China's Cleantech Landscape:

The Renewable Energy Technology Paradox

*by Federico Caprotti**

Introduction: China's Renewable Energy Technology Paradox[1]

Cleantech is playing an increasingly important role as a sector of investment on the international scale, attracting $8.4 billion in the North American, European, Chinese, and Indian markets in 2008.[2] This represents a thirty-eight percent increase on the $6.1 billion invested in cleantech in 2007 in the same markets.[3] Within cleantech, arguably the most important area, or sub-sector, of investment is renewable energy technologies and generation systems, which account for over thirty percent of cleantech investment flows.[4] However, the role of renewable energy technologies at the national scale is also increasing in importance. This article focuses on China, where the development of renewable energy sources is crucial to energy security and to providing alternatives to the carbon economy, which is currently generating many environmental externalities. Renewable energy technology development and manufacturing also provide clear opportunities for the Chinese central government to promote a domestic technology manufacturing base, and to achieve China's 2020 energy generation targets, as will be shown below. Therefore, renewable energy technology will play an increasingly important role in China's energy landscape. At the present time, renewable energy is both a current generation reality and a future technology opportunity: by 2005, renewable energy provided eight percent of the country's total energy consumption and sixteen percent of its total electricity output.[5] This is expected to more than double by 2020.[6]

At the same time, research reveals that the Chinese renewable energy technology market presents a paradox: a market of opportunity based on a need for the development of generating capacity from renewable sources, coupled with the existence of policy, fiscal, and technological obstacles which hamper the potential of China's cleantech market in renewable energies. China is depicted as a leading cleantech market in the short to medium term, especially in renewable energy technology, project infrastructure, and manufacturing.

However, many researchers have also highlighted the problems which seemingly go hand in hand with China's status as a predominant emergent renewables market in the short term, and as a projected market leader in the next five to ten years. These issues are not only restricted to the renewables business; they extend across the wider political and cultural context, bringing to light the importance of a network approach to renewable energy technology development, manufacturing, and deployment. In short, China's renewable energy market presents an opportunity with clear challenges. The following provides an analysis of the main obstacles facing and currently affecting the renewable energy market in China.

Changes in import duties need to be stable in order to truly promote technology transfer into China; fiscal policy stability aids foreign technology businesses' long-range strategy and planning.

Obstacles: Policy, Tax, and Long-Term Market Development

Energy landscapes can be uneven landscapes. This can be due to a variety of factors. However, above all, the existence of obstacles to the development of cleantech landscapes in a national context can mostly be related to policy, fiscal, and economic issues which can be deeply local. At the same time, global economic influences—both at the firm level and at the level of international economic policies—intersect with national regulatory and technology landscapes to constitute a complex environment in which clean energy technologies develop. China's cleantech landscape, and specifically its renewable energy market, is an example of the interplay of these forces. The following highlights some of the main issues facing the renewable energy market in the country today, focusing on energy pricing

* *Federico Caprotti is an assistant professor at University College London, Department of Geography. His research focuses on a comparative analysis of decision-making in cleantech investment; he is currently engaged in a British Academy-funded project on cleantech investments in wind power technology in China and the United States. The author is available by email at the following address: fkaprotz1@yahoo.co.uk.*

policy, technology transfer, private investment, and the need for emphasis on energy conservation as well as monitoring and evaluation.

Pricing Policy Shortfalls

China's 2006 Renewable Energy Law attempts, among other things, to set pricing standards for energy generated from renewable energy sources.[7] The law's broad aims are to increase the capacity generated from renewables in the country, and are part of a wider national strategy aimed at increasing power supply as well as diversifying the generating base, as a result of rising demand and a need for energy security.[8] The law's renewable energy pricing mechanisms are based on "feed-in" tariff models of the kind applied to European energy markets;[9] however, the link between pricing at source and grid distribution in China is proving problematic.[10] This is largely because utility companies have, in many cases, little incentive to connect a renewable energy project, such as a wind farm, to the grid. Once such projects are connected, utilities are required to purchase power generated by the projects; the price for renewables-generated power is higher than for coal-generated power, generally due to government-mandated subsidies and tariff levels (which are aimed at generating project revenue as well as paying off interest and loan principals required to build renewables projects in the first place).[11] Therefore, the current renewable energy landscape—especially in the case of wind power—features a backlog of completed projects which are not actually connected to the grid.[12]

Uncertainty over power prices hinders the inflow of capital focused on renewable energy projects.

Technology Transfer: Uncertainty Over Import Tariffs

Uncertainty also exists over the stability of China's current import duties on renewable energy technology and associated machine components. This uncertainty is an especially important factor in hampering already established technologies like wind turbines. For example, ninety-seven percent of large-scale (non-micro) wind turbines currently installed in China are imported (this includes components).[13] The Chinese government's import duty strategy for wind technology has varied widely since the dawn of large-scale wind generation in 1986, alternatively imposing high and virtually non-existent taxes (see Figure 1).

For example, from 1990 to 1995, import duties were largely non-existent as the central government attempted to stimulate partnerships and technology transfer to develop a wind power base for the country.[14] By 1996, the government's strategic focus had shifted to the development of a domestic, national, and localized wind turbine manufacturing market. In order to stimulate domestic manufacturers, the government levied duties on foreign wind technology imports. The imposition of duties was reversed again in 1998, and a robust domestic manufacturing market is indeed developing: between 2003 and 2005, local wind turbine production rose from $26 to $104 million.[15] However, during the same period, the share of imported turbine technology rose from $35.9 to $211.9 million.[16]

Uncertainty remains over the instability of import duties and other taxes on foreign technology imports: for example, in April 2008, the central government changed the import context again by refunding value added tax ("VAT") on imported turbine components; this tax refund was backdated to the start of 2008.[17] While this specific measure is aimed at easing the cost of importing wind technology to China, it also inhibits the development of domestic wind turbine manufacturing by providing incentives for importing essential components. Furthermore, changes in import duties need to be stable in order to truly promote technology transfer into China; fiscal policy stability aids foreign technology businesses' long-range strategy and planning. For example, the VAT rebate measure was accompanied by the cancellation of China's tariff-free policy for foreign turbine units with a capacity of less than 2.5 megawatts ("MW"). Although this is in keeping with the central aim of building wind farms with a generating capacity of not less than 100 MW,[18] the resulting shifting import duty and tax landscape is not conducive to transparent cost pricing for importers, domestic manufacturers and, indeed, wind project developers.

Private Investment Shortfalls

At present, wind power technology and project development in China could be improved by enabling more investment from private sources (see discussion of development needs above). Government subsidies and preferential loan systems exist, but uncertainty over power prices hinders the inflow of capital focused on renewable energy projects. In this respect, the

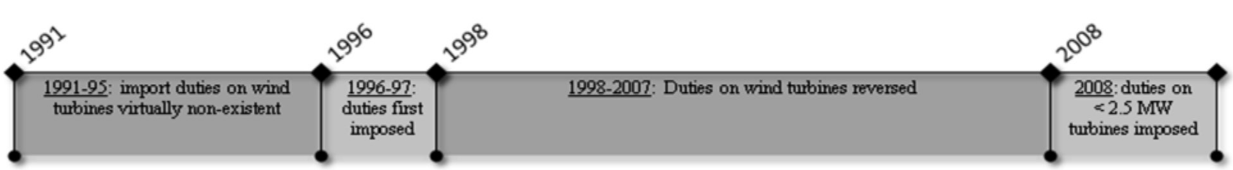

Figure 1: Timeline of shifting import duties and taxes on foreign technology imports.

Chinese renewable energy technology market is markedly different from other, more established renewables markets such as in European countries or the United States:

> [P]rivate investment has become the predominant force in wind farm construction in other countries. For example, around ninety-five percent of investment in wind farms was contributed by the private sector in India . . . ; However, unless a new investment mechanism with incentive policies and regulations is established [in China], and more financial channels are opened up, it [will] be difficult to realize the target of wind energy development.[19]

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A Decline in Energy Conservation Investment

From the point of view of sustainability discourse and policy, national and regional efforts to promote sustainability in China cannot be seen as separate from efforts to improve energy conservation capabilities. China is currently adding the equivalent of a 2,000 MW coal-fired power plant to its generating capacity *every week*, and has been doing so since around 2000.[20] This represents a large annual rise in the amount of fossil-fuel generated power, and a resultant rise in environmental externalities. In 2004, for example, the amount of energy capacity added to China's generation system was roughly equivalent to the amount of energy generated in the whole of Spain or California.[21] At the same time generating capacity has increased on the mainland, there has been an increased focus on renewable energy sources, especially hydroelectric, wind, and lately, solar power. However, this double trend—large incremental rises in generation capacity based on fossil fuels, and a rising interest in renewable energy sources—has been paralleled by a decrease in investment in energy conservation projects. This has led to the paradoxical situation that, from 1980 to 2000, China benefited from an energy supply surplus; since 2000, even with the added capacity, China has suffered from increasing energy shortages. Indeed, Jiang Lin, a China energy researcher at the Lawrence Berkeley National Laboratory in Berkeley, California, has recently argued that "support and policy commitments to energy conservation in China have weakened considerably during China's transition to a more market-based economy."[22]

China features several leading solar power and photovoltaic manufacturing and project companies, active in the domestic as well as in the international cleantech field.

Monitoring, Evaluation, and User Perspectives

A wider issue, applicable across all renewable energy markets, is the need for consistent, transparent, and precise monitoring and evaluation of renewable energy projects after they have been commissioned and progressed past the project stage. In particular, recent research has pointed to the need to include user perspectives both in terms of the efficacy of new energy technologies, *and* their wider socio-cultural acceptability within particular contexts.[23] The adoption of effective monitoring and evaluation ("M&E") programs can in turn be seen as a solution to the lack of connections from renewables projects to the grid. This is because effective M&E programs can be constructed around a set of key indicators—such as the number of projects connected to the grid, or a series of connections over a specific time span—which clearly track progress. However, underlying grid connection issues, such as electricity pricing and subsidies as well as incentives for utilities to connect renewable generation capacity to the grid, have to be resolved before M&E can be effectively applied.

Obstacles or Challenges?

These factors constitute a very real threat not to the development of China's renewable energy landscape, but to its progress. It would, in fact, be unrealistic to forecast a stalling of the Chinese renewables market, especially after the passing of the 2006 Renewable Energy Law and considering the number of projects still in the pipeline. Furthermore, the current project pipeline may provide a temporal buffer—a year at most—in terms of project development, which could help offset the negative effects of the current credit crisis and oil price declines on the renewable energy spectrum, from research and development ("R&D") expenditure to project development and grid connections.

The main risks posed by the obstacles identified above lie, instead, in the friction which could be exerted on the Chinese renewables technology market. This friction can be expressed in terms of slower growth in what is a dynamic and fast-developing market; erratic policy interventions, ineffective pricing mechanisms, and other factors can be seen as draining the Chinese market of potential energy just after the achievement of its take-off phase.[24] If China is to achieve its 2020 target of fifteen percent of national energy generation from renewables,[25] as laid out in its latest (2006-10) Five Year Plan, then these obstacles represent serious challenges to be faced before the end of the decade. This is especially relevant in the case of those already established projects, apart from hydroelectric power, which are expected to lead the renewables generation tables: wind power, for example, is expected to account for three percent of national generation capacity by 2020.[26] However, the identified obstacles should be considered challenges, not market conditions that will negatively affect the Chinese market in the long run. Indeed, apart from these obstacles, the Chinese renewable energy market is exhibiting signs of vitality, innovation, and opportunity. This article concludes by focusing, briefly, on these avenues of future renewables development.

China's cleantech market, especially in renewable energy generation technologies, is set to continue its take-off phase and gain altitude and international traction.

Conclusion: Innovation and Opportunity

As argued above, the main obstacles facing the Chinese renewable energy market are challenges to be faced in the realms of policy, pricing, and technology development incentives and subsidies. In terms of sustainability, China needs to be able to apply innovative policies to energy conservation and an amelioration of the lived environment, especially in urban areas. Landmark projects, such as those at Dongtan eco-city, mask the fact that conservation and emissions reductions are priorities which are secondary to continued growth. This focus on growth, in turn, leads to a continued focus on a carbon-fueled economy. However, there are some areas in which China's renewables market is exhibiting clear signs of innovation and leadership, as opposed to reaction to market conditions.

One of these areas is renewable energy technology exports. China is traditionally described as a net importer of renewable energy technology, technical know-how, and project development capabilities. This is especially the case where established technologies—developed mostly outside China—are concerned. In the case of wind power, mentioned above, China imports the great majority of its turbine technology as well as components.[27] However, by 2008, it had become an increasingly important exporter and manufacturer of other renewable energy generation technologies. Solar power is a case in point. China features several leading solar power and photovoltaic ("PV") manufacturing and project companies, active in the domestic as well as in the international cleantech fields. For example, Suntech Power Holdings ("Suntech"), a leading solar power player, has been involved in co-developing and investing in several large overseas projects, such as Elecnor, a thirty-five MW solar power plant in Spain, and Alamosa solar plant in the U.S. state of Colorado, an eight MW project.[28] Furthermore, Chinese solar companies have been engaged in opening up new markets for their solar expertise, as seen in the construction of Katsrin solar power plant in the Golan Heights, Israel.[29] The fifty kilowatt farm is the largest in the country to date, and was constructed by Israeli solar firm Solarit Doral, in conjunction with Suntech.[30] It is where renewable energy technologies are currently in the take-off stage—such as PV technologies—that Chinese renewables companies can be best positioned to compete and gain advantage over non-Chinese rival firms. Government investment in R&D must be rationalized and increased, however, if niche technology developments are to be effectively researched, marketed, and manufactured.[31]

Secondly, China's focus on large-scale renewable energy generation projects provides a clear opportunity for the pooling of large-scale project expertise; this will be increasingly relevant internationally, as the focus on renewables shifts to projects with larger generating capacities. China's aim of generating thirty gigawatts of installed wind power capacity by 2020, powering between thirteen and thirty million homes at full capacity, necessitates large-scale, highly-organized project development.[32] By 2020, the Chinese renewable energy project landscape is increasingly going to feature large-scale projects, generating more than 1,000 MW in capacity per project, connected to the grid.[33] The lion's share of these projects' generation capacity is likely to come from hydroelectric power and wind farms, with wind farms accounting for a majority of projects, at least in number.[34] Furthermore, offshore wind farms featuring large-scale wind turbines are going to be an increasingly important feature of coastal renewable energy generation: in November 2006, China's first offshore wind facility, with a capacity of 1.5 MW, was installed by China National Offshore Corporation using turbines manufactured by Xinjiang Goldwind. By 2009, work was underway on large-scale offshore wind farms, including the 102 MW Shanghai East Ocean Offshore Wind Farm.[35]

The points made in this article show that, in the case of renewable energy technologies within the Chinese cleantech market, China stands at a paradoxical waypoint. On the one hand, the Chinese context and market represent clear investment, development, and generation opportunities. On the other hand, the policy and fiscal obstacles identified in the article represent clear problems which will slow down development and sap the potential of this market—and of the development of China's energy system towards national 2020 targets—unless they are faced with clear political will at a central as well as a provincial level. China's cleantech market, especially in renewable energy generation technologies, is set to continue its take-off phase and gain altitude and international traction—unless the identified obstacles are allowed to slow down or, in the worst of cases, stall this cleantech trajectory.

Endnotes: China's Cleantech Landscape: The Renewable Energy Technology Paradox

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3 *Id.*

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22 *Id.* at 919.

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24 *See* Wen-Qiang et al., *supra* note 13.

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