that loan (in the second column of figure 4-4). To the current Libor

13 LIBOR – the London Inter Bank Offer Rate – is used as a benchmark rate to which a cap of 300 bps or basis points (or 3%) is added

Figure 4-4: Estimated cost of debt for Indian renewable energy projects, 2012



interest rate, the lender would need to add 5.5% for a currency swap from Dollars to Rupees over the life of the project, and 2% for a term swap, to convert the short-term Libor loan to a longer term (in this case, a 10-year) loan. A typical project premium for an India lender in India is 3.3%. Adding the impact of withholding tax, the foreign lender would need 12.1% to make the loan attractive. The Indian lender could make the same loan at 11.6%, but offering a variable rather than fixed rate, or approximately 13.6% if it could offer a fixed rate loan.

These numbers are central estimates, and there is some range, particularly around project premium. Thus, some foreign debt has been able to enter below the cap. However, we will note that given the Indian markets current low value placed on fixed debt, the foreign lending cannot compete with the variable rate debt of local borrowing.

The limits could increase the cost of renewable energy projects if the ceilings restrict foreign loans even when these loans are less expensive than available domestic fixed rate loans.

According to project developers and banks, the impact is real: a typical foreign loan may cost approximately 2% less than an equivalent domestic loan, and loans provided by banks, such as U.S. EXIM bank and Overseas Private Investment Corporation (OPIC) could be even cheaper. However, not many renewable projects in India are being financed by foreign loans due to high hedging costs,[14] as well as the interest rate ceiling. The availability of foreign loans is further limited by international lenders requiring a company (or project) rating equivalent to India's sovereign rating (BBB), in addition to requiring credit guarantees from the holding companies. Higher international funding transaction costs also make it difficult for small project developers to opt for foreign loans.[15, 16]

4.9 Technology risks

The availability of finance depends on the technology. Wind is typically easily funded, given its track record and increasing competitiveness — multiple large projects are getting financed, and project financing is becoming more prevalent after the introduction of generation-based incentives.

On the other hand, solar is still new, so many banks are cautious, and many banks are adopting an invest-a-little and then wait-and-see strategy. As a result, projects financed solely by equity are more common in the solar PV space. The question that arises is whether solar PV will mature fast enough such that banks will lend to the projects before developers exhaust their patience, strategic intent, and financial reserves.

14 Doors wide open for external commercial borrowings, Business Standard, March 17, 2012

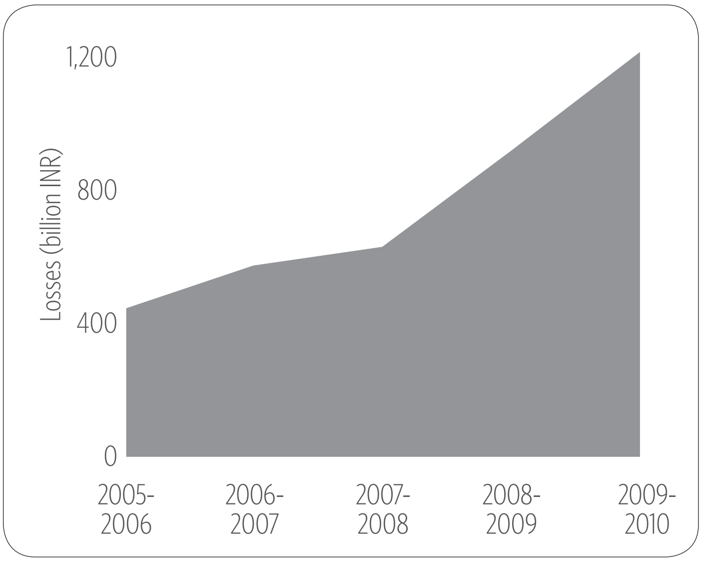
15 Discussion with Acciona, a wind power developer.

16 Further, at present Indian companies are reluctant to go for fixed rate foreign loan due to expectations of a fall in domestic interest rates as the benchmark interest rate is currently at a high level last seen in 2000-01 (Source: tradingeconomics.com).

4.10 State-level issues

We discuss state-level policy issues in more detail in section 7.2 and Appendix 3. However, with respect to the availability of debt, we observe significant differences between states. The primary concern is the finances of the SEBs (Figure 4-5),[17] who typically act as counterparties to most PPAs signed by renewable energy developers. In fact, according to banks that there are several states where it has become harder to provide loans due to the risk associated with the poor finances of the SEBs. The state of Tamil Nadu is noteworthy in this aspect: Though Tamil Nadu has the highest wind-energy capacity in India, banks are now refusing to provide debt to new wind-power projects, given the poor health of Tamil Nadu SEBs. Thus, while there are currently good investment opportunities in states with adequate SEB finances, such as Gujarat, as renewable deployment spreads to a wider range of states, access to debt in some states will increasingly be an issue.

Figure 4-5: Accumulated losses of SEBs, 2005-10



Source: PFC, CRISIL Research

17 Accumulated SEB losses increased from INR 447 billion in 2005-06 to INR 1,224 billion by 2009-10, largely due to lack of consumer tariff hikes and high transmission and commercial losses.

5. Equity – Ample availability, but can it last?

5.1 Cost of equity or required return on equity (ROE) and differentiation between technologies

In a rational world, expected return on equity should be higher than the cost of debt outside exceptional circumstances. Equity has decidedly more risk, and thus should attract higher returns. The role of debt, in fact, is normally to concentrate the risks to the equity holder and therefore enhance equity returns. Another role is to replace the equity capital of the developer so that they can recycle the money into the next project.

The spread between equity costs and debt costs represents the allocation of risks and returns between debt and equity. As more debt is taken on, that is, as a project has more leverage, we should expect equity returns to rise as risks are more concentrated. We should also expect to see some difference in debt equity spreads between technologies and markets.

For Indian wind projects, we see healthy spreads of 4-7% between the cost of debt and the expected return on equity that are similar to those found in other countries. Wind seems to be the easiest technology to get funded, given that wind is competitive and relatively risk-free.

For solar, the observed spreads appear to be low (0-3%). Thus equity investors are taking on more risk by assuming debt, but, due to the high cost of debt, do little to enhance their returns. On the face of it, at these return levels, equity investors might not be interested in the solar PV sector at all. However, interviews suggest that a few considerations might be driving investment:

- **Strategic positioning.**[18] Equity investors in solar appear to be trying to gain market share — to emerge as a dominant player once the technology matures — in the long term. However, the strategy of accepting lower returns in the short term to capture the market is not sustainable over time, because the high risk investment environment in India will require correspondingly higher expected returns. In the long run, the flow of information in the market — about the risk profile of projects — will help in obtaining more rational risk pricing.
- **Equity returns could be increased as the project progresses.**[19] Developers sometimes intentionally delay buying modules to enhance equity returns when they expect a future reduction in cost of solar modules. This has resulted in increasing the internal rate of return from the initial expected value of 15% to 20-25%. Developers may also invest in a project with lower initial returns expecting

18 Discussion with Astonfield Renewables.

19 Discussion with Astonfield Renewables.

Table 5-1: Summary of issues affecting equity cost and availability

	Issue	Negative Impact of Issue: Now	Negative Impact of Issue: Medium to Long Term	See Section
Cost and Terms	**Equity returns required by investors are reasonable** for good projects	NONE	LOW	5.1
Cost and Terms	**Required returns depend on technology** maturity and developer strategy	NONE	MEDIUM	5.1
Availability	**Equity is generally available** for good renewable energy projects	NONE	MEDIUM	5.2
Availability	**Equity is available from foreign investors** but facing a shortage of attractive projects	LOW	MEDIUM	5.2
Availability	**Equity availability is heavily skewed towards a few states** with good policy regimes and attractive business environments	MEDIUM	MEDIUM	4.10, 7.2
Availability	**Lack of debt may reduce available equity** in the medium term as equity investors cannot recycle investments from current projects to future investments	LOW	HIGH	4, 5.2

Table 5-2: Expected returns, cost analysis and debt-equity spreads for different renewable energy technologies in India

TECHNOLOGY	CAPITAL EXPENSES (RS. '10 MILLION/MW)	OPERATING EXPENSES (RS / KWH)	TARIFF (RS./ KWH)	TYPICAL INITIAL DEBT LEVELS (% OF TOTAL CAPITAL)	EQUITY INTERNAL RATE OF RETURN (%)	COST OF DOMESTIC DEBT (%)	DEBT-EQUITY SPREAD (%)
Solar PV	7-10	0.60	7.5- 12.5	70-75%	12-15%	12 -14%	**0-3%**
Solar CSP	12	0.90	11-15	70-75%	14-20%	12 -14%	**2-8%**
Biomass Power	5.5	1.00 (excl. biomass cost)	5	60-70%	20-25%	13 -14%	**7-12%**
Wind	6	0.45	3.7 -5	70-75%	15-18%	11 -12%	**4-7%**
Small Hydro	5.5	0.60	2.2-2.6	70-75%	17-20%	11 -12%	**6-9%**

Sources include discussions with project developers.

that the interest rates will fall, thus allowing the projects to be refinanced at a lower rate and thereby increasing equity returns. Some developers bank on the fact that debt can also be refinanced at better terms once the project is commissioned. The cash flows from the project can be securitized for the additional loan. The leverage can be increased further by increasing the debt at the holding company level and not at the project level. In each case, developers may be relying on trends that could stop or even reverse. Module prices, for example, may be oversold and prices could stabilize or even rise in the future. A developer facing a reverse in these expectations could suffer severe losses, or cancel the project. Thus, like strategic positioning, this enhancement is likely to be unsustainable in the long term.

- **The internal rate of return for equity can be higher at a holding company level.**[20] Developers typically use multiple levels of leverage. For example, some private equity funds raise equity as a combination of equity and debt. This results in a higher effective leverage. A similar strategy is employed by some private equity (PE) funds that invest in the early stages of a holding company. As projects are implemented within the holding company, the holding company level risk goes down, and it is possible to get subsequent rounds of equity at lower rates, inflating the returns from the initial equity investments. Developers may also be using scale (i.e., multiple projects within the holding company) and re-investing the cash flow from one project into subsequent projects. This way, equity IRR of lower than 15% at project level can be converted to greater that 20% IRR at the holding-company level. Further, some companies are focused on short-term exits, where by getting projects on ground — even for not so lucrative IRR — they expect to be either acquired or go to public markets. There is, however, a limit to which returns can be enhanced in this way without risks becoming overly concentrated. Furthermore, this practice is common in all markets, and thus cannot justify the relatively low debt-equity spreads found in Indian solar markets.

In summary, we find the required ROEs for renewable projects to be reasonable in the case of wind, but low in solar. One worry is that as this market matures, a number of the strategic and tactical considerations that developers currently use to justify their projects may disappear, leading to higher costs in the future.

5.2 The availability of equity

Equity drives investments. Equity induces developers to take on and develop a project and eventually, negotiate PPAs and loans. Discussions with stakeholders revealed that the availability of equity from both domestic and foreign sources is comparatively better than the availability of debt. In fact, our discussions revealed that international equity may be more readily available than domestic equity.

However, our discussions also revealed that the lack of availability of debt to refinance a project may actually force equity to be kept in a project for too long, and hence restrict the equity available for recycling and starting new projects. In particular, developers who have financed projects on their own balance sheets during construction, when debt is usually more expensive and difficult to get due to related risks and uncertainty, are finding that they cannot raise reasonably priced debt even after the project is built and operating. Without this debt, developers do not then have the capital available to invest in the next project.

20 Discussion with Astonfield Renewables, IFC, and Nercus Capital.

Where should policy makers turn to first to solve policy dilemma related to debt and equity cost and availability for financing renewable? Building on the analysis of Sections 3, 4 and 5, we find that the most pressing problems lie with characteristics general to all Indian financial markets. However, in the longer term, if solutions to bridge general Indian market conditions are found, then specific renewable energy policy and state-level policy issues will also need to be addressed.

6. Summary of the state of renewable energy finance and first indications of where policy matters

Section 5 suggested that, at least for now, there are few problems with the cost or availability of equity. However, equity for solar projects may become more expensive as markets mature and strategic investing diminishes; meanwhile, the availability of equity for all types of renewable energy may decrease if a lack of debt causes equity providers to exhaust their capital due to the lack of recycling options.

The high cost of debt, however, as in Section 4, is an immediate problem that is exacerbated by the short debt tenors and variable interest rates. If interest rates fall, tenors and variable rates are likely to become increasingly important. The availability of debt is not yet a major problem, but signs are that debt will become increasingly hard to secure as sector limits and risk controls begin to bite.

In section 3, we suggested that policy makers should identify the most significant policy areas affecting renewable energy finance and focus their attention there. We identified five sets of policy areas that affect the cost and availability of debt and equity for renewable energy:

- Policies related to general Indian financial market characteristics
- Specific renewable energy policies or having a singular impact on renewable energy
- Policies relevant to foreign investment in renewable energy
- Policies with different impacts on different renewable energy technologies
- Indian state-level policies

In tables 6-1 and 6-2, we repeat summaries of equity and debt issues laid out in chapters 4 and 5. However, here we compare the importance of these issues against the policy areas that they most influence. Table 6-1, which looks at the near-term issues, shows that the single biggest issue lies with general Indian financial markets. In other words, improving renewable energy finance cannot be done through renewable energy policy alone. Concerted effort dedicated to reducing renewable energy debt costs is a critical step that, today, overwhelms other policy concerns.

Table 6-2 moves us to the longer term. In the longer term, even if, or especially if, the problem of high interest rates is solved, we see a number of policy areas increasing in importance.

- Policy makers will need to focus on specific renewable energy policy, for instance, by fixing uncertainty and risk surrounding renewable specific policies such as the Renewable Energy Certificate market. (see section 7.1)
- As the current debt providers reach their limits, foreign debt providers and equity investors will become more important, suggesting a look at the impact of debt cost and quantity restrictions.
- As investors become overexposed or otherwise exhaust opportunities in the states with attractive policies and business environments, growth in renewable energy will depend on states with less attractive regimes, suggesting that these states need to be made more attractive either through state-level action or through Government of India policy. (See section 7.2)

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Table 6-1: Relevance of major issues to specific policy arenas – Current Impact

Issue Pertains to:

EQUITY

		General Indian Financial Markets	Specific to Renewable Energy	Foreign Investment in Renewables	Specific Renewable Technologies	Specific Indian States	Negative Impact – Now
Cost and Terms	Equity returns appear reasonable for good projects						None
	Technology maturity and strategic positioning affects required project returns						None
Availability	Equity is generally available						None
	Equity from foreign investors is also available		Yellow	Yellow			Low
	Equity availability is heavily skewed towards a few states					Orange	Medium
	Lack of debt may reduce available equity in the medium term		Yellow				Low

DEBT

		General Indian Financial Markets	Specific to Renewable Energy	Foreign Investment in Renewables	Specific Renewable Technologies	Specific Indian States	Negative Impact – Now
Cost and Terms	High general Indian interest rate environment	Red					Very High
	Longer tenor debt is generally unavailable	Orange					Medium
	Fixed interest rate debt is difficult to find	Yellow					Low
	Debt is usually offered on a relationship basis	Orange					Medium
	Shortage of debt		Yellow				Low
Availability	Banks place limits		Yellow				Low
	Renewable energy debt is often included within power or energy sector limits		Orange				Medium
	Some banks are not lending to renewable energy		Orange				Medium
	Limits on foreign debt	Yellow		Yellow			Low
	Technology risk				Orange		Medium
	State-level policy					Orange	Medium

Table 6-2: Relevance of major issues to specific policy arenas – Medium Term to Long Term Impact

Issue Pertains to:

EQUITY

		General Indian Financial Markets	Specific to Renewable Energy	Foreign Investment in Renewables	Specific Renewable Technologies	Specific Indian States	Negative Impact in Medium to Long Term
Cost and Terms	Equity returns appear reasonable for good projects		■	■	■	■	Low
Cost and Terms	Technology maturity and strategic positioning affects required project returns				■		Medium
Availability	Equity is generally available		■				Medium
Availability	Equity from foreign investors is also available		■	■			Medium
Availability	Equity availability is heavily skewed towards a few states					■	Medium
Availability	Lack of debt may reduce available equity in the medium term		■				High

DEBT

		General Indian Financial Markets	Specific to Renewable Energy	Foreign Investment in Renewables	Specific Renewable Technologies	Specific Indian States	Negative Impact in Medium to Long Term
Cost and Terms	High general Indian interest rate environment	■					Very High
Cost and Terms	Longer tenor debt is generally unavailable	■					High
Cost and Terms	Fixed interest rate debt is difficult to find	■					High
Cost and Terms	Debt is usually offered on a relationship basis	■					Medium
Cost and Terms	Shortage of debt		■				Medium
Availability	Banks place limits		■				High
Availability	Renewable energy debt is often included within power or energy sector limits		■				High
Availability	Some banks are not lending to renewable energy		■				High
Availability	Limits on foreign debt	■		■			High
Availability	Technology risk				■		Medium
Availability	State-level policy					■	High

So what can policy do about the renewable energy financing challenge? To begin to answer that question, in this section we summarize what has been done so far and whether those policies have been successful.

7. Government policy framework

The Electricity Act of 2003 transformed the power sector in India by driving changes such as deregulating power generation, opening access in transmission, and allowing the state electricity regulatory commissions to fix the level of renewable energy procurement. The National Electricity Policy (2005) and Tariff Policy (2006) followed, with the goal of increasing the share of renewable energy in the total energy supply mix.

Currently, the Indian government supports the development of renewable energy through a variety of incentives and mandates. These are described in Figure 7-1, which also maps each policy to the applicable technology — wind or solar — according to their relevance.

As introduced in Section 2.1, we have assessed the impact of policies discussed above on the delivered cost of electricity for actual wind and solar projects (Figure 7.1). We first calculate the counterfactual LCOE in absence of any incentives using underlying project-level parameters (e.g., debt-rate, debt-tenor, and hurdle rate) while maximizing debt. This counterfactual LCOE represents the lowest cost of electricity possible from these projects. We then add various incentives in a sequential manner and recalculate LCOE, using the same method – i.e., debt maximization — as before.

Given that we have focused on actual projects, we start with accelerated depreciation for solar PV and the generation based incentive (GBI) for wind. We observe that these policies reduce the LCOE of representative solar PV and wind projects by 18% and 10%, respectively. The approximate impact of both income tax benefits and CDM turns out to be 5%. Given that the support of average power procurement cost (APPC) towards LCOE is 16% and 50% for solar PV and wind, respectively; the rest of the LCOE — 67% and 40% for solar PV and wind, respectively — is supported by the preferential tariffs.

7.1 Renewable Energy Certificate markets

With the expiration of the generation based incentive (for wind and solar) and the lapse of accelerated depreciation (for wind), the Indian government is expecting the Renewable Energy Certificate (REC) market to take up the slack. The rationale for the new market mechanism is that, although India has huge renewable energy potential,[21] its sources are geographically dispersed; for example, in Delhi, the potential for renewable energy is insignificant, whereas some states have excess renewable energy sources (e.g., wind in Gujarat). However, in states with abundant renewable sources, the incremental cost of renewable energy above other, conventional, sources discourages local distribution licensees from purchasing renewable power beyond the level mandated by state policy. Thus, there should be an opportunity to reduce the costs of renewable energy for India as a whole by tapping the additional, relatively low-cost opportunities in states rich with renewable resources.

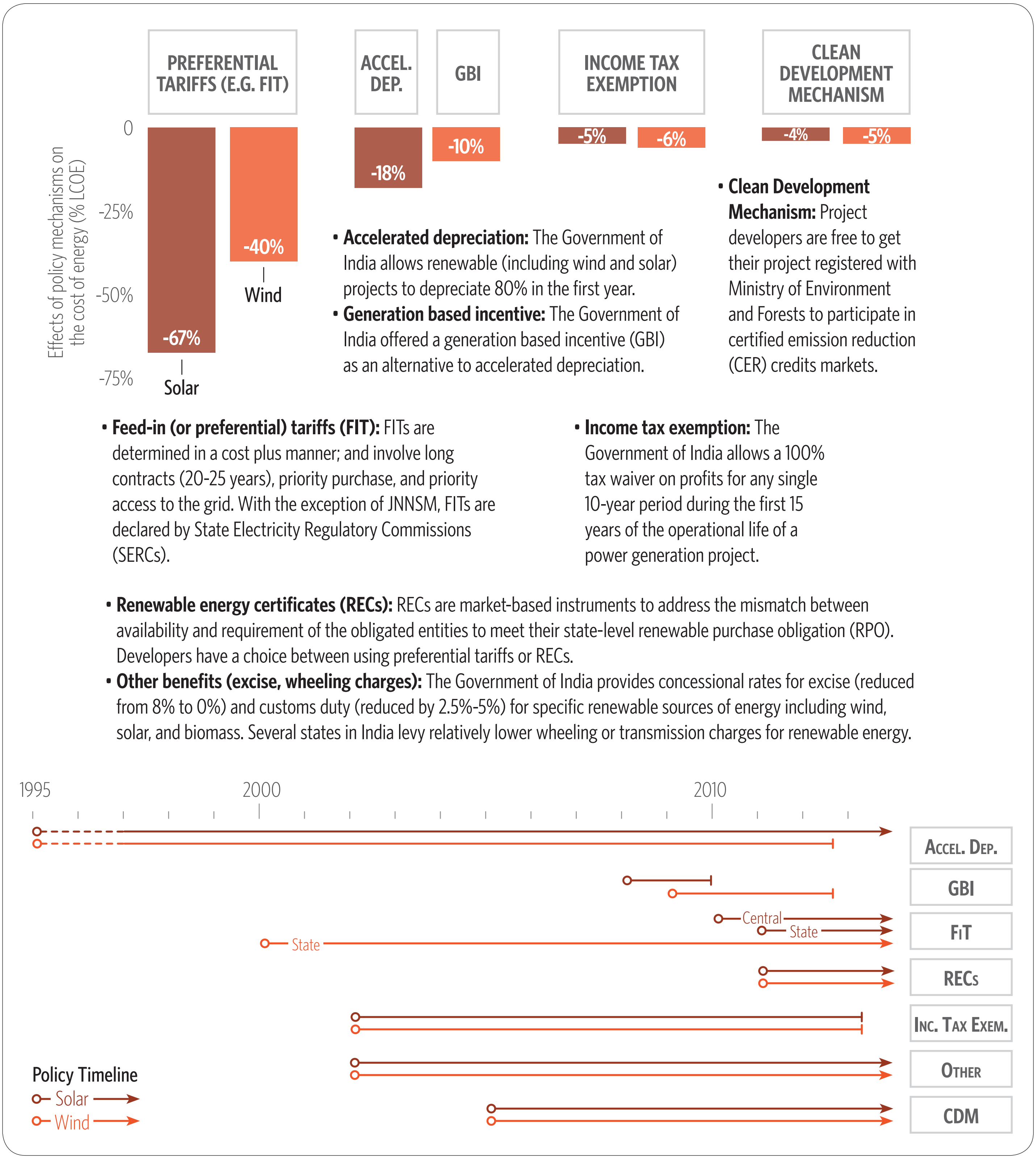
To address this mismatch and to reach the ambitious national level targets, The Government of India launched a market based mechanism in 2011 in the form of Renewable Energy Certificates (REC). Under this mechanism, certificates are issued to renewable energy power generators, which can be sold later in recognized power exchanges.[22] RECs have been widely touted by many analysts as the solution to drive investment into renewable energy generation.

However, our look into the actual performance of REC market trading shows that the current number of certificates issued is less than 4% of the technical REC demand potential, indicating that the full potential of REC markets is far from being realized. Our analysis, detailed in a companion report entitled, "Falling Short: An Evaluation of the Indian Renewable Certificate Market," clearly indicates that RECs are not considered viable financial instruments by investors yet, and several changes are needed if the REC mechanism is to deliver its intended results (Table 7-1). In our analysis, we conclude that the REC mechanism, as currently structured

21 Renewable Energy Potential of India is estimated at 84,776 MW, including Wind (45,195 MW), Small Hydro (15,000 MW), Biomass Power (16,881 MW), Cogeneration (5,000 MW), and Waste to Energy (2,700 MW) (IREDA 2009).

22 Feed-in tariff also co-exist in India and developers have to choose either FITs or RECs

Figure 7-1: Contribution of policies and market prices to overall renewable energy remuneration



and executed, is unlikely to achieve most of the government's objectives for the mechanism.

In particular, to create a stable market for RECs and reduce demand uncertainty, stricter compliance laws and enforcement of state-level RPOs will be required.

Further, to make RECs viable financial instruments, the government will need to not only declare state-level, long-term targets along with their annual targets but also enable well-functioning secondary markets.

7.2 State-level policy issues

The Electricity Act of 2003 empowers State Electricity Regulatory Commissions (SERCs) to establish policies and rules for renewable energy development. The Government of India has mandated renewable purchase obligations (RPO) targets and has established guidelines for setting RPOs. Accordingly, SERCs determine the RPO targets (a solar RPO and a non-solar RPO) and also establish state agencies responsible for enforcement of these targets. The obligated entities usually include distribution companies,[23] captive consumers, and open access users.[24] They can meet the RPO through generating renewable power themselves, by buying from other renewable power generators, or through REC certificates.

Despite this obligation and a host of supporting policies at the state and national level, there has been a wide variation between states. For example, wind capacity is more than 1,000 MW in states such as Tamil Nadu, Maharashtra, Gujarat and Karnataka, but less than 50 MW in states such as West Bengal and Kerala. For more detailed analysis, see Appendix 3.

Variation between states is explained by at least three factors as indicated by our analysis in Appendix 3:

- **Resource potential**– Some states have more renewable energy potential than others. For example, Rajasthan and Gujarat are the top two states in terms of solar irradiation in the country; they also hold the top two spots in terms of solar deployment, accounting for the majority portion of the solar PV installed capacity in the country. Conversely, resources only explain part of the story — for example, Gujarat has the highest wind energy potential but less than half the installed wind capacity of Tamil Nadu.
- **Policy environment** – States have taken a range of stances towards renewable policy and RPO targets. Table 7-2 shows the wide variation of RPO targets between states, and indicates how some states have yet to approve targets, while others have reduced their targets. Further, enforcement of RPO targets has been scattered, as have state-level policy support mechanisms. However, there are also many examples of strong and proactive policies towards development of renewable energy. For example, Gujarat's preferential tariffs for solar power helped the state install approximately two thirds of the total solar PV in the country by 2012, before the announcement of JNNSM.
- **Perceived counterparty risk** – State electricity boards (SEBs) or similar institutions typically buy power from renewable energy projects through PPAs. However, many SEBs are in bad shape financially. According to CRISIL, an analytical firm and rating agency, the aggregate accumulated losses of state-owned power utilities are estimated to reach INR 2 trillion by the end of March 2012,[25] with three fourths of these losses in the last five years (2007-12). The result is that developers and lenders alike perceive risk associated with PPAs because of the potential for non-payment by the SEB or renegotiation of the terms of the contract. Indian banks continue to be wary of lending to renewable energy projects that signed PPAs with state-owned electricity distribution companies in states where SEBs are in bad shape financially.

Other factors, undoubtedly, also contribute to variation between states. However, our analysis, set out in Appendix 3, indicates a significant correlation with each of these three factors. The result is that India renewable energy deployment is concentrated in a few states. While the performance of these states has been sufficient to drive growth at the national level, achieving targets will require significant deployment across most states in India. We have had several conversations with investors that indicated that their exposure to well-performing states such as Gujurat was too high and that they were actively looking to expand the geographic range of their Indian portfolio, but were finding it hard to do so.

23 State owned distribution companies operate 95% of the power distribution.

24 Many electricity intensive industries like Cement, Steel, Ferro Alloys, Paper & Pulpare operating their own power plants run by either thermal generation or generation from other resources including renewable energy. In 2007-08 nearly 15% of the installed capacity in the country was in captive power plants.

25 Power distribution companies' losses cross Rs 2 lakh crore, says Crisil, The Economic Times, May 7, 2012

Table 7-1: REC policy analysis

Government Objectives / Evaluation Criteria	Findings
Encourage cost reduction in renewable energy projects by promoting market forces and competition	**Unlikely to achieve** Participation in the REC markets has been too low to drive any cost reduction
Provide incentives to drive capital investment in renewable energy projects	**Unlikely to achieve** Time frame of RECs is much shorter than the investment horizon; investors discount RECs due to perceived uncertainty and risk over project life
Provide a mechanism to limit boom and bust cycles	**Not clear yet** Cannot test as the renewable energy market has not yet overheated; current participation and incentive levels suggest REC mechanism insufficient to dampen cycles
Weave together various state-level incentive and policy regimes within a national structure	**Unlikely to achieve** Does not incentivize states to work towards reaching national goals
Provide incentives incremental to other relevant policies	**Not clear yet** REC cash flows are supplementary to other policies and can work in conjunction with state policies, but have not to date
Allow for technologically differentiated incentives to support new and diverse sources of energy	**Not clear yet** Design allows for differentiation, however support for new renewable sources has been weak to date
Accomplish the above at a reasonable additional transaction cost	**Not clear yet** Direct transaction cost is low to date; it is unclear how costs will evolve as market matures
Accomplish the above with a reasonable additional cost due to higher perceived or real risks to developer	**Unlikely to achieve** Risk perception of using RECs has been high, failing to drive any investment

Source: "Falling Short: An Evaluation of the Indian Renewable Certificate Market," CPI (2012)

Table 7-2: RPO targets by state

STATE	YEAR OF FIRST REGULATION	PRE-REC TARGET			POST-RPO TARGETS					
		2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Andhra Pradesh (Draft)*	2005	5.0%	5.0%	5.0%					5.0%	5.0%
Assam	2010				1.4%	2.80%	4.20%	5.6%	7.0%	
Bihar				4.0%	1.5%	2.50%	4.00%	4.5%	5.0%	
Chhattisgarh	2008	10.0%	10.0%	10.0%	5.0%	5.25%	5.75%			
Delhi (Draft)*		1.0%	1.00%	1.00%	2.0%	3.40%	4.80%	6.2%	7.6%	9.0%
Gujarat	2005	1.0%	2.0%		5.0%	6.0%	7.0%			
Haryana	2007	2.0%	5.0%	10.0%	1.5%	2.0%	3.00%			
Himachal Pradesh		20.0%	20.0%	20.0%	10.01%	10.01%	10.25%	10.25%	10.25%	10.25%
Jammu & Kashmir					1.0%	3.0%	5.00%			
Goa & UT					1.0%	2.0%	3.00%			
Jharkhand					2.0%	2.50%	3.10%			
Karnataka	2008	1.0%	1.00%	1.0%	0.25%	0.25%	7.25%	7.25%	7.25%	7.25%
Kerala	2006	5.0%	5.0%	5.0%	5.25%	5.25%	5.25%	5.25%	5.25%	5.25%
Madhya Pradesh	2008		10.0%	11.0%	0.80%	2.50%	4.0%	5.50%	7.0%	
Maharashtra	2006	4.0%	5.0%	6.0%	6.0%	7.0%	8.0%	9.0%	9.0%	9.0%
Manipur	2010				2.0%	3.0%	5.0%			
Mizoram	2010				5.0%	6.0%	7.0%			
Meghalaya	2010				0.50%	0.75%	1.0%			
Nagaland					6.0%	7.0%	8.0%			
Orissa		3.0%	3.0%	4.0%	5.0%	5.0%	5.50%	6.0%	6.50%	7.0%
Punjab	2007	1.0%	1.0%	2.0%	2.4%	2.86%	3.44%	3.94%	4.0%	
Rajasthan	2006#	4.28%	6.25%	7.5%	8.5%	9.50%				
Tamil Nadu	2006	10.0%	10.0%	13.0%	10.15%	9.05%				
Tripura	2010				1.0%	1.0%	2.0%			
Uttarakhand		5.0%	5.0%	8.0%	10.0%	11.0%				
Uttar Pradesh		7.5%	7.5%	7.5%	4.0%	5.0%	6.0%			
West Bengal	2005			4-6.8%	2.0%	3.0%	4.0%			

Beyond India lies a wealth of renewable energy policy experience in other countries, including the U.S., Europe, China, and Brazil. To explore possible lessons for India, we begin with detailed financial modeling of specific Indian renewable energy projects and compare the results. Beyond the implications for cost (section 3), we have used these models to evaluate the impact of different policy instruments on overall project financing costs in the U.S., Europe and India. While our results point to some lessons that can be learned from these countries, general market conditions weaken their effect in India. Given that, we explore whether other important lessons could be drawn from other rapidly emerging countries such as China and Brazil.

8. Policy analysis — Case studies and international comparisons

8.1 Case study analysis – India versus the U.S. and Europe

In a 2011 study entitled "The Impact of Policy on the Financing of Renewables – A Case Study Analysis" CPI studied a series of renewable projects in Europe and the U.S. to evaluate the way policy can impact the cost of financing renewable energy through different "pathways." In this context, we defined pathways as general characteristics of policy that could affect investor cash flows or perceptions. Specifically we look at pathways that included (see Appendix 1 and Appendix 2):

- **Duration of revenue support** – That is, how long a preferential tariff, power purchase agreement, or other financial support mechanism would last. Generally, a longer support mechanism allows debt to be amortized more slowly with the result of higher effective leverage and lower financing costs across the project life;
- **Revenue certainty** – Here we looked specifically at the impact of having a fixed level of support or one that varied as a function of markets or commodity prices. A fixed level of support offers more certainty of cash flows and allows greater leverage;
- **Risk perceptions** – We looked at the range of risk premia applied to different renewable projects to ascertain the financial costs associated with riskier perceptions;
- **Completion certainty** – Here we looked at the cost of delays to a project caused by policy or regulatory hurdles delaying project completion. A project delay increases financing costs due to the delay in receiving the financial return.
- **Cost certainty** – Policy could also lead to uncertainty in costs; for example, by imposing additional requirements during the construction phase.

We analyzed each of these pathways through detailed financial modeling of representative onshore wind, solar PV, and a more innovative technology each in Europe and the U.S. and modeled alternative policy scenarios for each of the projects to determine the impact that changes to key policy pathways would have had to project financing costs. Figure 8-1 summarizes the results of the study.

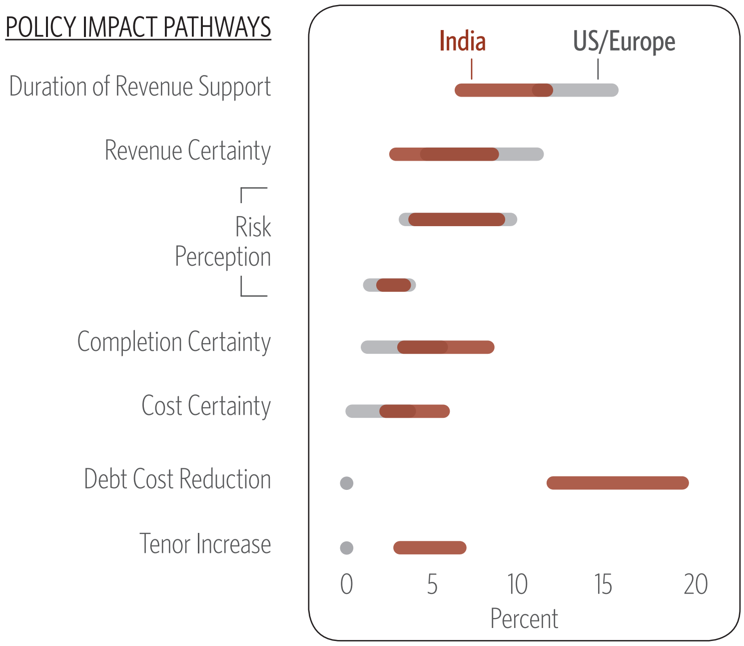
Our analysis indicated that in the U.S. and Europe, extending the length of a support policy could lower costs. We also found that mechanisms such as feed-in (or preferential) tariffs offering constant, stable prices could also lower costs, as could mechanisms with variable support, but appropriate and well-designed price floors, such as feed-in premia with floor prices. Meanwhile, cost and completion certainty could be solved mainly through already commercially available contracting arrangements.

In 2012, CPI decided to repeat this analysis for a set of India projects to see if the lessons were universally applicable, or whether there were additional insights to emerge from the analysis. Much of what is included earlier in this paper stems from this analysis. For India, we studied three projects in detail (see Table 8-1). Figure 8-2 presents the results of the same analysis for the Indian projects listed in Table 8-1.

Two points emerge from the analysis:

- Differences between the policy impact pathways are smaller in India. This is because one important mechanism for reducing financing costs is reducing risks to allow increased debt and project leverage. With debt costs so high in India, the value of leverage (and therefore reducing risks) is lower. Secondly, some of the commercial contract mechanisms

Figure8-1: A comparison of the range of impact of policy pathways on renewable financing cost in US/Europe and India.



to reduce construction risk may not be as reliable in India.

- More significantly, all of the policy pathways here are dwarfed by the potential impact of reducing debt costs. In this analysis, we have reduced debt interest rates by 5%, enough to cover most, but by no means all, of the interest rate gap with developed countries.

A key take away is that the higher interest rates, and shorter debt tenors, may reduce some of the effectiveness of developed world renewable policies. For Indian policy makers, a key lesson is that they should explore methods of reducing the cost of debt to renewable energy projects. Furthermore, they might look to countries with similar growth and interest rate environments, and particularly Brazil and China (see figure 4-1) as inspiration for policy solutions to India's renewable energy dilemma.

8.2 Brazil and China

Brazil and China face similar renewable energy financing issues and both have enjoyed significant growth in renewable energy. As shown in Figure 8-2, Brazil has been developing non-hydro renewable energy resources since well before 1990. While much of this generation is biomass, wind energy has recently become a significant component. Brazil continues to have more renewable generation than India, and this gap widened in 2010, with strong growth also in 2011 (not depicted). China's growth is more recent, with a strong growth in wind generation since 2008 leading China to move ahead of India.

Yet these countries have taken different paths to incentivizing renewable energy deployment. In China, more than 80% of the country's renewable energy capacity has been built by State Owned Enterprises (SOEs) and their subsidiaries. As such, these companies enjoying financing through government guarantees on debt

Table 8-1: India Case Study Project Descriptions

PROJECT	DESCRIPTION
Acciona's Tuppadahalli wind power project	• An estimated INR 339.4 crore, 56.1MW wind farm • Financed through domestic debt, probably for one of the longest debt tenors (14 years) in India at an interest rate of ~11.8% • Signed a 20-year power purchase agreement (PPA) — subject to revision in the 11th year —with a state-owned distribution company at a tariff of INR 3.39/kWh • This project was selected due to the combination of foreign equity and domestic debt coupled with high disclosure in public domain
Reliance Power's Dahanu solar PV project	• An estimated INR 560 crore, 40MW solar PV project • Debt financing by U.S. EXIM bank and ADB for tenors of 16.5 and 17.5 years respectively at an average interest rate of 12% • Signed a 25-year PPA with Reliance's distribution utility at a tariff of INR 14.95/kWh • This project was selected as it was the largest solar PV project in India at the time of selection and offered unique perspective on combination debt financing by bi-lateral and multi-lateral lending agencies
LANCO's Chinnu solar thermal project	• An estimated INR 1,800 crore, 100MW solar thermal project equipped with molten salt storage technology • Debt financing received from a domestic lender at an interest rate of ~11% for a tenor of 13-14 years • Signed a 25-year PPA with NVVN (a government sponsored nodal agency) at a tariff of INR 10.50/kWh • The project is one of the seven winners and one of the largest solar thermal projects selected under phase one of the central government's Jawaharlal Nehru National Solar Mission (JNNSM)

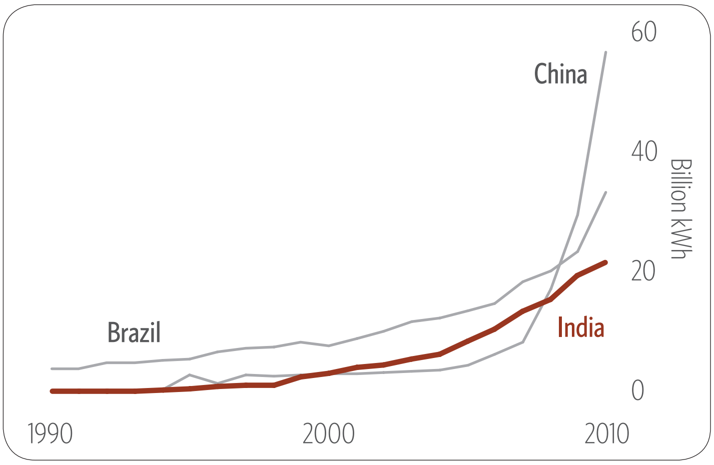
and access to low-cost government funding through related SOEs. Manufacturers, provincially-owned companies, and foreign joint ventures represent much of the remaining renewable energy deployment. The differences between China's and India's political and economic systems limit the potential applicability of any Chinese success stories.

Brazil's market-based, democratic system is generally analogous to India's, and Brazil's success in promoting renewable energy investment is potentially very relevant for Indian policymakers. Brazil has been successful encouraging renewable energy investment through low-cost, long-term debt financing at large-scale. A large public institution, the National Social Economic Development Bank (BNDES), has dominated the overall long-term debt market. BNDES issued almost twice as much in loans in 2011 as the World Bank did globally, and is the main source of credit for private and public companies in Brazil. BNDES has exclusive access to low-cost, risk-free funding from a workers' welfare fund (FAT), and the bank sets a long-term interest rate, known as TJLP (Taxa de Juros de Longo Prazo). As of June 2012, the TJLP was 5.5%, with tenors of 16 years.[26] This is well below the market rate of interest (30%) and central bank's interest rate (8.5%).[27]

According to a 2012 study by Deutsche Bank Climate Change Advisors, the availability of BNDES loans cut renewable energy costs in Brazil by as much as one fifth:

"We find that replacing BNDES loans with commercial debt increases the levelized cost of energy (LCOE) of a typical Brazilian wind project by 23%. Indeed, the low bid cap that Brazil's energy regulator has set for its next energy auction in March 2012 — USD 65/MWh, USD 15/MWh below what we calculate as the unsubsidized LCOE of a favorably-sited wind power project in Brazil based on commercial loans — underscores the strong influence of BNDES debt on the contract prices in Brazil's energy auctions."[28]

Figure 8-2: Non-Hydro renewable Energy Production in Brazil, China and India (1990-2010)



26 UPDATE 3-Brazil unveils stimulus, cuts BNDES lending rate, REUTERS, 27th June 2012

27 OCED Economic Surveys, Brazil, 2011.

28 Deutsche Bank Climate Change Advisors (2012): Attractive Price Discovery? Or the Discovery of Attractively-Priced Debt with High Capacity Projects? Unpublished draft, Frankfurt, Germany.

9. Conclusions and Next Steps

The main conclusions of our analysis can be summarized as these:

- The high cost of debt, that is, high interest rates, is the most pressing problem facing renewable energy financing in India and has significant impact on the levelized cost of electricity. As of now, neither the cost nor the availability of equity is a major problem, but this could change, particularly if debt becomes less available.
- General Indian financial market conditions are the main cause of high interest rates for renewable energy. Growth, high inflation, and country risks all contribute. A shallow bond market and regulatory restrictions on capital flows also adds to the problem. Continued high government borrowing keeps the risk-free rate elevated.
- Regulation and the structure of the India power sector also raise significant issues. State-level policies — including the financial weakness of the state electricity boards — increase project risk. National policies designed to weave state policies together do not adequately reflect the realities of financial markets or state-level risks.
- Differences in national financial markets impact renewable energy policy design and effectiveness. Lessons learned from, and policies developed by, developed economies may not be particularly useful given these differences in financial markets.
- Other developing countries have bridged the financing gap in unorthodox but successful ways. Brazil's BNDES is an especially promising example that deserves further study and consideration by Indian policymakers.

9.1 Next Steps for Research and Analysis

CPI's intent is to further extend this report's lines of inquiry in directions that will assist policymakers in identifying the most effective policy options. Several areas of immediate interest for future research include:

- Examining the design and implementation of funding mechanisms that would provide long-term, low-cost debt — for example, by examining best practices worldwide, including Brazil and China.
- Expanding the scope to include projects in different Indian states — to cover policy as well as institutional variations — and other technologies, such as small hydro or biomass.
- Extending the analysis to compare renewable energy markets and corresponding design features — for example, how sensitive are financing costs to a price band that is intended to provide stable price signals?
- Understanding how financiers and developers will alter their financial requirements when investing in portfolios of projects — for example, how does the cost of increasing development uncertainty impact willingness to invest?

Appendix 1

Methodology and assumptions

We developed project cash flow models to examine impact of policy pathways on the key financial metric: the levelized cost of electricity (LCOE). The inputs required were the project-related costs, revenues, and financing characteristics.

Base model: The basic idea is as follows. Given the project financial parameters, we calculated the "minimum revenue" (i.e., LCOE) that the developer would need to meet the ROE objective. We assume that, given fixed ROE and debt-rate, a rational developer would attempt to maximize leverage so as to minimize the cost of capital. Leverage is optimized so that the debt service coverage ratio (DSCR) condition is met throughout the project.

The model uses our best estimates of future cash flows for the lifetime of the project, considering the prevailing capital investment tax laws, depreciation schedules, etc. For example, the income tax calculations are based on prevailing tax laws in India, with the 10-year tax holiday for renewable energy projects. Detailed interviews with developers provided the financial parameters (ROE, debt-rate, debt-tenor, DSCR, etc), expenditures (capital, operations & maintenance costs, etc) as well as other sources of revenue (e.g., CER revenue). Any missing information was either collected via secondary research or via generic project-level information used by CERC.[29]

Finally, given that there is inherent variability in renewable energy generation due to intermittency of underlying sources, we use two different power load factors (PLFs) in our analysis. For calculating ROE, the P50 PLF is used, given that it represents the most probable output of the plant. However, for calculating leverage, the P90 PLF is used, as required by the banks.

Algorithm used for calculation of the LCOE: This results in an iterative optimization procedure for calculating the PPA price (or LCOE).

1. We start with a reasonable (high) value of LCOE.
2. Given the LCOE, the leverage is maximized while ensuring that the DSCR requirements are met.
3. Given the leverage, the LCOE is adjusted so that it ensures that the ROE requirement is met.
4. If the solution doesn't converge, the process in 2-3 is repeated.

This process is guaranteed to converge. The result is the optimized LCOE, where the twin conditions of maximizing leverage while meeting ROE are satisfied.

Limitations of the model: Our analysis has limitations. One of the most crucial is that the actual PPA price for the project can be different from the LCOE as derived by our model. This may happen due to many reasons. First, the actual (or realized) ROE from the project may be different from the stated ROE (or hurdle rate) by the developer. Second, as mentioned earlier, in absence of real project data, we used generic data based on CERC data.

Sensitivity analysis: Once we obtain the base model, we perform sensitivity analysis for the key parameters — debt-rate, debt-duration, debt-variation, return on equity, and technology cost — based on realistic ranges gathered from conversations with various stakeholders as well as secondary research.

Variable rate debt: To calculate the impact of variable rates, we need to account for two things. First, we calculate the impact of a variable-to-fixed debt conversation. Given that the Indian markets are not very liquid, we use a typical 10-year LIBOR swap, which is currently trading around 2%. We then calculate the impact of this swap in the same manner as an increase in debt-rate — the LCOE of the solar and wind projects goes up by 7% and 4%, respectively (see the impact of "variable debt rate" in Figure 3-2). Second, given that now the debt is fixed term, the risk for equity investors would go down, and we adjust for ROE expectations downward. For simplicity, we have assumed a downward adjustment in ROE expectations to be the same as the term-swap cost. This results in an equal and opposite change in LCOE (see the "equivalent ROE reduction" in Figure 3-2), and the effects of variable-to-fixed debt conversion and the resulting ROE adjustment cancel out.

29 CERC tariff order, March, 2012, available at http://cercind.gov.in/2012/orders/RE_35_2012.pdf

Appendix 2

An important thread of CPI analysis investigates how policy can influence the cost of renewable energy through risk and finance. This analysis is documented in a number of places, including in the CPI paper, "The Impact of Policy on the Financing of Renewable Projects." As highlighted in section 8 and Figure 8-1, for this report we have garnered significant insight into the issues of financing renewable energy in India by extending this analysis to a series of projects in India and then comparing the results to projects in the US and Europe. As with the US and Europe analysis, we focus on a set of generic "policy pathways" that address how different types of policies can influence costs by creating or removing risks, such as those associated with fixed revenues or that have revenues dependent upon commodity markets or of having certainty for a shorter or longer time period. To the US and European list of pathways (duration of revenue support, revenue certainty, risk perception, completion certainty, and cost certainty) we have added two that are specific to India (debt-cost reduction and debt-tenor reduction) to reflect particular policy pathways that are important for India.

In this appendix we provide some more detail on the Indian side of the analysis (see figure 8-1 and Table 8-1). We discuss how we have calculated the impact for each of the policy pathways in the Indian context. Chart A2-1, then, shows further detail for figure 8-1, presenting a breakout of the impact of each of the policy pathways on three individual projects in India, and comparing those against 5 projects included in our US and European analysis.

Duration of revenue support: This pathway essentially models the case where policy may influence the cost of renewable projects by allowing for longer-term PPAs. For example, the JNNSM solar PPA provides revenue certainty for 25 years which, in principle, would allow for longer debt tenors. Longer debt tenors would then allow for higher leverage given that debt has to be repaid over a longer period, and a higher leverage would result in a lower cost of capital and hence a lower LCOE. Our sensitivity analysis examines the case where the duration of the PPA is increased from 10 years to 20 years, where the former represents many of the existing PPAs and the latter represents a longer PPA available for wind projects.

Revenue certainty: This pathway essentially models the case where policy may influence the cost of renewable projects by allowing for higher revenue certainty. For our sensitivity analysis, we compare feed-in (or preferential) tariffs – a certain option – vs. REC – a more uncertain option. (Given the inherent variability in the REC revenue stream, a FIT lower than the average revenues under the REC scheme is required.) We calculate the required PPA price (or FIT) that would allow the same ROE as the REC scheme, where the revenues under the REC scheme are calculated as the sum of the average price of electricity as well as the REC prices, with the P50 and P90 cash flows determined by the average and floor REC prices, respectively.

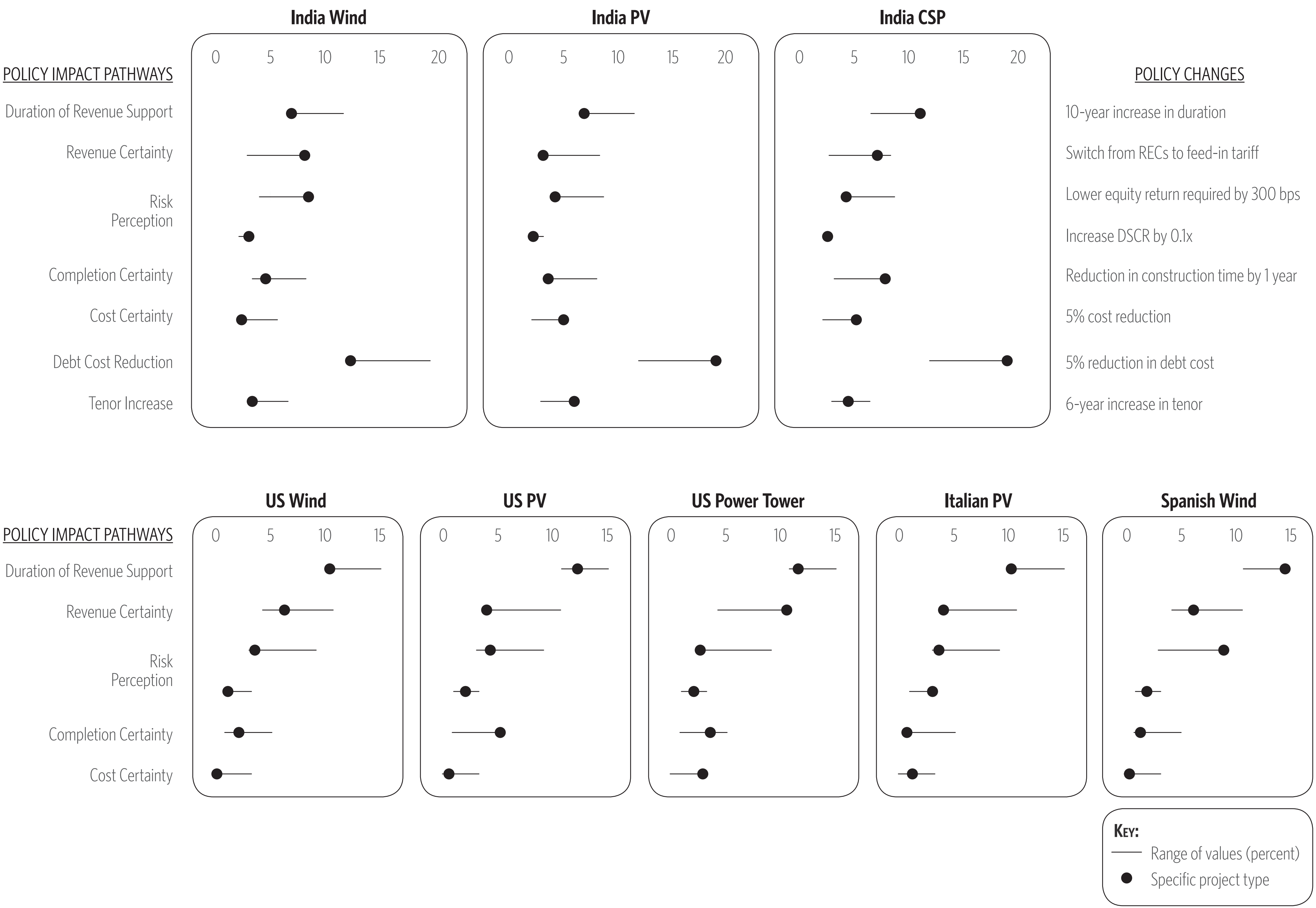
Risk perception: Under this pathway, we examine the likely impact of policy changes on reducing the risk perception of renewable projects. To do so, we look separately at equity and debt.

We examine equity first. In Section 3, we indicated that the ROE expectations are higher in India compared to the U.S. and the EU. For our analysis, we assume that the absolute ROE in India can be brought in par with global trends, which allows us to perform the sensitivity analysis with a 3% reduction in ROE. (However, as one may recall, the higher ROE in India is mostly due to the high underlying debt-rate and, therefore, this exercise may be of little value unless unaccompanied with a corresponding decrease in the debt rate.)

We examine debt next. To reflect reduced risk perception by banks, the sensitivity analysis is performed by relaxing the DSCR requirement by 0.1. Given lack of data in the Indian market, this is essentially borrowed from the CPI paper, "The Impact of Policy on the Financing of Renewable Projects," where a 0.1 change in DSCR captures the variation between the average DSCR and the boundaries of acceptable DSCR ranges in the U.S. and the EU.

Completion certainty: Under this pathway, we examine the likely impact of policy changes on reducing (risk related to) construction delays. As construction periods are reduced, cash flows are derived faster, resulting in faster repayment of loans, increasing leverage, and thus, reducing the LCOE. To perform our sensitivity analysis, based on the typically observed delays in renewable projects, we assume that the construction period is delayed by one year. This would typically increase the LCOE of the project, given that the leverage would go down due to delay in debt-related cash flows. However, given that most of our results are presented in form of the impact of policy parameters on reducing LCOE, we present the reduction of LCOE from the delayed case to the base case.

Figure A2-1: Impact of policy pathways on specific projects in India, US, and Europe



Cost certainty: Under this pathway, we examine the likely impact of potential cost overruns due to technology (e.g., solar PV module costs) as well as non-technology-related factors (e.g., labor prices).A lower overall cost directly allows for a lower LCOE. To perform our sensitivity analysis, based on global trends for technology cost reductions, we assume that the projects' costs are reduced by 5%.

Debt cost reduction: Indian debt markets are very different from developed world markets. Not only is debt more expensive but it is also typically available at a variable rate. The latter means that the equivalent fixed-rate debt would be even more expensive in India than is typically suggested (Section 4.3). As we show in Section 3, a major reason behind why the cost of a renewable project is higher in India is the high cost of debt. If policy could bring the Indian debt-rate down to the developed world counterparts, the cost of the renewable projects would go down. Therefore, our sensitivity analysis examines the case where the debt costs can be reduced by 5% from the base case.

Debt tenor reduction: Similar to high-debt costs, the lower debt-tenors are also an Indian phenomenon. Typically, due to asset liability mismatches as well as regulatory restrictions, Indian banks are not comfortable lending for long durations. This is, again, a situation where policy can help by allowing for longer debt tenors, which reduce the cost of renewable projects as identified earlier under the discussion for the revenue certainty pathway. To perform the sensitivity analysis, based on the difference between the length of typical debt-tenors and typical renewable project lifecycles, we consider the impact of an increase of debt tenors by six years.

Appendix 3

State-level policy issues

In India, installed capacity of wind and solar technology varies significantly across states. For example, wind capacity is more than 1,000 MW in states such as Tamil Nadu, Maharashtra, Gujarat and Karnataka, but less than 50 MW in states such as West Bengal and Kerala (Table A3-1).

Table A3-1: Solar and wind power installed capacity by state (MW), 2011-12

STATES	SOLAR PV
Gujarat	654.8 (1)
Rajasthan	197.5 (2)
Andhra Pradesh	21.8 (3)
Punjab	9 (9)

STATES	WIND
Tamil Nadu	5904.12 (1)
Karnataka	1726.85 (4)
Madhya Pradesh	275.9 (5)
West Bengal	4.3 (8)

Note: State ranking based on installed capacity of solar/wind technology is given in brackets. Source: Conditions on land transfers waived off, Chakraborty, 2012, Project Monitor, and Energy Statistics 2012, MOSPI, India

Renewable energy development in a state is likely to be correlated with renewable energy resource potential represented by key parameters such as solar radiation and wind speed. This is based on the simple fact that, all else being equal, higher resource potentials translate to higher power load factors. Higher power load factors allow higher generation of power given a certain installed capacity, and hence cheaper cost of generation. For example, Rajasthan and Gujarat, which are the top two states in terms of solar irradiation in the country, hold the top two spots in terms of solar deployment, accounting for the majority portion of the solar PV installed capacity in the country.

However, the variation in state renewable energy installed capacity is not fully explained by the variation in resources — for example, Gujarat has the highest wind energy potential but less than half the installed capacity of Tamil Nadu. Many other factors — such as policies and the business environment — are likely to affect renewable energy development. For example, we would expect more deployment in states with stronger policies. In the case of solar PV, the implementation of Gujarat's policy of preferential tariffs for solar power before the announcement of national solar mission (JNNSM) helped the state to install approximately two thirds of the total solar PV installed capacity in the country by 2012. (In addition, Gujarat's solar power policy has certain advantages compared to the JNNSM in terms of investment-friendly off-take price and no domestic content clause for solar power equipment.[30])

We would also expect more deployment in states that have reduced PPA risks due to better off-taker (i.e., SEB) finances. According to CRISIL, an analytical firm, the aggregate accumulated losses of state-owned power utilities are estimated to reach INR 2 trillion by the end of March 2012,[31] with three fourths of these losses in the last five years (2007-12). Even though renewable project developers sign long-term PPAs at preferential tariffs with these companies, SEB's poor financial health leads to the risk of default in payments or renegotiation of the terms of the contract. Indian banks continue to be wary of lending to renewable energy projects that signed PPAs with state-owned electricity distribution companies.

This is confirmed by the following, preliminary, analysis

30 Healthy return is the key to solar power, The Hindu, July 29, 2012

31 Power distribution companies' losses cross Rs 2 lakh crore, says Crisil, The Economic Times, May 7, 2012

Table A3-2: Regression results

TARGET FACTOR	REGRESSION I: SOLAR ENERGY			REGRESSION II: WIND ENERGY		
INSTALLED CAPACITY 2010/2011 (MW)	RESOURCE POTENTIAL	POLICY STRENGTH (2010)	SEB LOSSES (2010)	RESOURCE POTENTIAL	POLICY STRENGTH (2010)	SEB LOSSES (2010)
REGRESSION SIGN	+	+	-	+	+	-
EXPECTED SIGN	+	+	-	+	+	-

Sources: Solar radiation rank: http://www.solairedirect.in/framework.html; Wind energy potential: Energy Statistics 2012, MOSPI, India; RPO: State-wise Feed-in (or preferential) tariffs for Wind Power, Indian Renewable energy guide, energy alternative India, 2010-11.

(Table A3-2). Our analysis is based on a simple cross-sectional regression that correlates installed capacity with (a) resource potential, (b) SEB losses and (c) policy strength, where policy strength represents the key policy for the corresponding technology.[32] (We have taken the FIT rate and RPO target as the measures for solar and wind, respectively.) As expected, for both technologies, our results show the following with installed capacity: positive correlations with resource potential as well as policy strength; and a negative correlation with SEB losses. A detailed analysis including a larger set of variables and states can give us more precise estimates and causes of state-by-state renewable energy development.

32 Solar regression include nine states; Gujarat, Rajasthan, Andhra Pradesh, Maharashtra, Tamil Nadu, Orissa, Uttar Pradesh, Karnataka, Punjab. Wind regression include eight states; Tamil Nadu, Maharashtra, Gujarat, Karnataka, Madhya Pradesh, Andhra Pradesh, Kerala, West Bengal.

Appendix 4: Explanation of U.S.-India figure in 3.1

In Figure 2-5, we compare the levelized cost of electricity (LCOE) for renewable power projects in India to similar projects in the U.S. This comparison is performed for wind and solar power plants, using actual project level data, and is based on variation in three key project parameters — capital cost (CAPEX), power load factor (PLF), and financing cost.

We studied the following projects in India (more detail on these projects is provided in Section 8):

- Solar PV – Reliance Powers' 40 MW project in Dahanu, Rajasthan
- Wind – Acciona's 56.1MWproject in Tuddapahali, Karnataka

In the U.S., we focused on the following projects (more detail on these projects is provided in the CPI study "The Impact of Policy on the Financing of Renewable Projects"):

- Solar PV – Sunpower's 19MW project in Greater Sandhill, Colorado
- Wind – First Wind's 204MW project in Milford, Utah

It is illustrative to examine the solar PV projects first. The LCOE for the Greater Sandhill project is estimated to be USD 0.19/kWh. We normalize this to 100% and sequentially consider the impact of changes in CAPEX, PLF and financing costs for the Dahanu project:

- The CAPEX for Dahanu is lower, resulting in a reduction in the LCOE by 25%. (We have adjusted for differences in timing of these projects.)
- The PLF for Dahanu is lower, resulting in an increase in LCOE by 23%. (This may have to do with not only dustier environments in India but also better tracking technology in the U.S. The latter may explain some of the differences in CAPEX.)
- The financing costs for Dahanu are higher, increasing the LCOE by 25%.

So, although the changes in LCOE due to CAPEX and PLF effectively cancel out, the cost of electricity is higher in India due to higher financing costs.

Similar trends are shown for wind. The capital costs are lower, which reduce the LCOE by 29%. The PLF is higher, which reduces the LCOE by a further 5% to bring the overall reduction to about 34%. However, higher financing costs push up the LCOE by 22%, leaving the overall reduction to be about 12%.