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ASIA-PACIFIC PARTNERSHIP ON CLEAN DEVELOPMENT AND CLIMATE

Pursuing Clean Energy Business in India

Background Paper

Prepared by

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June 2007

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This background Paper is not intended to be used as a tool for basing final investment decisions upon but is intended to provide an introduction to some of the potential barriers for the development of renewable energy sector in India. The authors, along with contributors and agents, are released from and indemnified against all actions, claims and demands which may be instituted against the authors arising out of this background paper. The views expressed in this publication are those of the authors at the time of writing are not attributable to any other party. Every effort has been made to correctly attribute sources of information. No responsibility is taken for incorrect attributions which may have inadvertently occurred.

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1 Introduction

This paper is intended to provide a succinct background to a questionnaire which seeks the input from key stakeholders interested and involved in the renewable energy industry in India.

The aim of this project is to identify the barriers to enhanced development and deployment of renewable energy and distributed generation technologies in India and to seek solutions to overcoming those barriers. Of particular interest is in how private sector views can be communicated to policy makers in the Asia-Pacific Partnership on Clean Development and Climate (APP) and how partnership countries, such as Australia can play a role in providing solutions.

Stakeholders from the renewable energy industry will be asked to provide input to the project via a questionnaire and/or consultations which will seek their views on a) the barriers to accelerating investment and deployment of clean energy technology in India and b) the actions required to remove those barriers. From this input and research, together with our partner The Energy and Resources Institute (TERI), we will develop a report with recommendations and a Strategic Action Plan to be submitted to the Renewable Energy and Distributed Generation Task Force (REDGTF) of the APP.

This paper describes:

- A brief background on the APP (section 2);
- The scope of the "Pursuing Clean Energy Business in India" project (section3);
- A brief overview of the Indian Renewable Energy sector (section 4) - conducted by TERI and expanded upon in Appendix 1;
- A summary of key Barriers to financing the development and deployment of clean energy technologies in India (section 5) - based on a global literature review which is provided in full in Appendix 2.
- The consultation/questionnaire process that we will be adopting to seek key stakeholders input (section 6).

2 The Asia Pacific Partnership on Clean Development and Climate

The Asia-Pacific Partnership on Clean Development and Climate (APP) brings together Australia, China, India, Japan, the Republic of Korea and the United States to address the challenges of climate change, energy security and air pollution in a way that encourages economic development and reduces poverty. The APP represents around half the world's emissions, energy use, GDP and population, and is an important initiative that engages the key greenhouse gas emitting countries in the Asia Pacific region. Through the APP, business, government and researchers have agreed to work together to focus on the development, deployment and transfer of cleaner, more efficient technologies, which can achieve sustainable economic, social and environmental development.

2.1 Renewable Energy and Distributed Generation Task Force

Under the APP, the Renewable Energy and Distributed Generation Task Force (REDGTF), places emphasis on renewable and distributed generation technologies,

such as solar, wind, small hydro, geothermal, and biomass. Based on the energy needs in many rural areas, distributed generation technologies (decentralized, small-scale) are seen as a potential solution to delivering energy and electricity to areas which may not be served by grid applications in the near to medium term. Objectives of this task force include: facilitation of the development and deployment of renewable energy and distributed generation technologies, identification of areas for technology and knowledge transfer between partner countries, and promotion of opportunities for collaboration and accelerated solutions through the application of renewable energy and distributed generation technologies.

3 Scope and objectives of this project – "Pursuing Clean Energy Business in India"

This project seeks to identify the barriers and opportunities to accelerated development and deployment of renewable energy and distributed generation technologies through enhanced collaboration between APP partner nations; in particular Australia and India. The project will involve undertaking a global literature review, stakeholder engagement, questionnaire and case study development. An output of the project will be the development of a strategic action plan to facilitate greater knowledge transfer, policy intervention, investment and commercial activity between partner countries. Each phase of the project will involve input from Indian, Australian, and multinational experts in the renewable energy technology fields to inform the process and provide insight to enhanced collaboration and solutions toward accelerating the development of the renewable energy market in India and between partner nations. A particular focus will be on the identification of opportunities between Australia and India.

4 Overview of Indian Renewable Energy Sector

The Energy and Resources Institute conducted an overview of the Indian Renewable Energy Sector for this project. A brief summary of their findings are provided below and the full report can be found in Appendix 1.

Teri has highlighted energy security concerns and energy portfolio diversity to be the primary drivers for the renewable energy market in India. The current political environment coupled with a gap in current energy shortages in supply and increasing energy demand lead Teri to conclude that renewable energy will play an integral role in the future energy scenario in India.

Table 1 below offers a summary of renewable energy based power generation in India in present installed capacity, projections and investments required as per the government targets for 2012. The total installed grid connected power generation from RE sources is 102,971 MW as of 31st May 2007.

Table 1 Potential, targets and investments required to meet the targets

	Potential (MW)	Installed capacity till March 2007 (MW)	Target of addition in 11th plan (MW)*	Total expected capacity by 2012 (MW)	Investment required from 2007-2012 (million AUS $)
Small Hydro	15000	1976	1400	3376	2447
Wind	45000	7092	10500	17592	18358
Solar PV**		86	50	136	**
Solar Thermal		0	0	0	0
Solid Biomass	19500	569	500	1069	582
Bagasse CHP		615	1200	1815	1308
Waste to energy	1700	43	400	443	349
Geothermal	NA	0	0	0	-
Tidal/ocean	NA	0	0	0	-
Total		10297	14000	24295	23044

** Source: Report of the working group on New and Renewable Energy for 11th Five Year Plan*

*** There is very limited capacity of grid-connected power plants; the installed capacity primarily includes the decentralised individual systems. The investments required are dependent on the availability of subsidy.*

TERI's overview of the Indian Renewable Energy Sector also makes the following conclusions:

- The Indian power deficit at present is about 10%, and it is expected that it would remain at these levels even with the planned power generation capacity additions.
- This energy deficit coupled with direction provided by the Electricity Act of 2003 and other emerging policies will continue to provide support for a growing renewable energy market, which is likely to be a significant part of the Indian energy mix.
- It is expected that the present level of policy support for renewables will be stable and continue until 2012.
- The tariff policy under the Electricity Act also indicates opportunities to increase the competitiveness of renewable energy technologies through preferential tariff structures.
- The level of support and incentives should increase the viability of RE technologies, and RE is expected to compete with conventional power on price levels at some point in future.
- In the case of decentralised power generation, TERI projects that the present policy incentives should increase, mainly through subsidy arrangements, and continue, as the goal of government is to supply power for all.

5 Summary of key barriers

In undertaking this project a global Literature Review was conducted to identify the barriers to financing the development and deployment of clean energy technologies in India (see Appendix 2: Literature Review). A summary of the barriers extrapolated from the literature review are given below.

5.1 Perceived Lack of Coordination/Integration of Policy

From both the literature review and initial consultations, there appears to be a perceived lack of coordination/integration of how Renewable Energy policy appears to apply across Indian government ministries, states, sub-sectors, and in alignment with broader development issues. In both the literature and initial consultations, it has been suggested that policies are unclear and inconsistent between local and central governments and between the various ministries charged with creating and implementing policies related to renewable energy, power, and climate change. For example, some perceptions were that there are conflicting policies that may arise between the Ministry of New and Renewable Energy, the Ministry of Power and the Ministry of Environment and Forests. Additionally, some commentators have indicated that policies may not be consistent across sub-sectors, such as wind, solar, biomass, and hydro, and there is the potential that policies may conflict rather than align with broader development issues, such as public health, economic development, and climate change.

5.2 Market Distortions of Fossil Fuels vs. Renewables

This broad barrier encompasses: lack of accounting for externalities (both environmental and socioeconomic) in conventional fossil fuels, price distortions, uneven subsidies and tax structures, and capital cost accounting vs. lifecycle accounting. Some distortions may arise due to uneven price setting across and within sub-sectors, lack of price level guarantees, and lack of price rationalization; whereas other distortions may arise from challenges or unknowns, such as, quantifying externalities and tracking subsidies.

5.3 Perceived Lack of Clear and Consistent Long-Term Policy

Renewable energy policy can be complex and inconsistent, and may not, in some instances, extend beyond 2012. Both the literature and initial consultations reveal potentially misaligned incentives, poorly targeted subsidies, complexity in transparency and clarity in the policy frameworks, and few long-term policy guarantees.

5.4 Early Stage Financing Gap

There is a lack of funding for research, development, and demonstration of early stage technologies and a gap in financing from innovation to commercialization. While commercially-proven technologies appear to have adequate access to capital, a gap remains in seed or venture capital for small to medium sized enterprises and innovative early stage technologies.

5.5 Weak or Unclear Legal/Regulatory Environment

Despite an English Common Law system with strong investor protection rights on paper, the enforcement of the legal and regulatory environment in India appears to be a significant barrier for enhanced private sector participation in the renewable energy market. It was suggested in the literature review that informal governance plays a part in a system based on social relationships and reciprocity that emerges from a long and complex legal process and lack of legal enforcement. Additionally, regulatory issues such as time delays and complexity in the permitting and siting of projects may pose additional legal and regulatory hurdles.

5.6 Lack of Capacity at all Levels

Lack of awareness and capacity throughout the entire renewable energy project supply chain remains a significant barrier. There appear to be disconnects and lack of information both horizontally and vertically in areas of finance, policy, project

development, maintenance, and consumer education. High risk perceptions and hesitance to participate in the renewable energy market often stem from lack of information on the part of bankers, policy makers, project developers, personnel, and consumers.

5.7 Technology- Specific Barriers

As renewable technologies depend upon renewable resources, challenges arise in the way of intermittent nature and uncertainty of supply, low conversion efficiencies, lack of mature energy storage technologies, uncertain forecasting, environmental and/or social issues (i.e. emissions, construction, land impacts, etc.). Some technologies remain in early stages and have yet to emerge with scalable commercially proven models.

5.8 Lack of Access to Affordable Capital

Many renewable energy projects are currently financed on balance sheets and through relationship lending rather than on the merits of the project. Novice developers and financiers add to greater risks and time delays, increasing cost and availability of capital. Additionally, lack of consumer-side financial products and microfinance compound issues in dissemination of renewable energy distributed generation technologies.

5.9 Need for Improved RE Project Risk

The risk profile of many renewable energy projects are not yet suited to the return profiles of projects. Inherent project risks coupled with additional intermittent nature and early stage technologies of renewables can create an unattractive risk/return profile fro project financiers. Lack of information and renewable energy being a nascent industry add to the risk perception and lack of available products to manage and mitigate risk, such as insurance products and innovative financing.

5.10 Uncertainties Surrounding Carbon Finance

Although renewable energy projects in India have the potential to create a secondary revenue stream through the Clean Development Mechanism (CDM) under the Kyoto Protocol, some of the uncertainties that surround CDM projects are: low Certified Emission Reduction (CER) price levels, uncertainty over CER price projections, difficulties with baseline emissions assessments, clarity of eligibility criteria, and lack of confidence in the system that will approve projects.

6 Questionnaire/consultations process

This project seeks the input of key stakeholders who will be approached and invited to participate in the project by answering a questionnaire via an on-line platform. As wide as possible stakeholder audience will be approached directly and via partners/supporters of the project such as industry associations and government departments.

The Questionnaire will consist of three sections:

i) Barriers - which respondents will be asked to rank in level of importance
ii) Actions to remove barriers – which respondents will be asked to rank in terms of priority
iii) Qualitative responses for individuals to provide expert commentary

For Australian companies there will be an additional section with Australian specific barriers, actions and questions.

The questionnaire/survey process will run over the months of July and August 2007. A final report with recommendations and a Strategic Action plan will be prepared and delivered to the REDGTF of the APP in November 2007.

7 About Clean Technology AustralAsia

Clean Technology AustralAsia Pty Ltd (CTA) was established to accelerate the deployment of Clean Technologies in the Asia Pacific and to build the Cleantech industry in Australasia.

Through the AustralAsian Cleantech Forum™ and the India Cleantech Forum, CTA creates a platform for knowledge exchange and commercial interaction for the full range of investors, funds and companies interested in Cleantech investing (see www.cleantechnology.com.au).

CTA provides professional services to the Cleantech network that includes strategic advice, information on Cleantech investment trends, executive search, consulting on finance and sustainability strategy and facilitating investors and companies in their needs for capital and growth. CTA also identifies and packages “clean technology solutions” to environmental problems and projects for sustainable development in Australia and internationally.

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8 Appendix 1- Overview of the Indian Renewable Energy Industry

This paper was provided by The Energy and Resources Institute, India for this APP project and is reprinted here in full.

Renewable energy sector in India

Renewable sources of energy would play an important role in the future energy scenario in India. The present and projected gap between the demand and supply of energy would induce faster development of renewables in India. In case of India, the push for renewables would come more from the energy security and diversity concerns rather than those of environment. The challenge of supplying energy to the vast population in sustainable manner could only be met through higher share of renewables in the overall energy scenario.

Resource Potential and status

India has high availability of renewable energy resources like solar, wind, biomass, and hydro etc. The table below gives resource potential of various renewable resources and the installed capacity for grid connected power generation in India.

Table 1 Potential of renewable energy sources

Resource	*Potential (MW)*	*Installed capacity as on 31st March 2007 (MW)*
Wind	45000	7092
Small hydro	15000	1975
Biomass power / cogeneration	19500	1184
Solar	4-6 kWh/m^2/day	2.74
Waste-to-Energy	1700	43

Source: Annual report, Ministry of New and Renewable Energy, 2006-07

The figures mentioned in table above are indicative only, since detailed assessment of resources is an ongoing process especially in the wind and biomass sectors. The availability of resources when combined with the demand for energy in various sector gives an indication of the potential for renewables. The total installed power generation capacity, gird connected, based on renewable energy sources is 102971 MW as on 31st May 2007.

Brief history

Recognizing the importance of the renewable sources of energy, CASE (Commission for Additional Sources of Energy) was set up, under Department of Science and Technology, Ministry of Human Development, Government of India, in 1981 with the objective to develop, and demonstrate renewable energy technologies. Subsequently, in 1982, the Department for

Non-conventional Energy Sources was created in the Ministry of Power, which was later upgraded to an independent Ministry of Non-Conventional Energy Sources in 1992. Since then the sector has undergone many phases of development such as the 'classical' development cycle with initial stage of technology development and demonstration, followed by the policy and financial incentives for market creation. On the financing front, in order to overcome the barrier of high initial cost and high financing risk perception of the renewable energy technologies; IREDA (Indian Renewable Energy Development Agency Limited) was established in March 1987 as a public sector enterprise to finance renewable energy projects. IREDA provides loan for renewable energy projects at lower interest rate. Depending upon the commercial viability of different renewable technologies the interest rates increase step by step. However, today in many sectors the interest rates offered by IREDA are at par with market interest rates.

As a result of these efforts at various levels the industrial base has been developed in India in different renewable energy sectors like wind, small hydro and solar energy. In addition to the above-mentioned sources, there is renewed interest in the development of biofuels sector. However this sector is still developing and the industrial base is not yet fully developed although, efforts are underway in that direction.

Government policy and regulation

The Ministry of Non-conventional Energy Sources, which is recently renamed as Ministry of New and Renewable Energy (MNRE), has prepared a draft renewable energy policy, which is yet to be approved and notified.

The most important legislative development, which had induced the recent growth in renewable power sector, is the "Electricity Act 2003'' which was notified in June 2003. It recognizes the role of renewable energy technologies for supplying power to the utility grid as well as in stand-alone systems. Some of the important provisions in the Act in this regard, are given below.

Electricity Act 2003

Section 3 (1)

The Central Government shall from time to time, prepare the National Electricity Policy and tariff policy, in consultation with the state governments and the Authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy.

1.0.2.2 Section 4

The Central Government shall, after consultation with State Governments, prepare and notify a national policy, permitting stand alone systems (including those based on renewable sources of energy and other non-conventional sources of energy) for rural areas.

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Majority of the states in India (18 out of 28) have already established the state electricity regulatory commissions (SERC). The state electricity regulatory commissions (SERCs) are now crucial players in the context of state level policies for renewable.

Section 61 (h)

The Appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the promotion of co-generation and generation of electricity from renewable sources of energy.

Section 86 (1) (e)

One of the functions of the state regulatory commission is to *promote co–generation and generation of electricity through renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any persons, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee.*

The section 86(1) (e) makes it mandatory for the distribution companies to buy certain percentage of the total energy consumption from renewable sources of energy. The SERCs have been given responsibility of determining this percentage or a quota for renewable power.

As per the provisions (section 3(1)) of the Electricity Act 2003, the Ministry of Power, Government of India also notified the National Tariff Policy on January 6, 2006. Some of the important provisions with regard to non-conventional energy generation are:

National Tariff Policy

Section 6.4

Pursuant to provisions of section 86(1) (e) of the Act, the Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentage for purchase of energy should be made applicable for the tariffs to be determined by the SERCs latest by April 1, 2006.

Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the Act within suppliers offering energy from same type of non-conventional sources. In the long-term, these technologies would need to compete with other sources in terms of full costs.

The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non–conventional sources, to be followed in cases where such procurement is not through competitive bidding.

Implementation of Section 86 (1) (e) of the Electricity Act 2003 and Section 6.4 (1) of the National tariff Policy are underway. Different states are in the process of issuing tariff orders for renewable energy based electricity generation and specifying quota/share for power from renewable energy in accordance with the provisions of the "Electricity Act 2003'.

Essentially, The National Electricity Policy 2005 and Electricity Act 2003 have given clear mandate to state electricity regulatory commissions (SERC) to promote renewable energy; including fixing a share for RET based electricity. Presently the investment decisions are based on (apart from resource potential in different states):

- The buy-back tariffs
- Wheeling charges
- Whether banking of power is allowed or not
- Whether `Third Part Sale' is allowed or not

Therefore, the proviso of the National Electricity Policy 2005 and Electricity Act 2003 has a strong bearing on the investment climate.

The present status of issuing tariff orders and specifying quotas for renewable energy procurement in some of the major Indian states is summarized in table 2 below:

Table 2 Status of specified quotas for renewable energy procurement in different states

S.No.	State	Quota/Renewable Purchase Obligation	Time Period
1	Andhra Pradesh	Minimum 5% of total energy consumption (of this 1/2% is to be reserved for wind)	2005-06, 2006-07 & 2007-08
2	Gujarat	Minimum 1% of total energy consumption	2006-07
		Minimum 1% of total energy consumption	2007-08
		Minimum 2% of total energy consumption	2008-09
3	Himachal Pradesh	Minimum 20% of total energy consumption	2007-10
4	Haryana	Up to 2% of total energy consumption	2006-07
		Up to 2% of total energy consumption	2007-08
		Up to 3% of total energy consumption	2008-09
		Up to 10% of total energy consumption	2009-10
5	Karnataka	Minimum 5% and maximum of 10% of total energy consumption	
6	Kerala	Minimum 5% of total energy consumption (of this 2% from SHP, 2% from wind and 1% from all other NCE sources)	2006-09
7	Madhya Pradesh	Minimum 0.5% of total energy consumption including third party sales from wind energy	2004-07

8	Maharashtra	Minimum 3% of total energy consumption	2006-07
		Minimum 4% of total energy consumption	2007-08
		Minimum 5% of total energy consumption	2008-09
		Minimum 6% of total energy consumption	2009-10
9	Orissa	3% (for wind and SHP)	
10	Rajasthan	Minimum 4.88% of total energy consumption	2007-08
		Minimum 6.25% of total energy consumption	2008-09
		Minimum 7.45% of total energy consumption	2009-10
		Minimum 8.50% of total energy consumption	2010-11
		Minimum 9.50% of total energy consumption	2011-12
11	Tamil Nadu	Minimum 10% of total energy consumption	2006-09
12	Uttar Pradesh	5% of total energy consumption	-
13	West Bengal	Minimum: 1.9%	2006-07
		Minimum 3.8%	2007-08

Source: Regulations of different state electricity regulatory commissions

Besides, most of these states have also specified the purchase tariff for procurement of power from different renewable energy based projects. These tariffs have been worked out on the basis cost of generation assuming 14% to 16% returns on the equity by the investors. As the resource and hence generation (as well as costs) varies from state to state, the purchase tariffs estimated by different state regulatory commissions too vary from state to state. The purchase tariffs for different renewable energy projects in different states are given in Annex I.

Fiscal and financial incentives

There is no direct financial incentive /subsidy for grid connected power generation projects based on renewable energy source. However, the interest subsidy is provided through IREDA. Presently applicable interest rates for different renewable energy projects for grid connected power generation are as given below:

Table 3 Interest rates of IREDA for different power generation technologies

Renewable Energy Source	Interest rate (%)
Biomass	10.75
Bagasse cogeneration	11.25
Small hydro	10.75
Wind	10.25

Source: Financing guidelines, IREDA, http://www.ireda.in

In addition to the financial incentives, the wind energy projects, and the select equipment used in biomass/bagasse power generation can claim the accelerated depreciation in the first year of the project. This provides the tax benefit for the investors.

Foreign investment policy for renewables

Foreign Investors can enter into a joint venture with an Indian partner for financial and/or technical collaboration and also for setting up of renewable energy based Power Generation Projects.

There is a liberalized foreign investment approval regime to facilitate foreign investment and transfer of technology through joint ventures. The proposals for up to 74% foreign equity participation in a joint venture qualify for automatic approval. 100% foreign investment as equity is permissible with the approval of Foreign Investment Promotion Board (FIPB). Various Chambers of Commerce and Industry Associations in India can be approached for providing guidance to the Investors in finding appropriate partners.

Foreign Investors can also set up liaison offices in India. Government of India is also encouraging foreign Investors to set up renewable energy based power generation projects on Built- Own and Operate basis. ***Source:*** Ministry of Non-Conventional Energy Sources, http://www.mnes.nic.in/frame.htm?invopp.htm

Investment trends

The trends of installed capacity for different renewable energy technologies for power generation are given in figure below.

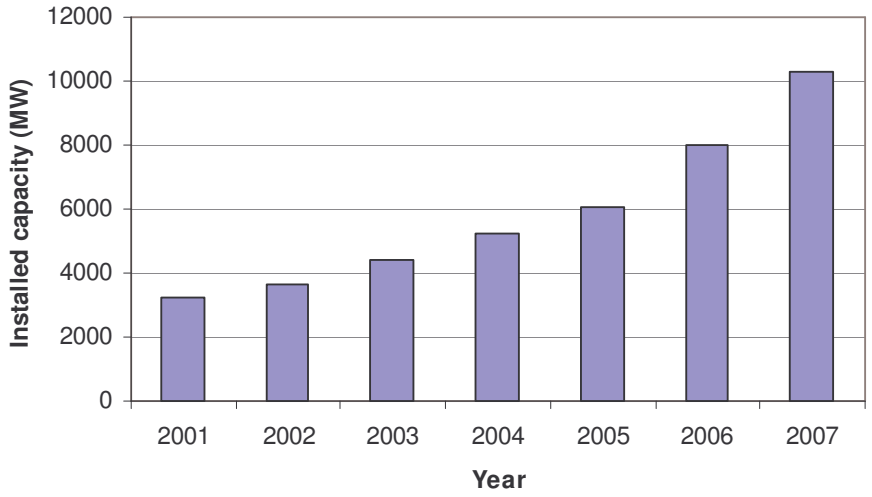


Figure 1: Total installed power generation capacity based on renewable energy sources

As it can be seen from above figure, there is a steady growth in installed capacity. However, the increase in growth rate after 2004, which can be attributed to the more favourable policy environment. The trend in installed capacity technology wise is given in table below.

Table 4: Total installed capacity based on different renewable energy sources from 2001-2007

	Total installed capacity (MW)						
Renewable energy source	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Hydro	1341	1423	1463	1603	1693	1747	1976
Wind	1626	1867	2483	2980	3595	5342	7092
Solar PV	2	2	2	3	3	3	3
Solar thermal	0	0	0	0	0	0	0
Solid Biomass	63	132	164	234	290	378	569
Bagasse CHP	210	226	304	379	437	491	615
Waste to energy	15	17	25	42	47	35	43
Geothermal	0	0	0	0	0	0	0
Tidal/ocean	0	0	0	0	0	0	0
Total	3241	3650	4441	5240	6065	7995	10297

Source: Annual reports of Ministry of New and Renewable Energy, Government of India, 2000-01 to 2006-07

The table 5 below shows the cumulative investments in the main renewable energy sectors in India.

Table 5 Estimated annual investments in different renewable energy based power generation sectors (million AUS$)

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Wind	500	421	1077	869	1075	3054	3060
Small Hydro	367	143	70	245	157	94	400
Bagasse Cogeneration	210	17	85	82	63	59	135
Solid Biomass	34	80	37	82	65	103	223
Waste to Energy	13	2	7	15	4	1	1

There are no projects in the solar thermal, geothermal and tidal and ocean sectors, which were added since 2000 or operational as on 2007.

It is clear that the investments in the renewable energy power generation have been increasing, and the growth rates have also increased post 2003. This is primarily due to high growth in wind sector. The higher growth rates could be attributed to the change in policy environment post Electricity Act 2003.

The investments in the renewable power generation are primarily from the private sector, barring the initial demonstration projects. For financing of the renewable projects, IRDEA was formed in 1987, as the technologies were new thus IREDA financing was made available in order to promote the renewable energy technologies. However, now other financial institutions (FIs) have started financing renewable energy projects. The trend of annual loan disbursements from IREDA in different sectors is shown in table below.

Table 6 Annual loan disbursements by IREDA (million AUS$)

	2001	2002	2003	2004	2005	2006
Wind Energy	81.7	33.9	33.5	26.1	15.2	80.0
Small Hydro	22.1	21.6	34.0	20.7	18.9	22.4
Biomass Cogeneration	45.4	31.3	40.3	7.1	7.0	1.8

Biomass Power	34.0	25.6	27.1	10.0	8.6	85.2
Waste to Energy	0.2	2.9	8.1	0.5	0.5	0.0

Source: Annual reports of Ministry of New and Renewable Energy, Government of India, 2000-01 to 2006-07

The table 5 shows that the total annual investments in renewable power generation are increasing. However, the loan disbursements by IREDA have been declining since 2001, although in 2006-07 there was an increase. Even in 2006, the share of IREDA financing was less than that in 2001. Thus it can be concluded that other mainstream FIs have started financing the renewable energy projects and their share is increasing. This could be result of (a) the fact that the interest rates now offered by IREDA are same as those offered other FIs, (initially IREDA interest rates were subsidised and lower than normal market interest rates) whereby such projects are no longer considered risky by FIs maturity of the renewable power generation sector in India.

The important renewable energy sectors for grid connected power generation in Indian are wind, small hydro, biomass (inclusive of cogeneration) and waste to energy. Other sectors like solar thermal, geothermal and tidal and ocean are not being focused and thus there are no targets for them in the 11th plan period i.e. till 2012.

Wind power

The total estimated potential for wind power is about 45000MW. This potential, based on the resource assessment carried out till now, is in the states of Gujarat, Tamil Nadu, Karnataka, Maharashtra, Rajasthan and Madhya Pradesh. The figure below shows annual installation of wind power in India. It is clear that since 2003 the there has been very high growth in wind power sector.

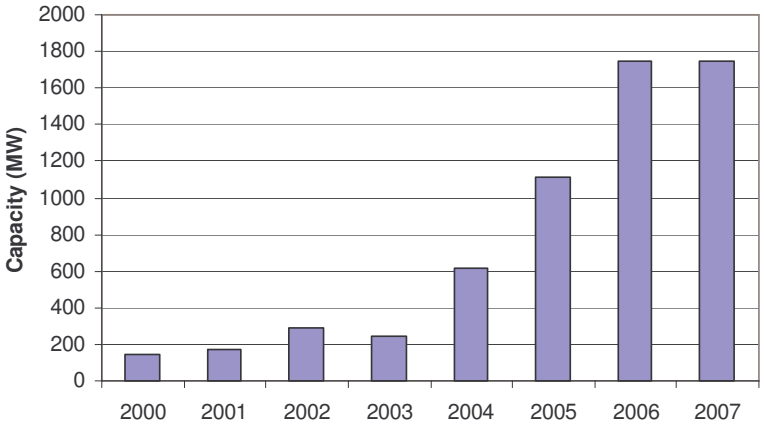


Figure 2: Annual wind power capacity additions

The investment trend has also changed from smaller investments driven by the tax incentives to higher size of individual investments with focus on power generation. This is a result of the policy and regulatory environment, which has provided (1) assured market through state level quota for renewables and (2) power purchased tariffs assuring guaranteed returns. The total annual investment in wind sector in 2006-07 is approximately AUS$ 3100 million.

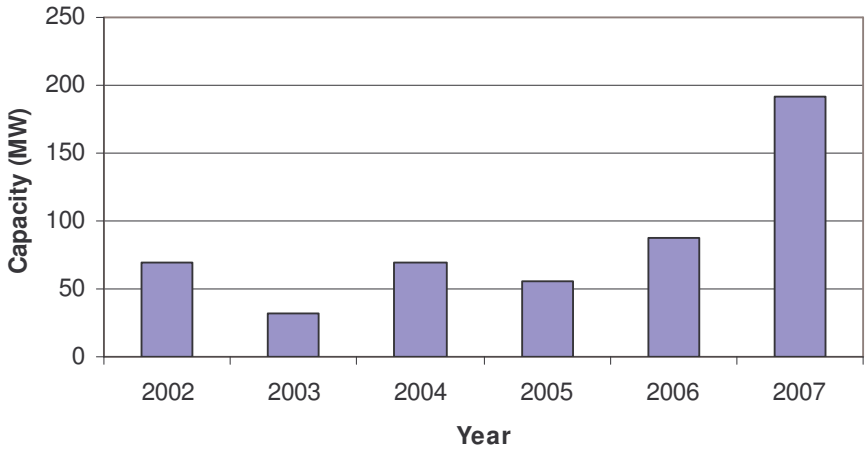
Main incentive in this sector apart from the feed in tariff is the 80% accelerated depreciation for wind power projects. As a result 80% of the project cost is depreciated in the first year of project resulting in lower tax liability.

As per targets prepared by MNRE for 11th plan (2007-12) the target for wind power is 10500MW. With present investment cost of wind power at AUS$ 1.74 million the total investment required would be about AUS$ 18358 million.

Biomass power

The biomass based power generation has seen a steady growth rate. The total installed capacity based on biomass is 569MW. The policy support has not resulted in very high growth in biomass power sector as in case of wind power. However, the growth is maintained with investments from private sector even though the tax benefit, which is available in case of wind power, is not available for biomass power projects. The figure below shows the annual capacity addition based on the biomass.

Figure 3: Annual capacity additions based on biomass



These investments are mainly from the private sector with financing through IREDA and /or other FIs.

MNRE's plan as far as biomass based power in 11th plan is concerned, is to add 500 MW. With present investment cost of AUS$1.16 million per MW, the total investment required would be about AUS$582 million.

Bagasse cogeneration

The bagasse based cogeneration sector is also growing. The total installed capacity in India is 615 MW. In this sector, the investments are mainly from private sector -primarily from the cooperative sector, as most of the sugar industries are owned by cooperative societies in India. The individual size of projects is in the range of 5MW. The investment size depends on whether the project is greenfield or retrofit.

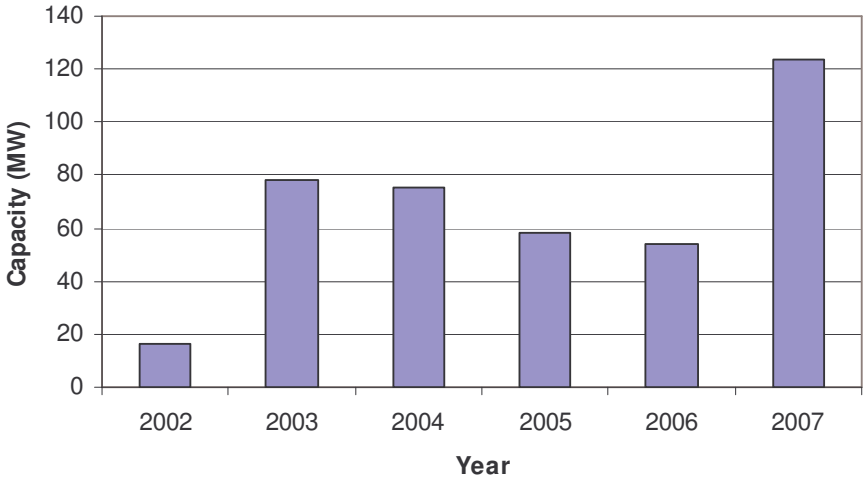


Figure 4: Annual capacity additions of bagasse cogeneration projects

The target for bagasse based power generation till 2012 is 1200MW. With present investment cost of bagasse power at AUS$ 1.09 million per MW; the total investment required would be about AUS$ 1308 million.

Waste to energy

The power generation from urban and industrial waste is being perused in India; however the growth in this sector is low. Till now the total installed capacity based on urban and industrial waste is about 43MW. However, the potential is high. Further, the waste to energy projects are also important from waste management point of view. Thus, MNRE has proposed a target of 400MW capacity addition from waste to energy projects. Based on this target, the investment required by 2012 is AUS$ 349 million.

Small Hydro Power

Small hydropower is an emerging sector amongst all the other renewable energy sources. As on 31.03.2007, a total of 1975MW of small hydropower had been installed in the country. The annual installations are given below.

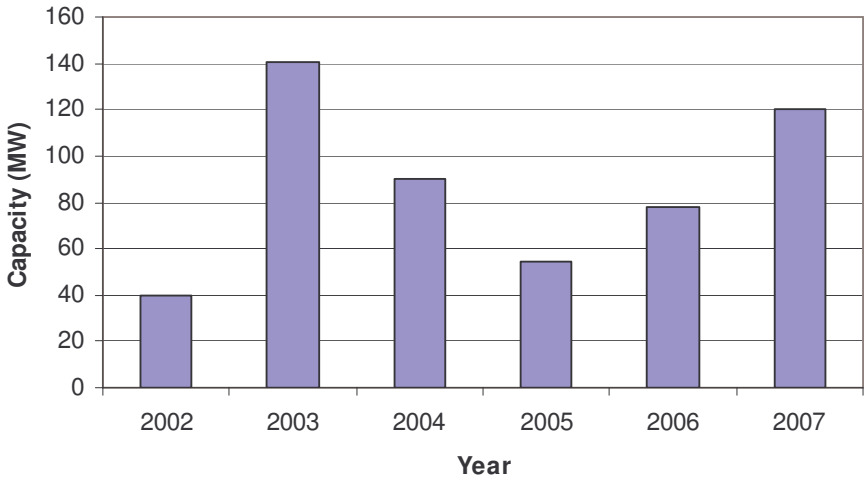


Figure 5: Annual small hydro power capacity additions

Private developers are coming forward to set up small hydro projects with the help of subsidies and incentives given by the state governments. The developers procure the site from the landowners, procure electromechanical equipment from the manufacturers and then construct the small hydro projects and sell electricity to the grid. In some cases the developers also use the power generated for their own use.

The target for small hydro sector in the 11th plan is to add 1400MW by 2012. The investment required to achieve this target is AUS$ 2447 million with the installation cost of AUS$ 1.74 million per MW.

Decentralised power

The decentralised power (off grid power generation) is an important sector. There are about 125,000 unelectrified villages in India. Out of these about 25000 unelectrified villages have been identified for electrification through renewable energy, as these are remote village where grid extension is not feasible. The MNRE programme targets these remote unelectrified villages for electrification using renewable energy sources. The decentralised power generation for village electrification is driven by social objectives and government target of providing electricity for all. Thus the decentralised power generation for village electrification is provided support through subsidy; presently subsidy up to 90% of the project cost is being provided by MNRE. The target till 2012 is to provide decentralised energy systems in 10000 villages.

Growth prospects

The table below shows the summary of the renewable based power generation in India in terms of present installed capacity, projections and investments required as per the targets for 2012.

Table 7 Potential, targets and investments required to meet the targets

	Potential (MW)	Installed capacity till March 2007 (MW)	Target of addition in 11th plan (MW)*	Total expected capacity by 2012 (MW)	Investment required from 2007-2012 (million AUS $)
Small Hydro	15000	1976	1400	3376	2447
Wind	45000	7092	10500	17592	18358
Solar PV**		86	50	136	**
Solar Thermal		0	0	0	0
Solid Biomass	19500	569	500	1069	582
Bagasse CHP		615	1200	1815	1308
Waste to energy	1700	43	400	443	349
Geothermal	NA	0	0	0	-
Tidal/ocean	NA	0	0	0	-
Total		10297	14000	24295	23044

** Source: Report of the working group on New and Renewable Energy for 11th Five Year Plan*

*** There is very limited capacity of grid-connected power plants; the installed capacity primarily includes the decentralised individual systems. The investments required are dependent on the availability of subsidy.*

In case of solar thermal, geothermal and Tidal/ocean energy presently the plan does not have any target. Thus the projections as well as investments could not be assessed with the available data.

The developments in the renewable energy sector in India are driven by the environmental as well as energy security reasons as well as environmental. The power deficit at present is about 10% and it is expected that it would remain at these levels even with the planned power generation capacity additions. Further, the policy direction provided by the Electricity Act 2003 would continue to provide the policy support for renewables. There are number of Indian states which have already complied with the provisions of the Act. As a result of being energy deficit and with emphasis on achieving energy security the policy support for renewable based power generation would continue in near future. This stable policy environment would result in high growth in initial years, as evident post 2004. This growth rate would stabilize after all the states have policies / regulation in place for renewable power, thereby fixing the total market size. It is expected that the present level of policy support would continue till 2010-2012. The tariff policy indicates introduction of competitiveness within renewable energy technologies. Thus, the level of support and incentives would change with increasing viability and it is expected to compete with the conventional power in future. Similarly in case of decentralised power generation, the present thrust and support would continue, as the goal of government is to supply power for all. It is also expected that the decentralised power generation would continue to be driven by the government policies, mainly through subsidy.

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9 Appendix 2- Literature Review

Identifying Barriers to Financing Clean Energy Technologies for Sustainable Development in India

Erin I. Kuo & Peter Castellas
Clean Technology AustralAsia, Ltd. April 2007

1. Executive Summary

With both domestic and international concerns increasing over energy security, climate change, and sustainable development, the clean energy technology sector is growing at a rapid pace. In India, if some of the barriers to development and deployment can be overcome, the conditions are right for the country to potentially become a world leader in the development and deployment of Renewable Energy (RE) and Distributed Generation (DG) technologies.

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Some of the specific drivers fuelling rapid growth in the RE and DG market in India stem from aggressive policy targets aiming to bring electricity to all Indian households by 2012, increased energy security concerns, environmental degradation and pollution, natural resource and infrastructure constraints, public health concerns, and energy demands outstripping supply. In addition there has been recent maturation and commercialization of RE technologies and investor and finance sector interest in new market opportunities in India is growing.

As energy demands are expected to increase disproportionately to capacity additions, it has become clear that RE and DG technologies have a significant role to play in meeting sustainable development needs. By early 2007, 44% of Indian households lacked access to electricity and less than 30% of rural Indian households had access to residential water, primarily due to lack of energy for motive power. Despite drastic domestic increases in power generation capacity in recent years, India remains unable to meet current energy demand and remains a net importer of oil and coal.

However despite many factors that position India to be a potential global leader in RE and DG technologies there are significant political, legal, technological, and financial barriers that inhibit the sector's growth.

Political barriers emerge from complexity in the clarity and consistency and perceived lack of alignment across government ministries, states, and technology sub-sectors. Legal and Regulatory barriers encompass informal governance, elements of corruption, weak enforcement, and lack of clarity and consistency. While the technology barriers reviewed in the literature focus on a greater need for capacity building, and performance and reliability factors in new technology. Financing barriers include: lack of access to affordable capital, a need for institutional capacity building, need for innovative risk management, and issues around accessing carbon finance.

This paper reviews a global body of contemporary literature in the Renewable Energy (RE) and Distributed Generation (DG) Technology fields to explore current trends and barriers to financing clean energy technologies in India. This literature review serves as a pre-cursor to a project under the Asia-Pacific Partnership on Clean Development and Climate, entitled *Pursuing Clean Energy Business in India*, which aims to identify a plan to accelerate the development and deployment of clean technologies across partner nations. It is planned a questionnaire, consultations, and additional research and analysis of technology-specific issues and defined case studies will be undertaken to follow this review.

2. Introduction

The Asia-Pacific Partnership on Clean Development and Climate (APP) brings together Australia, China, India, Japan, the Republic of Korea and the United States to address the challenges of climate change, energy security and air pollution in a way that encourages economic development and reduces poverty.

Clean Technology AustralAsia (CTA) is undertaking a Project under the APP entitled, *Pursuing Clean Energy Business in India.* The Project will identify the market and policy barriers to accelerating investment and deployment of renewable energy (RE)) technologies in India and will outline a plan to enhance business opportunities and collaboration between Australia and India (and other Partnership countries). The Project will involve an extensive consultative process with input and contributions from key industry, finance sector and research and government representatives.

The first component of the Project is to undertake a global literature review to identify, synthesize, summarise and evaluate contemporary research and reports that have been written on analysing the barriers to financing RE and distributed generation (DG) technologies in India.

This Review seeks to create a contextual framework for exploring opportunities in pursuing clean energy business in India for the APP and highlights the perceived and real barriers that will be examined through the consultations and analysis conducted for this Project.

This Review explores secondary sources of information that have previously identified barriers to clean energy development and deployment in India, specifically focusing on RE and DG technologies. Recognizing there have been many efforts focused on identifying market opportunities and barriers to financing renewable energy in India, this report summarizes those recent and relevant findings that will provide background information to help facilitate consultation among key stakeholders who will be engaged in the Project.

While setting the context for these consultations and additional research and analysis to advise on accelerating collaborative commercial opportunities in clean energy technology development in India, the primary objective of this paper is to identify specific barriers to financing renewable energy projects in India from political, regulatory, technical and institutional points of view. The format of this review is broken into sections:

- a brief discussion of the information sources;
- a situation analysis;
- a detailed discussion of political, regulatory, technical, and financial barriers;
- an evaluation; and
- conclusion.

3. References/Sources

The sources for this review come from internationally recognized sources of research in the fields of: financing sustainable development, market analysis in India, commercial opportunities in clean technology, Indian policy and law, and global energy issues. The sources of this study encompass private companies' analyses, both domestic (Indian) and multinational government agencies, academic and research institutions, and collaborative partnership arrangements. Sources explore emerging issues in both conventional and non-conventional energy sources, enabling policy initiatives and barriers for renewable energy development, current framework and projected forecasts for the renewable energy market, case studies in renewable energy in India, and barriers to accelerated deployment of clean technologies.

Some of the internationally recognized sources include: the World Bank, Government of India, World Institute of Sustainable Energy, Indira Gandhi Institute of Development Research, the International Energy Agency and REN21. While it is noted that time and scope of this review will limit the sources utilized, an attempt has been made to gather the most

relevant, credible, and contemporary information in reference to this project to give a broad-based overview of the barriers to financing renewable energy and distributed generation technologies in India. Where comments and findings in this review are not directly referenced it can assumed that a number of sources had made relevant points.

4. Situation Analysis

Rapid growth and demand for renewables

Renewable Energy and Distributed Generation technologies represent a nascent sub-sector of the clean energy technology market. These technologies are undergoing rapid growth and have potential for significant financial, socioeconomic, and environmental benefits. With growing international concerns over climate change, energy security, and sustainable development, the renewable energy market has seen a recent surge of interest and market activity.

In 2005, the World Bank and Global Environmental Facility (GEF) committed $250 million to renewable energy projects, and New Energy Finance estimates M&A activity in Renewable Energy (RE) reached $14 billion, a level which has grown at 50% per annum in the period 2000-2005. In 2005, there were 85 publicly traded RE companies with market caps greater than $40 million, creating a $50 billion market, and AIM clean energy stocks rose 29%[1]. The International Energy Agency (IEA) predicts $16 trillion of investment inflows in the energy sector until 2030[1], $8.1 trillion of which is predicted to flow to developing economies to meet energy needs[2].

The literature reviewed identified a broad range of drivers fueling the increasing activity and rapid growth in the RE sector including: energy security concerns, environmental degradation and pollution, resource and infrastructure shortages, public health concerns, energy demands outstripping supply, especially in rural areas, socioeconomic drivers, maturation of RE technologies and investor and finance sector interest in new market opportunities.

Affordable energy has been linked to indicators of human development, and in developing economies, access to energy and electricity can increase access to education, reduce indoor air pollution, provide energy for medical equipment and storage, provide water and sewer services, create jobs, stimulate micro-enterprise, reduce poverty and increase life expectancy. In the next few decades, demand for primary energy use is expected to grow at 35-40% in South Asia[3], and the Intergovernmental Panel on Climate Change (IPCC) anticipates an increase from 2006 levels of 3-5xs in global primary energy use to 2050[4]. In many areas, conventional fuels and infrastructure have not been able to meet current energy needs, leading to energy shortages, social unrest, and compounding development issues.

Many of the current energy shortages exist in rural areas where there is a lack of grid connectivity and where distributed generation technologies may be the only way to deliver cost effective and timely access to energy. New Energy Finance estimates 2005 investment inflows to RE DG technologies at $7 billion[1], and in the developing world, distributed conventional energy expenditures are estimated to be roughly $20 billion per year. In areas where access to the grid is cost-prohibitive or technically challenging, RE DG, which are less dependent upon large scale infrastructure, can be developed faster, thus meeting the energy needs of the rural poor in a more economical and timely fashion. The World Bank estimates costs of grid extension to rural areas to be $8,000-10,000 per kilometre in addition to raw materials cost of $7,000[5]. Additional benefits of DG technologies may be reduction in Greenhouse Gas (GHG) Emissions, increased energy security, diversity of supply, reduced costs as the source is closer to the point of consumption, reduced transmission and

[1] REN 21. Renewables Global Status Report 2006 update.

[2] The World Bank. Clean Energy and Development: Towards an Investment Framework. 2006.

[3] REEEP Renewable Energy and Energy Efficiency Partnership. 2003.

[4] The World Bank. Clean Energy and Development: Towards an Investment Framework. 2006.

[5] REN 21. Energy for Development—The Potential Role of RE in meeting the MDG's. 2005.

distribution (T&D) losses, increased network support, and greater economic viability. It has been demonstrated that in off-grid applications of less than 5kw, RE is more economical than conventional sources of energy, and in mini-grid applications of 5-500kw, many RE technologies are potentially more cost effective than conventional fuel sources[6].

Renewable Energy in India

Emulating global RE trends, India is poised to become a major player in RE and DG technology and offers significant potential for rapid market growth and commercial opportunities. At the end of the third quarter in 2006, India ranked 3rd in the Ernst & Young Country Attractive Indices and 4th in the E&Y Renewables Infrastructure Index. The 2007 Ernst & Young Energy outlook report highlighted that in 2005, Suzlon, an Indian wind energy company, floated an IPO and received bids 15xs the issue size, while Vestas RRB India Ltd acquired outstanding shares of partner company, Vestas Wind Systems, to make it a 100% Indian company [7]. In the investment banking arena in 2005, Goldman Sachs invested $10 million in an Indian waste to energy biotech company, and Citigroup invested in one of India's largest sugar producers for ethanol[8]. In 2006, venture capital saw some activity in RE, with U.S. based Vinod Khosla securing a 10% stake in Praj Industries (bioethanol), and Indian based Sterling Infotech Group acquiring a 40% paid up share of a Finnish wind turbine manufacturer, Winwind Oy[9].

Energy demand has outstripped domestic production, and India has become a major buyer of energy. Despite doubling its generation capacity over the past decade, India is unable to meet current energy demands and is currently 70% dependent upon imported oil[12]. In 2004, India was the 3rd largest importer of ethanol and the 5th largest consumer of energy globally. Currently 44% of households and 56% rural households do not have access to electricity[10], and less than 30% of rural families have residential sources of water due in large part to energy shortages for motive power[11]. There is a current electricity energy shortage of 8% and a peak demand shortage of 11.6%[12], with increases in energy requirements projected at 6% per annum and electricity consumption at 7.6% per year and peak demand projected to increase by 77% by 2012. To meet this demand, power generation capacity would need to increase by 2.5xs current levels[12].

Many efforts have paved the way for accelerated development and deployment of RE and DG technologies in India. The potential for future growth of the RE DG market in India stems from a number of interrelated developments:

Policy targets: The government of India has set an aggressive target of electricity for all by 2012, with an objective to add 10,000MW in RE capacity and source 10% of total power capacity from renewables[13]. In 2006, the Indian President, Dr. A.P.J. Abdul Kalam announced a target of energy independence by 2030 and an increase in RE contribution from current levels of 1-5% to 25%[14]. By 2006, India's Integrated Rural Energy Program using RE had served 300 districts and 2200 villages.

Resource availability: India averages 300 clear and sunny days per year, has an installed wind capacity of over 7000 MW, 3.8 million biogas plants, 15,000MW small hydroelectric capacity. India is the 4th largest producer of wind power, 5th largest producer of energy from commercial biomass and small hydro and ranks globally in the top 5 countries with maximum RE power capacity.

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[6] The World Bank. Technical and Economic Assessment: Off Grid, Mini-Grid and Grid Electrification Technologies. 2005.
[7] Ernst & Young. India Energy Outlook: Charting Rapid Growth . 2007.
[8] REN 21. Renewables Global Status Report 2006 update. 2006.
[9] Pillai, G.M. The Greening of Finance. 2006.

[10] Government of India. Integrated Energy Policy. 2006.
[11] The World Bank. Energy for Development—The Potential Role of RE in meeting the MDG's. 2005.

[12] KPMG. India Energy Outlook. 2006.
[13] Ernst & Young. Renewable Energy in India: Charting Rapid Growth. 2007.
[14] Assocham. 1st Annual South East Asian Renewable Energy Conference. 2006.

Human capital: Rural India has a potential workforce over 400 million, a majority of which are considered un/under employed[15].

Leapfrogging Opportunities: India maintains a position of limited existing energy infrastructure, providing technology transfer and leapfrogging opportunities.

Health concerns: In 86% of rural households, traditional biomass is the primary cooking fuel[16], and India experiences the largest number of indoor air pollution related health problems in the world with 500,000 deaths each year, primarily women and children who have the greatest risk and domestic exposure[17].

Public Financing: IREDA, a public finance institution, was established in 1987 and as of 2006 had funded almost $1billion of renewable energy projects resulting in a 2,700 MW capacity addition[18].

Government Programs: India has a dedicated Ministry of New and Renewable Energy (MNRE) and a number of ministries have taken on specific renewable technologies to develop and support. Many resource assessment programs have been implemented or are slated as future projects, including: Wind Resource Assessment Program (WRAP), National level Biomass Resource Assessment Program (NBRAP), and Solar and Wind Energy Resource Assessment (SWERA). RE specific research institutions have emerged, including Centre for Wind Energy Technology (CWET) for wind, Solar Energy Centre (SEC) for solar, and National Institute for Renewable Energy (NIRE) for bioenergy. MNRE (aka MNES) is also currently in process of creating small enterprises for manufacturing and servicing of RE systems and devices.

With one of the most populous and geographically diverse nations in the world, and with GDP growing at 7-8% per annum[19], India holds tremendous potential in RE and DG. However despite an increasingly favourable policy environment, technological innovation and growing investor interest there are significant barriers impeding accelerated market growth and RE and DG project implementation.

5. Barriers

The barriers to accelerating finance, investment and deployment of RE technologies in India include political, regulatory, technical, and financial barriers.

5.1 Policy/Political Barriers

Both Central and State Governments in India have created enabling policies to encourage development of Renewable Energy projects and rural electrification through Distributed Generation; however, there remain gaps in clear, coordinated, mutually reinforcing policies, an uneven playing field, and lack of a consistent long-term policy framework. The current policies that encourage RE and DG development include: Electricity Act of 2003, National Tariff Policy, National Electricity Policy, and Rural Electrification Policies, as well as state fiscal incentives, tax holidays, and depreciation allowances. While enabling policies continue to progress and adapt to encourage further development of RE, political barriers remain.

5.1.1 Perceived Lack of coordination between Central and State policies and across Ministries

One barrier that exists to financing RE and DG in India arises from the challenges of alignment of Indian state governments, ministries, incentives, and disparate policies.

[15] Pillai, G.M, ed. The Greening of Finance. 2006.
[16] Government of India. Integrated Energy Policy. 2006.
[17] REN 21. Energy for Development. The Potential Role of RE in meeting the MDGs. 2005.

[18] www.ireda.in
[19] Ernst & Young. Renewable Energy in India: Charting a Path to Rapid Growth. 2007.

The literature suggests that many of the policies set at the central level may not consult the States who are primarily responsible for achieving policy targets, and historically targets have not been met[20]. To date, states along with the private sector act as implementers of policy targets and thus far have implemented central guidelines in a limited, inconsistent and uneven manner. Central Government Ministries tend to be charged with various tasks related to climate change, energy, power, resource management, and development and may face difficulties in attempting to coordinate and communicate to bridge discussions and align policies to support and mutually reinforce one another, resulting in suboptimal outcomes. For example, the Ministry of Power is charged with rural electrification and is promoting decentralized distributed generation, while the MNRE is tasked with new and renewable energy policies, and the Ministry of Environment and Forests is the clearinghouse for climate change policy. While various RE policy targets and fiscal incentives have been set, there appears to be a lack of coordination between policies to promote RE and DG across sub-sectors and states and provide links to broader development policies and initiatives.

5.1.2 Uneven Playing Field

Market distortions and uneven fiscal incentives have been and remain a significant barrier to commercial viability of RE and DG technology adoption and uptake.

Governments continue to support fossil fuels with subsidies, incentives, research funds, tax relief, favourable regulations and laws that benefit conventional energy generation. The inability of RE to compete favourably on price stems from failure to account for environmental and socioeconomic externalities in the price of conventional fossil fuel energy sources, non-recognition of portfolio value in price stability, and subsidies and tax structures heavily biased toward conventional forms of energy. However, the central government has acknowledged a need for rationalization of fuel prices, to avoid setting independent price levels[21]. It has also acknowledged that socioeconomic benefits such as employment and energy security may support differential taxes and that the distributed nature of renewables can provide development benefits that may not be feasible via grid extension. Additionally, real costs to society from conventional energy sources, in the form of infrastructure decay, public health, natural resource depletion, and climate change, are beginning to factor into pricing and policy considerations but lack formal accounting as impacts are difficult to quantify. Compounding the distortions, energy generation project costs are often viewed in cost-per-unit basis ($/MW installed) rather than on a lifecycle accounting basis which includes initial cost, fuel cost, operation and maintenance cost, equipment lifetime, and decommissioning cost.

5.1.3 Perceived lack of Consistent, Clear, Long-term Policy Framework

There is a lack of a clear and consistent policy framework to facilitate private participation in the RE DG market.

The turn-over in policy frameworks and policy changes remain a barrier, and the majority of current RE policies do not extend beyond 2012 in most cases[22]. Additionally, it has been noted that India has one of the more complex subsidy and policy arrangements for RE in Asia[23], and the private sector feels there is a lack of transparent rules and procedures[24]. Past incentives, such as one-off depreciation, have not been conducive to long-term project maintenance[24].

[20] Babu et al Removing Barriers for Renewable Energy CDM Projects in India and Building Capacity at the State Level. 2003.
[21] MNRE New and Renewable Energy Policy Statement 2005. 2006.
[22] The World Bank. Clean Energy and Development: Towards and Investment Framework. 2006.
[23] Ferrey, Steven. Small Power Purchase Agreement Application for RE Development: Lessons from five Asian countries. 2004.
[24] Babu et al Removing Barriers for Renewable Energy CDM Projects in India and Building Capacity at the State Level. 2003.

5.1.4 Lack of Public Funds/Policy as a potential bridge to commercial viability

A gap in financing exists to facilitate the commercialization of early stage technology R&D to bring potentially viable technologies to a demonstration and commercial mode.

Public funds and public policy may not be coordinating or funding the necessary RD&D of scalable commercially viable technologies to encourage greater private sector participation. Although it is acknowledged that key drivers fuelling development of RE and DG technologies are shared socioeconomic and environmental concerns, there is a lack of co-ordination between the Indian government and international finance institutions to provide public funds or subsidies aimed at acceleration of development of near term commercial technologies. More government intervention is required to start the development process, reducing cost and proving economic viability for newer technologies that are not receiving the same historic or current subsidies or incentives as conventional fuels. Although there is one clean energy fund that has been established in the state of Maharashtra and a public financing arm, IREDA, that has lent considerable support to RE and DG projects, there is a lack of publicly funded clean energy development funds.

5.2 Legal/Regulatory Barriers

The English common law system and formal legal arrangements create an accessible landscape for foreign participation in Indian business and create relatively strong investor protection laws on paper; however, weak enforcement, informal regulatory mechanisms, and unclear uneven regulations are cited as significant barriers to increased private sector involvement in RE and DG project development.

5.2.1 Informal Governance

In India, formal mechanisms in legal recourse, such as courts, are overshadowed in practice by informal governance mechanisms such as reciprocity, relationships, and trust[25].

As cited by the World Bank, the legal process in India can take over 10 years on average[25], causing businesses to seek informal modes of recourse, preferring relationships and social networks to legal recourse. The most common methods for overcoming regulatory or legal barriers have been cited as bribes and relationships with government officials[25]. With the intention of protecting small to medium sized enterprises (SMEs) and allowing them to flourish and thus create more jobs, government has set investment caps on certain industries, thus intervening and controlling entry into some markets. Lack of reliability in the formal legal system creates regulatory risk that many investors and project developers are likely unwilling to accept.

5.2.2 Weak Enforcement

Amid strong investor rights laws and an English common law system, weak enforcement in the legal and regulatory arena pervades the Indian business landscape[25].

While firms are required by law to disclose information and operate in a transparent manner, the quality of information is not monitored and there are few robust established or enforced systems to monitor the financial or legal disclosures firms must make. This regulatory oversight creates a lack of credibility for potential joint ventures, M&A, and investment inflows. Formal regulatory bodies have been hesitant to enforce standing regulations and laws and have consistently not enforced Independent Power Producer (IPP) contracts. Often RE policy targets are not mandatory and thus carry no penalty and are not enforceable from a regulatory perspective. Additionally, lack of enforcement at the consumer level has had consequences of high network losses, estimated to be as high as 40% due to theft and weak

[25] The World Bank. Financing Firms in India. 2006.

[25] Ferrey, Steven. Small Power Purchase Agreement Application for RE Development: Lessons from five Asian countries. 2004.

to no enforcement or penalty. This has resulted in losses of roughly $6 billion per year nationwide, thus depleting capital for further developing power generation capacity. The weak and non-enforcement of policies and regulations reduces investor and developer confidence.

5.2.3 Uneven/Unclear Regulations

Regulations governing development, generation and distribution of energy across RE sub-sectors and between states tend to be uneven and inconsistent.

While some sub-sectors may have relaxed rules or no enforcement, others may face stringent regulation. Grey areas that remain in the legal and regulatory arena include areas such as protecting Intellectual Property (IP) to allow for technology transfer and leapfrogging opportunities, while guaranteeing the holder of knowledge or IP protection and sanctity. The private sector has also cited a tariff structure that may reset mid-contract after 3 years, leading to a severe lack of predictability in overall returns and reducing the amount of bankable projects. Additionally, the complexity and inconsistency in transmission access, ability to sell to the grid by IPPs, pricing structures, permitting, prohibitive transaction costs that may discourage policy goals and siting restrictions all contribute to the uneven and unclear regulatory framework that inhibits accelerated penetration of RE and DG technologies. For large scale RE projects or bundled RE DG projects the complex legal structures and corresponding expertise required to understand and interpret these arrangements pose legal and regulatory challenges to most first time project developers and often prove prohibitive.

5.3 Technical Barriers

Some RE technologies, such as wind, are reaching the stage of being economically feasible, however, most RE and DG technologies remain in early stage innovation, technical demonstration, or subsidy/incentive supported modes, as yet unable to compete with conventional fuels on price and performance[26]. Exacerbating the techno-economic feasibility are high aggregate losses in transmission and distribution due to technical and commercial issues, resulting in lost revenue yielding less capital for RE and DG and greater urgency to add to current power generation rather than build new infrastructure and adopt new technologies. The predominant technical barrier falls under the broader category of capacity or lack of knowledge and expertise at the technical level. Other technical challenges relate to performance and reliability of new technologies, lack of entrepreneurs, lack of infrastructure, intermittent nature of RE, lack of credible resource information, scale, safety risks and lack of standardization, each of which tends to vary in severity depending upon the technology sub-sector.

5.3.1 Capacity Issues: Lack of expertise at all levels

As a new and emerging sector, RE and DG industries face a lack of technical and commercial expertise, skills, and information at all levels of financing, development and implementation. The inexperience in project development, financing and implementation has inhibiting effects such as causing projects to be delayed, to appear more complex, to increasing transaction costs on a per kilowatt basis, or to be deemed unviable.

Project Sponsor: At the project sponsor and development level, gaps in technical expertise exist in: technology, financing, business development, construction, regulations, management, engineering, planning, permitting, geographic resources, operations, and maintenance as well as the ability to not only utilize the RE supply but provide a usable product to the consumer.

Technical: A lack of technical expertise exists in installation, operations, maintenance, troubleshooting, and other aspects of implementation.

[26] Beck, et al. Renewable Energy Policies and Barriers. 2004.

Consumers: On the demand side, consumers lack much of the technical expertise as that at the personnel level; additionally, consumers lack information about the costs and benefits of new technologies, RE technology characteristics, sources of finance, operating and maintenance experience and installation services.

Financiers: Financiers tend to lack technical expertise and previous experience in financing RE and DG projects, thus are unable to create a project evaluation matrix, disaggregate project risks, reference procedures or benchmark performance. This lack of previous experience and unfamiliarity with the technologies and RE DG companies and projects creates heightened perceptions of risk and may increase unwillingness to finance or participate in deals.

Investment: Domestic and international venture capital and private equity investors have comparatively little expertise in investing in the Indian clean energy technology sector

5.3.2 Performance and Reliability of New Technologies

To complement this literature review, The Energy and Resources Institute (Teri), New Delhi, will be conducting more in depth research and analysis of technology-specific barriers and tech mapping in India. Thus, this literature review will remain limited to broad categorical technical barriers, leaving the exploration of tech-specific issues to later stage project research and analysis.

Solar

Solar energy is one of the more familiar RE technologies with a distributed nature, creating opportunities for solar distributed generation systems. Investors and consumers tend to feel that solar along with biofuels have the greatest near term potential for significant financial gains. Solar technologies are perceived to be relatively mature, though still lacking techno-economic viability. Current silicon solar technologies demonstrate a conversion efficiency of roughly 15%, which when coupled with high capital costs does not lend itself to economic viability. In theory, silicon solar technologies can achieve a 32% conversion efficiency, which would create a commercially viable model; however, current useable technology is not able to attain these levels. Sunlight forecasting and low quality energy storage technologies create uncertainties and barriers for converting to solar energy technologies, and the capital intensive nature prohibits market penetration. Other recent limiting factors have been shortages of silicon for solar photovoltaic (PV) panels; however, India has been the 3rd largest producer of silicon solar cells globally[27] and currently exports solar systems.

Solar PV

Barriers: Not economically viable, low conversion efficiency of 15%, forecasting of sunlight, technology weaknesses for energy storage, large area needed for collectors compared to conventional energy, capital intensive
Benefits: no carbon releases, one of the fastest growing technologies, technical maturity and familiarity, costs decreasing at 20% per capacity doubling (historically)
Incentives: soft loans, tax holidays

Solar Water Heating

Barriers: Consumer expense of retrofitting plumbing, consumer lack of awareness of costs and benefits, consumer lack of access to capital, consumer unwilling to wait for 4-6 year payback period, requires specific conditions such as soft water, sunlight, need back up for periods of low sunlight
Benefits: can be cost competitive with fossil fuel water heating technologies, no carbon emissions

Solar Thermal Electric

Barriers: early stage technology, primarily prototypical, not economically viable

Wind

[27] Ernst & Young. Renewable Energy in India—Charting Rapid Growth. 2007.

India has emerged as a global leader in wind energy development and currently boasts 50 wind farm developers, 33 wind turbine manufacturers, and is the 4th largest producer of wind power. Suzlon, a publicly traded Indian wind energy company, is a major player in the international wind energy market. With every global doubling of wind capacity, wind energy cost has decreased by 12-18%. This sub-sector has grown on average at 25% per annum for the past 10 years.
Barriers: intermittent and unreliable resource, critical component failures, high initial costs, as yet is not cost competitive with coal, currently no installed project that has undergone project financing, need for greater reliability of off-take
Benefits: no carbon releases, renewable, potentially additional source of revenue for farmers during poor crop years

Biomass/Biofuels
Biomass is seen to be one of the most promising areas of RE and DG technologies. Currently, 86% of rural households use traditional biomass, i.e., wood chips, dung cakes, and lumber residues for cooking and lighting. The bioenergy sub-sector is comprised of cogeneration, combustion, gasification, and liquid biofuels, including ethanol and biodiesel. Traditional burning of biomass results in severe indoor air pollution and related health effects and low conversion efficiency at roughly 10%[28]. Converting from traditional burning of biomass to more efficient biomass stoves can increase efficiency to 15-30%. While there are no net carbon releases in most bioenergy projects, there may be nitrogen oxide releases (NOx) which are not only GHGs but also contribute to acid rain, asthma, and other human and environmental health issues. Biomass also requires harvesting of some organic material, thus energy plantations or forests can be degraded and plantations may have environmental impacts. With a growing population and a growing demand for food supply, energy plantations will compete with food production for arable land. Currently petrol blending standards have been set at 5% ethanol and there is a proposal to create a standard for 20% biodiesel blend in traditional diesel[29]. The economic feasibility of biofuels will depend upon the fluctuating prices of the underlying fuel source, such as sugar, the fuel stock, and the price of competing substitutes, i.e. oil. There remains some degree of immature technology and some cost effectiveness uncertainties. The potential market for bioenergy is estimated to be 16,000 MW[30].

Biofuels—ethanol and biodiesel
Biodiesel: there are uncertainties over the yields of the most viable oil seed crop in India, Jatropha curcas, estimated to yield between 0.4-1 tonne of oil/hectare. Production costs are estimated to be twice that of diesel.
Ethanol: calorific value is 56% of petrol. Crop cultivation can be water intensive, although cellulosic and less water intensive approaches appear more promising. The current commercially established process is fermentation with cellulosic in early stages.

Biomass Power
Barriers: Fuel supply availability and variability, resource price variability, environmental liabilities

Biomass Gasifier
Barriers: Fuel supply availability and variability, odour issues face some opposition, need for land and financing.
Benefits: 60-70% energy savings in cooking efficiency

Hydrolectric
Small hydroelectric projects are bridging electricity gaps in rural and hilly areas that have geographical obstructions to grid connectivity. Currently over 187 small hydro projects are under construction with an aggregate capacity of 521 MW. There are small carbon emissions during project construction, and emissions fall to zero once power generation begins, allowing for carbon credits under the Clean Development Mechanism (CDM). The MNRE has subsidies available for small hydro, and a project can claim tax exemption for 10 years.

[28] MNRE. Draft Renewable Energy Policy 2006. 2007.
[29] Ernst & Young. Renewable Energy in India—Charting Rapid Growth. 2007.

There is a 250,000 MW potential capacity from hydro and a target has been set to add 45,000 MW by 2016. Significant risks and challenges are associated with this sub-sector, including: geological risks, resulting in increased cost, long delays obtaining clearances, project delays due to land acquisition, issues of resettlement, disputes between states over shared water resources, resource variability with flow, flooding, offsite monitoring resulting in prolonged breakdown and long response time, environmental issues in manipulating natural river flows and associated ecosystems, novice developers, and high up front capital cost that is offset by low lifetime cost.

5.4 *Financial Barriers*

Despite increasing enabling environments on the domestic and international front, institutional capacity in the finance sector, cost and access to capital, and inefficient risk management tools hinder accelerated investment inflows into RE technologies and projects in India. A recognized industry bottleneck is access to long-term external finance and the non-availability or lack of access to adequate financing at reasonable costs and terms contributes to a slow down in development and implementation of projects. In addition, immature and new to market technologies have entered the marketplace without capacity building at the institutional level, creating higher risk perceptions and risk profiles unsuited to the expected returns.

Recently, India created a foreign investment policy to facilitate joint ventures (JVs) and offer support in finding Indian partners for RE power generation projects, as well as policies to encourage increased FDI and private investment include duty concessions, tax holidays, depreciation allowances, and soft loans. Additionally, many IFIs are offering financial assistance in RE generation, including the World Bank, USAID, and Asian Development Bank.

Debt required for RE projects in India is in excess of 3-4 times the debt contribution for the plan period from 2007-2012[30]. .

5.4.1 Lack of Access to Affordable Capital

The lack of access to capital affects project developers, due to high capital costs and creditworthiness issues, entrepreneurs due to lack access to equity finance and consumers due to lack retail and micro-finance products.

Project Developers' risks: Due to the higher ratio of initial capital costs to operating costs for many RE and DG projects, there is a need for longer-term financing instruments at affordable rates. As most RE and DG projects tend to be small scale, they often do not attract or cannot afford commercial financing structures, such as project financing. Projects therefore tend to be predominantly balance sheet funded. In this arrangement, financing terms are based on the creditworthiness and strength of the borrower rather than on merits of the project. Borrowers are typically exposed to unlimited personal liability, if they are able to obtain the financing necessary. RE and DG technologies are also often new to project developers and sponsors and this lack of experience on the part of the sponsors and developers can lead to higher completion and operational risk, further reducing the creditworthiness of the potential borrower. Novice sponsors and developers can increase the complexity and implementation time of a project, adding additional risk to the lender's portfolio which can be passed along to the borrower in the way of higher transaction costs.

Financiers' unfamiliarity: In India, banks tend to provide funding to their existing customers, working from past relationships, trust, and credit history and are hesitant to extend financing to new and unfamiliar clients[31]. This, in part, is due to the weak regulatory environment and lack of legal enforcement, creating unease in banks lending to small unfamiliar clients when they have no firm guarantee of legal recourse. Additionally, as banks tend to lack experience

[30] Pillai, G.M. The Greening of Finance. 2006.
[31] Crestar Capital. Designing Financial Structures and Financing Instruments for Energy Efficiency Projects in India. 2004.

in the RE and DG sector, and the type of projects tend to be newer to banks and financiers, their risk perceptions are heightened, compounding the lack of debt extended to clients without a credible and established relationship.

Lack of Equity: Small scale RE and DG project sponsors tend to lack sufficient personal funds as equity in the project or as collateral for banks to extend credit. Familiar with systems based on relationships and reciprocity and facing some of these institutional barriers, sponsors often seek alternative and informal financing mechanisms. Venture capital and private equity forms are new to the RE sector and so start up and early stage growth capital tends to come from project sponsors or developers and their immediate friends and families, limiting the amount of capital and creating informal governance mechanisms.

Consumer finance: On the consumer side, access to retail finance and microfinance are in very early stages in India. The initial capital cost to install RE DG systems is often prohibitive without tailored finance packages aimed at the consumer level, which currently do not exist. As upfront RE system costs to the consumer can range from 20-200% above costs of conventional energy systems, consumers who seek support in overcoming the initial capital barrier need to find financing mechanisms to support their uptake and adoption of these technologies. Due to the distributed nature of end users of distributed generation technologies, they often reside outside of the formal credit system, thus creating creditworthiness issues at the consumer level.

5.4.2 Need for Institutional Capacity Building in the Finance Sector

Knowledge gaps and lack of experience in the RE and DG markets, hinder the financial sector from proper ability to analyse, appraise and subsequently invest in or finance a RE project.

The broader financial community are unfamiliar with RE technologies, unfamiliar with newer financing arrangements, lack examples of best practices or established methodology for project evaluation, and have an inability to gauge whether the project or investment related information they are being provided is credible. As knowledge gaps persist, it becomes difficult to identify credible experts in an emerging sector with unfamiliar players. Lack of information may also lead to difficulties in establishing the break even level or minimum performance requirements of a project, and financiers may not have a baseline for measuring or verifying performance or projections.

5.4.3 Need for improved RE Project Risk Management

There are a number of financial risks and uncertainties associated with RE such as the intermittent nature of renewables' energy generation, early stage technology performance, demand, reliable off-take, consistent policy, and expertise at the management and implementation levels.

Commercial financing in power generation has seen a significant decline since 1997, and financiers have cited that the decline is likely due to insufficient returns on investment based on lack of enabling political and market conditions and uncompensated risks[32]. Multiple studies have demonstrated a lack of appropriate and much needed risk management instruments to offset traditional project risks. This is especially the case with RE and DG technologies.

Additionally, insurance is currently not offered for non-performance, technical failure, or indemnity, and no risk premium has yet been built into financial mechanisms or pricing structures. Many of the reports reviewed cite the need for capacity building in the insurance sector and the need for innovative insurance products, suggesting a gap in insurance instruments in these emerging sub-sectors.

[32] The World Bank. Clean Energy and Development: Toward an Investment Framework. 2006.

These RE project risks coupled with political, technical, regulatory, and sometimes currency risk, have also prevented privatization of utilities and entry of the private sector into the market.

5.4.4 Uncertainties surrounding Carbon Finance.

In addition to traditional modes of financing projects, RE and DG projects have the potential to create a secondary revenue stream through the Clean Development Mechanism (CDM) under the Kyoto Protocol (KP). The principle of the CDM is to allow signatories of the KP in developed countries to buy certified emissions reduction certificates (CERs) from eligible projects in developing countries to achieve GHG emissions reductions targets at reduced cost, subsequently providing revenue for sustainable development projects in developing countries. As of April 2007, India had registered roughly 35% of all global CDM projects, equating to over 240 registered and approved projects[33]. In India, the Ministry of Environment and Forests leads the efforts at the Central government level to act as a clearinghouse for CDM projects.

Though CDM revenue holds promise for additional revenue streams to enhance project viability, accessing Carbon Financing under the CDM illuminates its own set of challenges. Some of the uncertainties that surround CDM projects are: low CER price levels, uncertainty over CER price projections, difficulties with baseline emissions assessments, clarity of eligibility criteria, and lack of confidence in the bureaucratic system that will approve projects[34].

6. Evaluation

With both domestic and international concerns increasing over energy security, climate change, and sustainable development, the clean energy technology sector is growing at a rapid pace. The conditions are right for India to potentially become a world leader in the development and deployment of RE and DG technologies.

In India, increasingly significant deal flow and attractive market opportunities have fueled investment interest, and accelerated market penetration of renewables; the growth in wind power being a good example. The growth in deployment of renewables is likely to continue strongly as India faces severe energy shortages and aims to supply electricity to all residents by 2012, renewable energy and distributed generation will inevitably have a part to play in meeting government policy targets and development goals.

India's central and state governments have set aggressive policies to encourage the development and procurement of clean energy technologies. However, despite many efforts aimed at accelerating market development, there remains a lack of a clear and consistent alignment of policies across central and state jurisdictions that provide certainty to private sector participation.

The government policy environment is changing quickly. For RE to be accelerated a key challenge for government is to level the playing field with fair and consistent subsidies and tax incentives and set the conditions for consistent pricing structures to remove market distortions and reduce biases against renewable sources of energy.

It also appears that there is an international call for concerted government efforts through domestic governments, collaborative partnership arrangements, and international financing institutions to provide bridge capital to help create techno-economic viability of emerging technologies and coordinate research, development, and demonstration across sub-sectors, regions, and nations.

[33] http://cdm.unfccc.int/index.html
[34] Babu et al. Removing Barriers for Renewable Energy CDM Projects in India and Building Capacity at the State Level. 2003.

To support these collaborative efforts, regulatory barriers need to be addressed to reduce corruption, uphold a clear and reliable set of consistent rules, and encourage technology transfer and increased financing through a strong legal framework and recourse guarantees. While Indian culture and bureaucratic inefficiencies may play a role in reinforcing alternative and informal governance mechanisms based on relationships and reciprocity, regulatory institutions must create and uphold a strong and enforceable framework that is accessible and visible to potential international partners wishing to enter the market.

Correcting policy biases and enforcing an already robust regulatory framework with strong investor rights protection will begin to create the enabling environment for foreign investment and increased private sector participation. Having more favourable incentives and arrangements in place will also be important if India wants to attract foreign direct investment, JV partnerships and international technology collaboration.

Technical barriers for RE DG project financing and implementation remain a tangible and difficult hurdle to overcome without time, scale, and temporary subsidies. The conversion efficiencies of many RE technologies currently on the market have not yet reached levels for economic viability. Though market mechanisms, such as emissions trading and CDM, may hold potential to enhance viability in the future, both the market mechanisms and technical advances will take some period of time to reach the desired engineering parameters and robust market participation to create scale and impact.

The relatively young market for RE and DG has potential for dynamic long-term growth but still lacks access to affordable capital and innovative and applicable financial mechanisms. There is a need to build capacity within the financial community to become more familiar with current technologies and technologies that may be coming down the pipeline. In addition there is a need to innovate financial structures and products to allow greater project and technology specific commissioning, uptake and participation in this emerging market place.

Though lack of experience and knowledge tend to exist as current barriers across all components of the RE financing, development and implementation continuum, it appears that there is opportunity to bridge knowledge gaps and import best practices from partner nations which could provide leapfrogging opportunities in technologies, financing, and project evaluation. The APP is a tangible way that the knowledge transfer can be accomplished. While knowledge may be transferred at a more rapid pace, given a regulatory environment that protects sensitive IP, technology transfers may experience a much longer lag time. It will take time to build technical and institutional capacity to accommodate the skills and expertise needed to adapt and implement the new technologies as well as helping consumers to adjust behaviours and preferences.

The correlation between access to clean, reliable and affordable energy and human development indicators bridges the gap between seemingly disparate development goals. Whereas many of India's rural areas will not likely be served by the national grid in the medium to long term, renewable energy and distributed generation hold the potential to increase per capita income, increase time and infrastructure for education, create jobs, stimulate micro enterprise, increase gender equality, improve access to and quality of healthcare, and reduce environmental and health issues arising from lack of electricity and traditional burning of biomass.

Near term commercial opportunities are certainly viable, as evidenced by recent financial transactions and investment inflows to sub sectors such as wind power. Policies are also being developed that continue to evolve to encourage private sector participation and technology deployment opportunities.

Important next steps in developing a road map to accelerate investment and deployment of clean energy technologies include: to identify technology strengths and gaps in partner countries, inventory case studies and best practices to explore the causes of successes and failures, and engage key players in the renewable energy, distributed generation, and

technology transfer to draw upon their expertise to overcome the barriers and seek potential solutions to financing clean energy technologies in India.

In this dynamic market place, the key players in the RE DG sector are a) private financiers and investors that have taken an early lead to create deal flow and find attractive market opportunities and create innovative financial products; b) international financial institutions such as the World bank and Asian Development Bank c) the five ministries and central government who set policies and targets related to renewables, power, development, and environment; d) local renewable energy companies with significant market penetration and mature technologies, and e) multinational companies that have created a presence on the ground to develop relationships and create inroads to new business opportunities. It is anticipated that representatives from these key stakeholder groups will participate in the ensuing consultations for the Project to share insights and guide the analysis in identifying barriers and potential solutions to pursuing clean technology business opportunities in India.

7. Conclusion

The barriers that precipitated out of the literature review can be summarized as follows:

1. **Perceived Lack of Coordination/Integration of Policy**
   a. Across Ministries and States (i.e., from Central to States, between States, MNRE, Ministry of Power, Ministry of Environment and Forests, etc.)
   b. Across sub-sectors (i.e., wind, solar, biomass, hydro)
   c. In alignment with broader development issues (i.e., climate change, economic development, public health, etc.)

2. **Market Distortions**
   a. Not accounting for Externalities (both environmental and socioeconomic)
   b. Pricing (lack of price rationalization, uneven price setting across and within sub-sectors, lack of price level guarantees)
   c. Uneven Subsidies and Tax Structures
   d. Capital Cost Accounting instead of Lifecycle Accounting

3. **Perceived Lack of Clear and Consistent Long-Term Policy**
   a. Lack of long-term Policy frameworks beyond 2012
   b. Complexity and Transparency
   c. Misaligned incentives and poorly targeted subsidies

4. **Early Stage Financing Gap**
   a. Lack in funding for Research, Development, and Demonstration of early stage technologies

5. **Weak or Unclear Legal/Regulatory Environment**[35]
   a. Informal Governance
   b. Corruption
   c. Lack of legal enforcement
   d. Challenges in permitting and siting

6. **Capacity at all Levels**
   a. Financiers
   b. Sponsors/developers
   c. Personnel/skilled labour
   d. Consumer
   e. Political

[35] Legal and Regulatory issues deferred to more in depth analysis predicted to be covered in Baker and McKenzie APP project.

7. Technology Barriers[36]

a. Raw material or Resource dependent (variability, intermittent nature, uncertain supply)
b. Conversion efficiencies
c. Energy Storage
d. Forecasting
e. Environmental and/or Social Issues (i.e. NOx emissions, relocation, etc.)

8. Access to Affordable Capital

a. Lack of Creditworthiness (balance sheet financing, relationship lending)
b. Novice developers and financiers (greater risks and time delays)
c. Lack of Consumer-side financial products and microfinance

9. Risk

a. Inherent Project Risk coupled with additional risks of Renewables
b. Lack of Capacity leading to greater risk perceptions
c. Lack of Insurance products to manage risk

10. Carbon Finance

a. CER price levels and price uncertainties
b. Clarity and confidence in eligibility and process of application for approval
c. Difficulties in baseline emissions assessments
d. Capacity—awareness of CDM and in roads to access Carbon financing

Though not directly extracted from the literature, the process of gathering literature and various data sets and perspectives suggests that access to clear and consistent information and data may present itself as an additional barrier to emerge from consultations. Other potential barriers may not be present in this summary report but may be encountered through interviews with industry participants, working in this sector. For example, through informal consultations it has been highlighted that cultural barriers may pose additional challenges for Australian companies attempting to enter the Indian marketplace. It is envisaged that the following phases of stakeholder engagement through surveys and consultations as well as examination of specific projects and case studies and further analysis should yield further information in identifying the barriers and issues to financing renewable energy projects in India and potential strategies for overcoming these barriers.

In the ensuing one-on-one interviews and questionnaire to follow this literature review, the following are sample questions that may be posed to stakeholders to gain further insight into the barriers and opportunities in renewable energy and distributed generation technologies business in India:

- What institutional reforms are necessary to generate increased efficiency?
- What are some examples of both successful and not successful case studies in renewable energy and distributed generation?
- What are the currently available financing mechanisms to support RE DG project development?
- Where are there opportunities for technology transfer, both importing and exporting?
- How do you improve access to and affordability of capital?
- What are the opportunities between partner countries?
- How do you increase capacity at all levels?
- What risk/return profiles are being utilized by financiers? How are they benchmarking and evaluating potential projects? What are the criteria for investment?
- What is needed to encourage greater development and deployment of RE and DG technologies in India?

[36] Technical Barriers to be covered in more depth by Indian partner Teri during project analysis phase.

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