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Financing Rural Renewable Energy: A Comparison between China and India*

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Abstract

This paper analyses the current status of rural renewable energy in China and India, develops and employs an analysis framework to study the environment, channels, instruments and innovative mechanisms of financing rural renewable energy in China and India, and makes a primary comparison.

1. Introduction

Energy is a core component in any developing economy, in eradicating poverty and improving living standards. It contributes directly to meeting both basic needs and more sophisticated human needs. However, many households, small businesses, and communities in rural areas of both China and India have no access to electric grids or modern cooking fuels. Over 800 million inhabitants out of China's total population of 1.3 billion live in rural areas. Of these, 30 million people do not have access to electricity.[1] India accounts for a sixth of the world's population and about 40 percent of the people do not have access to modern energy.[2] Of the 87 million rural households, not more than 30 percent have access to electricity.[3] In practice, most of the so-called electrified villages do not have reliable, regular, adequate, or good quality power.[4] Villagers rely on kerosene for lighting and biomass fuels (often burnt in inefficient stoves) such as wood, animal dung and agricultural residues for cooking.[5] The lack of energy is among the key retarding forces preventing economic development and, consequently, slowing down poverty alleviation and the growth of the rural sector. And the impact that lack of access to modern energy has on economic and social development and the lives of poor people is increasingly recognised by China's and India's government. Both countries give rural electrification of high priority so as to meet its economic, social, political and regional development goals. In China, the electrification in

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rural areas is listed as one of key areas for development in the 9th, 10th and 11th Five-Year Plans. India is also seeking to provide rural electrification solutions, as evidenced by the Ministry of Power Accelerated Rural Electrification Program, which targets 100,000 villages.[6] The problem is the expansion of energy coverage to the rural areas. Although traditional strategies such as fossil fuels-based grid extension are expanding coverage, and must continue to be a major part of the energy access equation in two countries, China and India still face some serious problems. These include the following:

a) Shortage of fossil fuels: The two countries already rank among the world's top five energy consumers with astonishing economic growth rates nearing 10 percent per year.[7] China's consumption of energy has increased by 4.3 percent per year since 1980 and that of India by 5.4 percent.[8] In 2006, China's total energy consumption was 2.46 billion tons of standard coal equivalent.[9] India consumes about four percent of the world's total energy per year.[10] According to the International Energy Agency (IEA), overall demand for energy in China and India is projected to approximately double by 2030. The IEA forecasts that two-thirds of all future energy demand will emanate from just the two countries. China and India have rich coal resources (China is the number one coal producer and India has the fourth largest coal reserves in the world), but most of the coal is mainly burned directly with low efficiency. Both nations have, thus, oil and gas playing a comparatively important role in their national economic and social development. China's oil demand has been growing at an average seven percent since 1990,[11] and it is now the world's second largest consumer of oil after the United States. Chinese demand for oil is expected to more than double from 7.1 million barrels a day in 2006 to 16.5 million barrels by 2030.[12] Oil comprised 36 percent of Indian primary energy consumption in 2005 and is expected to grow from 119 Million Tons Oil Equivalent (MTOE), from 2004 to 250 MTOE by 2025, reflecting an annual growth of 3.6 percent.[13] However, their domestic oil cannot meet the need of economic and social development. China imports 50 percent of its oil consumption[14] and India imports more than 70 percent.[15] Although the two Asian giants consume only a third as much oil as the United States today, by 2030, China and India together will import as much oil as the United States and Japan do today. Their combined oil imports will rise from 5.4 million barrels per day in 2006 to 19.1 million bpd in 2030;[16]

b) Environmental constraints: As their consumption of fossil fuels accelerates, so will India's and China's emission of greenhouse gases such as carbon dioxide. Although today, they contribute only four percent and 14 percent, respectively, to total global carbon dioxide emissions,[17] (and emitting just 10 percent as much greenhouse gas per capita as North America), India's and China's emission is rising far faster than North America.[18] These figures are projected to increase to five and 18 percent respectively by 2025. This represents a 3.3 percent annual average percentage increase for China over the next 20 years, and a 2.9 percent increase for India.[19]

c) Higher cost: The grid extension is often more expensive in rural areas than in urban areas because of its lower load densities, low capacity utilisation rates, high electricity line losses, and requirement for accompanying infrastructure development such as roads. Extending the lines to rural areas, therefore, would only increase the costs of the overall generated electricity. A 2000 World Bank/UNDP study on rural electrification programmes placed the average cost of grid extension per km at between US$8000-US$10,000, rising to around US$22,000 in difficult terrains. Extending the electric grid to remote and low-density rural areas can cost seven times more than providing electricity in an urban area.[20]

How can one then solve the aforementioned problems? It is obvious that, with such limited energy resources, it is difficult to meet the energy demands of urban areas and industries, let alone solving energy problem in rural area with fossil fuels.[21] In fact, the centralised utility model is not always the most effective channel to deliver new energy services to those currently without access.[22] With the advent of mature renewable energy technologies, the supply of power to remote rural areas from the centralised grid is becoming less competitive, as well as being more harmful to the environment and requiring more extensive infrastructure.[23] For instance, the price of generating electricity through solar photovoltaic (SPV) has fallen 60 percent between 1990 and 2007. The efficiency of SPV cells has also gone up many times – from five percent in 1954 when the first cell was developed to 24 percent now. The cost of generating electricity through SPV had fallen from US$300 per watt in 1954 to US$4.5 per watt now.[24] Although not all renewable technologies are yet cost-competitive in many applications, in many rural applications of the existing transmission grid, it is more cost effective to install a dispersed renewable energy technology to provide electricity than to extend the transmission grid to the region so as to supply centrally generated electricity. In particular, new forms of energy production that can provide stand-alone power, operated by small and medium-sized enterprises, may bring down this cost. There is increasing recognition of the need for small rather than big power stations to meet power demands in particular locations, for example, in remote areas and on islands.[25] Renewable energy sources also lend themselves to smaller power stations. Small-scale power generation offers environmentally-sound ways to produce energy for local use from locally-available materials.

In order to solve the problem of electricity supply in rural areas of China and India, local renewable sources of energy are becoming a more attractive alternative. The problem is how to enhance the development of rural renewable energy in China and India. Many studies show that the development of rural renewable energy depends on a variety of socio-techno-economic-institutional factors, but the financing is a key ingredient. However, up to now, some main issues of the financing for rural renewable energy in China and India have not been adequately explored and/or sought after. Therefore, it is necessary to conduct research related to the financing rural renewable energy in China and India.

In this study, an analysis framework for financing rural renewable energy is developed. In this analysis framework, (1) the complicated issues of financing rural renewable energy in

China and India are classified into four types, including the environment, channels, instruments and innovative mechanisms of financing rural renewable energy; (2) financing environment is defined as regulatory, legislative and policy conditions; (3) financing channel is defined as the source of financing; and (4) financing instrument is defined as the specific delivering method of financing.

The remaining sections of paper are presented as follows: Section 2 analyses the current status of rural renewable energy in India and China. Section 3 develops and employs an analysis framework to study the environment, channels, instruments and innovative mechanisms of financing rural renewable energy in India and China. Section 4 makes a primary comparison of financing rural renewable energy in China and India. The final section makes some concluding remarks.

2. Current Status of Rural Renewable Energy in China and India

Both China and India recognise the importance of expanding access to modern energy services for their rural areas through the development for renewable energy. They already are two world's leading countries in rural renewable energy systems (See table 1). China has an impressive history in the use of renewable energy for rural development, with some of the world's rural largest programmes on small hydro, biomass, wind, photovoltaics (PV) and biogas. At the end of 2006, the installed capacity for small hydro in China was 50,000 MW. China has over 200,000 stand-alone wind turbines, located in rural areas, with total installed capacity of 30 MW. At present, there are over 20 domestic wind turbine generator manufacturers in China.[26] By end of 2005, China's installed capacity of PV systems in over 70 MW, of which about 50 percent is used to supply electricity to the residents of remote rural areas, a market that is growing at 20 percent annually.

By the end of 2006, geothermal pump generation was developed in many provinces of China. The total national installed systems so far have exceeded 30 million square metres in construction areas. According to a partial statistics, the total geothermal pump sales have exceeded 100 million yuan and are increasing by 20 percent each year.[27] At the end of 2006, the installed capacity for a small hydro in China was 50,000 MW, with annual power generation over 150 TWh, which accounts for 39 percent and 36 percent of the total installed hydropower capacity and annual hydroelectric generation of China respectively.[28] In recent years, about two million new household biogas digesters are built every year. By the end of 2005, 18 million households had adopted biogas technologies, annually producing biogas seven billion m3 and there are 3,556 biogas plants, treating animal waste amounting to 87 million tons.[29]

In India, over 3,000 remote and inaccessible villages and hamlets have been provided with basic electricity services through distributed renewable power systems. India is the largest producer of world's rural solar home systems and biomass gasification. India's installed capacity for small hydro was 1,850 MW as at 30 September 2006. Rural applications of solar PV increased to cover 340,000 home lighting systems, 540,000 solar lanterns, and 7,000

solar-power water pumps. There are 600,000 solar cookers in use. India has also achieved 70 MW of small-scale biomass gasification systems for rural (off-grid) power generation.[30] Currently, biomass helps to meet 70 percent of the basic energy needs of the rural areas, covering almost 70 percent of the population in India.[31] About 100,000 biogas plants and 16,530 SPV lighting systems were installed during 2004-05. Biomass power projects aggregating to 140 MW capacity were installed, which created a large number of employment and income generation opportunities, especially in the rural areas. In addition, 100 percent producer gas-operated engine were developed and deployed in several villages for rural electrification. Over 150,000 square metres of collector area has been installed for solar water heating in the domestic, industrial and commercial sectors in India. As a result, the coverage of the cumulative-installed collector area has increased to one million square metres.

Table 1: Leading countries in rural renewable energy systems 2005[32]

	1.	2.	3.	4.	5.
Village power Small hydro, wind, PV, biomass	China	India	Nepal	Vietnam	Sri Lanka
Water pumping Mechanical wind, PV	Argentina	China	South Africa	Namibia	India
Solar Home Systems	India	China	Thailand	Kenya	Sri Lanka
Biogas	China	India	Nepal		
Biomass Gasification	India	China			

Source: REN21 :Global Status Reports

3. Financing for Rural Renewable Energy in China and India

Both China and India have long recognised the potential for renewable energy technologies (RETs) as environment-friendly, versatile and sustainable energy alternatives for rural areas and have made great progress in renewable energy in rural electrification, but RETs have not yet succeeded as a major alternative source of energy in rural areas of the two countries. In addition, many households, small businesses, and communities in the rural areas of both China and India still have no access to electric grids or modern cooking fuels. Therefore, there is need to speed up the development of rural renewable energy so as to expand energy coverage to the rural areas.

China plans to electrify 10,000 villages and 3.5 million rural households with renewables by 2010. India has recently proposed to augment cooking, lighting, and motive power with renewables in 600,000 villages by 2032, starting with 10,000 remote un-electrified villages by 2012.[33] The Indian government has tasked the Ministry for Non-conventional Energy Sources to electrify 25.000 rural Indian villages based on renewable energy as part of the major rural electrification programme.[34] The key question is how the two countries can speed up the development of rural renewable energy and to achieve the aforementioned goals. Many studies indicate that the development of rural renewable energy depends on a variety of

socio-techno-economic-institutional factors, but financing is a key ingredient. The development of rural renewable energy can be speeded up through appropriate financial incentives, subsidies, and strengthening the supporting infrastructure to ensure reliability, quality and efficiency. However, up to now, some main issues of the financing for rural renewable energy in China and India have not been adequately explored and/or sought after.

In this study, an analysis framework for the financing rural renewable energy is developed. In this analysis framework, (1) the complicated issues of financing rural renewable energy in China and India are classified into four types, including the environment, channels, instruments and innovative mechanisms of financing rural renewable energy; (2) financing environment is defined as regulatory, legislative and policy conditions; (3) financing channel is defined as the source of financing; and (4) financing instrument is defined as specific delivering method of financing. The following section of this paper employs this framework to systematise the issues of the environment, channels, instruments and innovative mechanisms of financing rural renewable energy in China and India.

3.1 Financing Environment for Rural Renewable Energy

The favourable regulatory, legislative and policy conditions are critical for financing rural renewable energy. These conditions strongly affect the possibilities and competitiveness of renewable energy sometimes in a way that economically-viable rural renewable energy projects are financially not viable.

3.1.1 China's Financing Environment

China's government started to pay attention to renewable energy development in the rural areas and realised the importance of providing the required regulatory, legislative and policy support for the financing for rural renewable energy in 1970s.

In 1973 the Chinese government promulgated the Agricultural Law. Provision 57 clearly states that agricultural and rural economy development must utilise and protect natural resources such as land, water, forest, grassland and wild life in a sustainable way. Renewable energy and clean energy such as hydraulic energy, biogas, solar energy and wind energy should be utilised and developed in a sustainable way. It aims to encourage the development of ecological agriculture and to protect and improve ecological environment.

The 1995 Electric Power Act, the first Chinese law that discusses energy policy, stresses that China wants to develop water resources in the rural areas and promote small hydropower systems for rural electrification. The deployment of solar energy, wind, geothermal, biomass, and other renewable energy resources will be encouraged and supported by the government.

In 1996, the Ministry of Electric Power issued the "Parallel Operation Regulations for Wind Power Generation." It requires that the power grids must allow interconnection and parallel operations of wind farms, and that the power grids must buy all the electricity generated by

the wind farms. It further specifies that the purchase price should include production cost, repayment of debt and interests, taxes, and a reasonable profit. The difference in prices between the wind energy and the average market price should be borne by all the customers of the power grid, not just the customers closest to the renewable energy projects.

The 1998 Energy Conservation Act again recognises and emphasises the importance and strategic role of using renewable energy to reduce emissions and to protect the environment.

In 1999, the State Planning Commission, through the State Council, approved regulations to support the development of renewable energy and to accelerate the local production of the power equipment.

The middle-term and long-term development policies have emphasised that rural electric development will be a critical task of China's energy development. The development strategies should adapt to local conditions, and importance should be placed on small hydro, wind, solar energy, geothermal, and biomass resources. The long-term development policies are mainly reflected in "China Agenda 21" and "Long Term Objectives on Economic and Social Development of China", especially the "Outline for Development of the New and Renewable Energy in China (1996-2010)". The 6^{th}, 7^{th}, 8^{th}, 9^{th}, 10^{th} and 11^{th} Five-Year Plans listed middle-term policies of renewable energy development in China during the different periods.

Sometime in 2003, the National Development and Reform Commission (NDRC) initiated the formulation of strategic planning for renewable energy development in 2020 to promote renewable energy technology development in China and keep up with world trends. The strategy is based on renewable energy resources and technology characteristics in China to meet the social and economic development requirement, and it draws on foreign experience and lessons learned. The strategy presents the objectives, layout and policy measures for renewable energy development in China in the next 20 years, guiding the path of development and construction of key projects in the renewable energy field.

The renewable energy law, which came into effect in January 2006, defines renewable energy to include hydroelectricity, wind power, solar energy, biomass energy, geothermal energy and marine energy. The law aims to boost China's renewable energy capacity to 15 percent by the year 2020 and outlines a commitment to invest US$180 billion in renewable energy over this period. It sets the stage for the widespread development of renewable energy in China, particularly for commercial-scale electricity generation facilities. It stipulates that the development and use of renewable sources are areas of priority for future energy development and requires grid operators to purchase resources from renewable energy producers, and offers financial incentives to foster renewable energy development, including discounted lending and a range of tax breaks.

Through this legislation, the state officially encourages the construction of renewable energy power facilities. China's electricity grid is obligated to purchase all the electricity generated

by approved renewable energy facilities located in its service area. The grid's buying price for renewable energy is set by the NDRC and it will adjust the buying price from time to time as necessary. The cost of purchasing this power will be spread amongst the customers on the whole country grid. The law includes other details related to the purchase and use of SPV, solar water heating and renewable energy fuels. Finally, the law includes specific penalties for non-compliance.

The Ministry of Finance in China promulgated "Interim measures for the administration of special funds for the development of renewable energy", which took effect on 30 May 2006. The new interim measures for the administration of special fund for the development of renewable energy define the scope and principles of the policy as well as focus on specific steps the government is taking to finance renewable energy development. This will be conducive to increasing the government's investment in renewable energy, better introducing social investment and bank funds into the sector, and promoting the development of renewable energy. It is in precisely this situation that the Chinese government has defined the goals of this special fund and financial management policy: scientific and technological research and development; use of renewable energy resources in remote agricultural and livestock areas; exploration of resources; equipment manufacturing; among others. Support will be given to key projects involving the development of alternatives to oil, such as solar energy, geothermal energy, wind energy and ocean energy.

3.1.2 India's Financing Environment

The importance of the increasing need to provide renewable energy sources was recognised by the Indian government in the early 1970s. For nearly 40 years, India's significant efforts have gone into the design, development, field demonstration and large-scale use of a number of renewable energy products and systems.

In 1981, the Indian government established a Commission for Additional Sources of Energy (CASE) in the Department of Science and Technology, on the lines of the Space and Atomic Energy Commissions. CASE was charged with the responsibility of formulating policies, and their implementation, programmes for development of new and renewable energy apart from coordinating and intensifying research and development in the sector.

In 1982, CASE was incorporated in the newly created Department of Non-Conventional Energy Sources, which, in 1992, became the Ministry of Non-Conventional Energy Sources (MNES) and was renamed as Ministry of New and Renewable Energy (MNRE) in 2006. India is the only country in the world that has an exclusive ministry which deals with new and renewable energy sources. MNRE supports the implementation of a large broad-spectrum of programmes, covering the entire range of new and renewable energies. The programme broadly seeks to, inter-alia, supplement conventional fossil fuel-based power; reach renewable energy, including electricity, to remote rural areas for a variety of applications, such as water pumping for irrigation and drinking water purposes, drying farm produce, improved chulhas and biogas plants, energy recovery from the urban, municipal and

industrial wastes. In addition, exploitation of hydrogen energy, geothermal energy, tidal energy and biofuels for power generation and automotive applications is also envisaged.

The 9th, 10th and 11th Five-Year Plans clearly indicated that rural development and energy are major goals for the plan periods. The use of non-conventional energy is specifically mentioned. The various programmes of the MNRE (MNES) are expected to be strengthened and it is expected that there will be increased emphasis on renewable energy using locally available resources. To this end, decentralised energy planning through Integrated Rural Energy Programme will continue as will the various MNRE (MNES) technology initiatives (biogas, biomass, solar, wind, etc.).

In 2003, India's government enacted the Electricity Act. The Act is the most important legislative development which has stimulated the recent growth in renewable power in India. The Act recognises the role of renewable energy technologies for supplying power to the utility grid as well as in stand alone systems. The Act 2003 has several provisions favourable to renewable energy power, including rural electrification. It provides for local generation and distribution of electricity by panchayats (legally-elected village level governing body), rural franchisees, non-government organisations and user associations by involving local communities in managing electricity distribution. Under the proposed open access scheme, the Independent Power Producers can set-up renewable energy power plants for captive use, third party sale, power trading companies and for their own transmission and distribution, both in rural and urban areas. The Act also directs the central government to prepare national electricity and tariff policies, including renewable energy-based power.

Currently, MNES is in the process of developing the same for renewable energy. The most important feature and the highlight of the Act is that it empowers the state electricity regulators to promote renewable energy and specify for the purchase of electricity from renewable energy sources, a percentage of the total consumption of electricity in the area of the distribution licensee. This is considered a major boost for the promotion of the renewable energy sector in India. In other words, once it is implemented, the utilities in the state will have a target of procuring renewable energy-based power, based on a certain percentage as specified by the regulator. In this liberalised electricity market, the financing mix for renewable energy is likely to change as new financing institutions and mechanisms are expected to enter the market.[35] The Act also has several provisions favourable for renewable power, including rural electrification. Its most important feature, however, is to stipulate that distribution companies must buy part of their electricity purchases from renewable sources. This is considered a major boost for renewable energy promotion in India.[36]

3.2 Financing Channels for Rural Renewable Energy

The financing channels of rural renewable energy of China and India mainly include government finance, international funding, commercial banks and non-bank financial institutions, public stock markets and private-sector finance.

3.2.1 Government Finance

Financing rural renewable energy is a part of financing rural electrification. Financing rural renewable energy is different from financing renewable energy on the bulk power market. It is an issue of improving social equity, rather than of correcting market imperfections. The government finance is the most important channel for financing rural renewable energy. The governments of both China and India have a strong role to play in financing rural renewable energy by initiating national programmes and providing financial incentives.

In late 2001, China's State Development and Planning Commission (renamed the NDRC in 2003) launched an ambitious renewable energy-based rural electrification programme known as Song Dian Dao Xiang, literally "Sending Electricity to Townships." The programme electrified more than 1,000 townships in nine western provinces – Xinjiang, Qinghai, Gansu, Inner Mongolia, Shaanxi, Sichuan, Hunan, Yunnan, and Tibet – bringing power to nearly one million people and providing the basis for rural economic development. Installation was completed in June 2003 and consisted of 20 MW from PV, 840 kW from wind, and 200 MW from small hydropower (in Hunan and Yunnan provinces). The government provided US$240 million to subsidise the capital cost of equipment. The Chinese Township Electrification Program is the first nationally based implementation of renewable technologies to supply electric service to the rural population. It is also one of the largest renewable energy-based rural electrification programmes in the world and it has enough critical mass to create a truly robust and sustainable renewable energy infrastructure in China, especially for PV. The programme represents an important launch point, as the lessons learnt will have an immediate impact, not only on future objectives of rural electrification, but also ostensibly on renewable energy programmes worldwide.

Similarly, India's IERP, using renewable energy, had served 300 districts and 2,200 villages by early 2006. More than 250 remote villages in seven states were electrified under the programme during 2005, with additional projects under implementation in over 800 villages and 700 hamlets in 13 states and federal territories.

3.2.2 International Funding

In China and India, international financing sources have played a major role as incubation funds for the development of rural renewable energy. Many rural renewable energy projects in China and India have been financed by multilateral and bilateral organisations.

In China, projects financed by international funding include "Capacity building for the rapid commercialisation of renewable energy", "China renewable energy development project", "The solar village project", "Wind power project in China's Hubei", "Clean energy research project", "The Brightness Program" and "CERUPT: Inner Mongolia Huitengxile wind power project".

In India, the projects financed by international funding mainly include "Optimising development of small hydel resources in hilly areas", "Indian hybrid energy project – world renewable spiritual trust", "India renewable resources development project", "Second renewable energy project", "India renewable energy development project" and "The Commercialising Renewable Energy in India."[37]

3.2.3 Commercial Banks and Non-bank Financing Institutions

Internal financing in both China and India will become a significant source of financing. The two countries have a well developed rural banking infrastructure, but the links to the renewable energy sector are weak. In both countries, traditional banking systems are still not active in financing rural renewable energy in view of the high risk and low profit associated with these loans. Financial institutions are not always interested in giving or opening lines of credit for rural renewable energy.

3.2.4 Public Stock Markets

In China and India, the public stock markets have opened up to renewable energy. In India, many Indian renewable energy companies have chosen to go public on the Indian stock exchanges.[38] In China, the 23 renewable energy enterprises have been listed on the Shanghai and Shenzhen Stock Exchanges.

3.2.5 Private Sector Finance

China's private sector finance for rural renewable energy, especially for rural small hydropower (SHP) has grown fast. For example, during 1994-2002, private investment in new SHP in Zhejiang province amounted to US$1 billion, accounting for more than 70 percent of the total. In Jingning county of Zhejiang, more than US$105 million was accumulated from private enterprises to set up 91 SHP stations with a total capacity of 155.4 MW since 1990. In Guangdong, private investment accounted for over half of the total SHP investment of US$839 million during the 9th Five-Year Plan period.

In 1999, the Indian central government announced a policy of opening electricity generation to private participation. To help the private sector create a market for renewable energy, the India Renewable Energy Development Agency (IREDA) took a number of measures to raise awareness among investors and banking institutions of the viability of renewable energy technologies and overcome the barriers of access to market for renewables.

3.3 Financing Instruments for Rural Renewable Energy

In both China and India, a number of financing instruments have been used to facilitate the financing of rural renewable energy. An overview of the existing financing instruments to help promote investments in the development for rural renewable energy of the two countries is presented below:

(1) Grants

Declining cash grants on a sliding scale over the life of the project are built into more recent projects to "push" the market early on and then allow a transition to a fully-commercial market. Some projects are offered fixed cash grants for each system installed once the certification of the installation is available. For example, in the China Renewable Energy Development projects, a US$100 cash grant is paid directly the solar home systems (SHS) dealer.

(2) Renewable energy service companies (RESCOs)

The RESCO concept is most suitable for small-scale renewable energy systems like the PV SHS. Rather than sell SHS to homeowners, the RESCO sell the service that is produced by the SHS and, in turn, collects a monthly fee. The RESCO can aggregate a large number of consumers into a single project rather than for each SHS. The consumer overcomes the high cost barrier by having only to make small monthly payments. Dozens of RESCOs have been set up to provide the services of sale and installation and maintenance of household solar PV systems in China and India, and solar water heating in India.

(3) Low interest and long-term loans

India's IREDA provides low-interest loans to wind farm developers. Loans are expected to progressively approach commercial market rates as the technologies gains wider acceptance and are considered more transparent and effective at reducing product costs than direct subsidies.

The India Hilly Hydel project established a revolving fund, also administered by IREDA, to provide low-interest financing to private entrepreneurs for small hydel projects. Like in the India Alternate Energy project, these loans are expected to progressively approach commercial market rates as the technology gains wider acceptance. The India Hilly Hydel project also creates a national strategy and masterplan with detailed investment proposals for additional small hydel projects.

The Chinese government has established specific low interest loans for rural energy development since 1987. The interest rate for large and medium biogas projects, solar energy applications, and wind technologies is only half of that from compatible commercial loans. In addition, China has established special low interest loan programmes for small hydro projects.

(4) Joint Ventures

China has engaged in several successful joint ventures with companies in other countries. For example, the United States' company, Tang Energy Group Ltd., helped established ZhongHang (Baoding) Huiteng Windpower Equipment Co., Ltd. in China in 2001. Since then, "Baoding" has captured a dominant share of the Chinese market for blades and nacelle covers

for 600 kW to 750 kW wind turbine generators. While to-date, Baoding has sold only to Chinese wind farms, it is preparing to export blades to other Asian wind farms.

(5) Asset Financing

China is the 3rd largest location for asset financing for wind projects, after the United States and Spain. In India, asset financing has focused on wind, although the majority of investment is by captive power generators.

(6) Venture Capital/ Private Equity

In China, venture capital funding for renewable energy is soaring. Venture capital investment in RETs reached US$403 million in 2006. Thirteen of the 17 deals in RETs were in solar, totaling US$367.8 million. Wind power accounted for two deals totaling US$22 million while there were two deals in biomass amounting to US$13.2 million.[39] After the United States, China is the second largest recipient of venture capital.[40] In 2006, roughly half of the VC/PE (US$100 million) was private equity investment for expanding wind manufacturing capacity.

(7) Subsidies

In China, the main subsidies for rural renewable energy are provided by the central and local governments to support research, development and demonstration projects for rural renewable energy. In India, subsidies such as interest subsidy and capital subsidy are mainly provided by the MNRE.

(8) Import Duty Reduction

In China, the imports of renewable energy technologies used to be exempt from payment of import duty. In India, this is the case for renewable energy technologies not produced in India.

(9) Reduction in Value Added Tax (VAT)

In China the rate of VAT is 17 percent. The VAT for biogas, wind power and small hydro is only three percent, 8.5 percent and three percent respectively. There is not VAT for power generation from municipal solid waste. In India, the VAT on renewable energy equipment is lower than the normal rate.

3.4 Innovative financing mechanisms for rural renewable energy

The key issue of financing rural renewable energy in China and India is the availability of capital to renewable energy developers and rural end-users, while the issues involve the cost, the ease of obtaining low-cost funds, and institutional complexities that hinder financing and market growth. While conventional funding and financial instruments such as capital

subsidies, donor grants, and tax rebates and similar fiscal incentives have been able to achieve a certain level of penetration, the large-scale use and commercialisation of renewable energy products and technologies requires innovative approaches to the selection and delivery of financial instruments and channels. Many innovative mechanisms for financing renewable energy have been devised and tested by China and India to promote rural renewable energy. These innovative financing mechanisms include the mechanisms that combine government and community financing (India); development of a market-oriented institutional and financial model for decentralised solar systems (India); wind-power development through combination of the Clean Development Mechanism (CDM) and public sector financing (India); scaling-up of renewable village power through governmental finance and bidding based on market regulation (China); experience of the first CDM project in renewable energy financing in China (China); financing the utilisation of landfill gas through economic incentives (China); commercialisation of solar hot water systems through a 'financial intermediary scheme' (India); market development for solar lanterns in a post-subsidy regime (India) and developing a sustainable financial model for solar pumping systems (India).[41]

4. Primary Comparison of Financing Rural Renewable Energy in China and India

Both China and India realise the importance of providing the required regulatory, legislative and policy support for financing rural renewable energy. China has created a favourable environment for financing rural renewable energy. It is one of 48 countries worldwide that have enacted laws for renewable energy development.[42] There is no a national renewable energy legislation in India yet. India also does not have any energy policy today. However, an Expert Committee constituted by the Planning Commission has prepared an Integrated Energy Policy Report covering all sources of energy, including renewable energy sources. This report has highlighted the need to maximally develop domestic supply options and diversify energy sources. It has also projected that renewables may account for five to six percent of India's energy mix by 2031-32 and has observed that the distributed nature of renewables can provide many socio-economic benefits for the country, including its rural, tribal and remote areas.[43]

The demand for the finance of rural renewable energy in both China and India still faces severe constraints on the supply side, such as amount of funds, terms and conditions of funds and available financing instruments. Thus, the practical relevance of the many financial instruments is rather limited in the commercial financial markets of the two countries for RET financing. India has the most complex system of subsidies and financing arrangements for rural renewable energy investments compared to other Asian nations.[44]

China does not yet have a fully developed financial incentive system for rural renewable energy, but the government has been providing support to the sector since the 1950s. The major financial incentives in existence today include subsidies, tax-related incentives, custom duties, and pricing incentives, and the government is moving towards more comprehensive quantity- and price-based support mechanisms.

India has created special funding agencies to provide loans for rural renewable energy projects at below-market interest rates. The key institution is the IREDA which is the main national provider of finance for renewable energy projects. Local commercial banks, in turn, are drawn into renewable energy financing by the example of the IREDA. It recently increased its share capital to US$226 million, which will allow it to leverage higher levels of private investment. Unlike India, the Chinese central government finances rural renewable energy through some different departments. For example, it finances research and development on key renewable energy technologies through the NDRC and the Ministry of Science and Technology (MOST). Funds offered by MOST during the 10th Five-Year Plan period will be US$3.4 million. In addition, there are some subsidies for demonstration projects and training courses from the former State Economic and Trade Commission (SETC), the Ministry of Finance, and the Ministry of Agriculture. The former SETC's Department of Resource Conservation and Utilization provided low-interest loans from the state budget to support the development of rural renewable energy. The Ministry of Water Resources provides low-interest loans of about US$26 million for small hydropower development.[45]

Both China and India are actively expanding their rural renewable energy presence, but much of India's growth has been financed domestically.[46] However, foreign as well as domestic companies have been active in China. The world's leading wind equipment suppliers – Vestas, GE Energy and Gamesa – have each set up wholly-owned manufacturing facilities in China. And seven foreign development banks, including the International Finance Corporation, Germany's DEG and France's Proparco, have invested in China's renewable energy projects. Chinese renewables companies are also actively seeking development opportunities beyond their border. For example, six Chinese solar companies have been listed on overseas stock markets. They are Suntech (NYSE: STP), JA Solar (NASDAQ: JASO) Rene Solar (AIM: SOLA), Solarfun Power (NASDAQ: SOLF), Trina Solar (NYSE: TSL), and Canadian Solar (NASDAQ:CSIQ).[47]

Both China and India have devised and tested many innovative mechanisms for financing renewable energy, but the innovative modes of the two nations are different, as explained in Section 3.4.

5. Conclusion

In conclusion, the comparison of financing rural renewable energy of China and India clearly indicates that there are similar and dissimilar options for financing rural renewable energy between India and China. They are reflected in the environment, channels, instruments and innovative mechanisms of financing rural renewable energy of these two countries, respectively. It is obvious that the analysis of the similarities and differences between China and India through a comparison of financing rural renewable energy will be beneficial to promote the experience exchange and technology cooperation in financing rural renewable energy of China and India so as to expand modern energy to rural areas of two countries. More importantly, as the two world's leading countries in the development of rural renewable

energy, China's and India's experiences in financing rural renewable energy will be of strategic and practical interest to other developing countries and emerging middle-income countries in the region.

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