Sustaining growth, sustaining the environment: a comparative analysis of wind energy policies in China and India

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ABSTRACT

China and India represent two exemplary cases to address the contentious compromise between two needs: on the one side that of economic development, and on the other side that of coping with climate change concerns. Wind energy is the focus of this paper, where the aim is to investigate how the two countries have supported this new technology to complement their efforts for securing energy needs. The comparative analysis is built upon a deep investigation of the institutional and market structure of the wind market in China and India in light of their historical evolution. Despite one relevant similarity that national wind energy markets have been fundamentally domestic-driven, important differences emerge as to the relation between the public and private involvement.

Keywords: India; China; wind energy; energy regulation; public and private enterprises

JEL classification: *L51, Q01, Q4*

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1 Introduction: global status of wind energy development

Wind power is today considered as the renewable energy with the greatest potential of growth, hence providing the greatest potential to contribute to carbon emissions reduction. According to the Global Wind 2008 Report previsions (GWEC, Global Wind Energy Council 2009) wind energy is expected to satisfy 10-12 percent of the global electricity demand by 2020 with a total of 1,500,000,000 MW installations, by that reducing CO_2 emissions of 1.5 billion tonnes per year with respect to a BAU scenario.

From 1997 to 2008 wind industries worldwide have been expanding at an average growth rate of 28.7 percent (Earth Policy Institute 2008), and today wind installations produce worldwide 121,188 MW of energy (WWEA, World Wind Energy Association 2008). Their impressive growth is expected to make wind energy contribute the most in the renewable energy scenario. Even supposing a low technological development for renewable systems, wind energy is expected to account for the largest share with respect to the other non-conventional energies (EWG, Energy Watch Group 2008).

The boom of the global wind market started in 2005, when, after a few years of irregular performances, the number of new installations begun to grow constantly. In particular, in 2008 impressive rates of growth were achieved at the global level and the wind power capacity increased by more than 27,000 MW, bringing the world total to almost 121,188 MW (WWEA, World Wind Energy Association 2008).

In the last two decades the global wind market has evolved considerably. Until recently, Europe (Germany, Spain and Denmark in particular) has been dominating the market. Today Europe maintains the leading role in terms of installed capacity, but since 2006 the dynamism of new comers, such as China, and the astonishing increase in generation capacity in countries like the US are geographically redistributing the central poles of wind energy production. In 2006 Germany, Spain and Denmark were respectively first, second and fifth in the global ranking, Germany alone possessing a share of 31.2 percent in the global wind market. Three years after the three European countries have all worsened their position and seen their market share being eroded, while the US has gained the first place increasing its from 15 percent to 20.8 percent (see Table 1). As regards the Asian region, in 2008 the situation was that the large additions to capacities in 2008 pushed up China's ranking in the global wind sector from the 8th to the 4th

position. India has steadily maintained its 4th place until 2007 whereas the following year its ranking slipped to the 5th position.

Table 1 Global wind installed capacity – Top 10 countries

Country	MW	Global Market Share
USA	25,170	20.8
Germany	23,903	19.8
Spain	16,754	13.9
China	12,210	10.1
India	9,645	8.0
Italy	3,736	3.1
France	3,404	2.8
UK	3,241	2.7
Denmark	3,180	2.6
Portugal	2,862	2.4
Rest of world	16,693	13.8
Total top 10	104,104	86.2
World Total	120,798[1]	100.0

Source: GWEC, 2009

It upon these premises that we aim to investigate the institutional and technological paths that China and India have undertaken for the promotion of wind energy. To

[1] We have maintained GWEC's data on total wind installations worldwide, despite this data slightly diverges from the data provided by the World Wind Energy Association (2008), cfr. p.2.

accomplish this task, we will contextualize the analysis in the broader scenario of climate change and energy shortages (section 2), in order to understand which role wind power is expected to play against these two issues. Section 3 is intended to provide a deeper analysis of the wind energy contexts in India and China, by offering an institutional as well as market explanation of their historical paths. Then, section 4 will focus on the main important issues pertaining to the wind sector in the two countries. Upon the problems and challenges that have been emerging along the discussion, it will be instructed a comparative analysis in order to test whether China and India face the same problems and to understand the nature and the reasons behind them. The last section concludes.

2 India early comer and China late comer in the wind energy market: energy needs and climate change

The increasing role of China and India in promoting wind technologies is explained by several factors. Their fast-growing, energy-hungry and coal-intensive economies imposed to consider renewable energies, *wind power* in particular, *as supplementary sources for fulfilling the energy requirements*. Renewable sources, in addition to their potential contribution to energy security, have also been regarded as advantageous in virtue of their distributed and decentralized nature. Wind energy, in particular, can be locally available, hence making it possible to supply energy more extensively than a centralized system. In conditions where a power supply-demand gap threatens economic growth, grid supply is often unreliable and remote rural areas are still not served by electricity due lacking connecting grids. For villages where grid connectivity is hard to achieve or not cost effective, off-grid solutions based on stand-alone systems of small wind turbines may represent a cost-efficient way of supplying electricity.

Finally, the promotion of wind energy has become all the more important also on the ground of both local environmental problems and global climate change. The *energy sector is the main responsible for greenhouse gas emissions in both countries, representing 69.2 percent (891.3 MtCO2eq) and 59.1 percent (296.6 MtCO2eq) of the total in China and India respectively* (Niederberger, Saner 2005). As a consequence of the large and still growing use of coal that afflicts these countries, several local air pollution problems affect the population (in the form of respiratory diseases and reduced pulmonary functions) and the environment (with damages of acid rains to urban buildings, forests and cropland, Peng, Wu et al. 2002, Xu 1998).

Moreover, in the global scenario between 2006 and 2030 China and India will account for just over half of the increase in world primary energy demand (IEA 2008). They will be responsible for 31 percent of the world increase in oil consumption, but most of all for 71 percent of the increase in coal use.

China and India are among the few countries whose energy mix is dominated by coal. If coal represents about 30 percent of commercial energy consumption worldwide, in China it totals 63 percent of primary energy consumption (IEA 2007) and in India more than 57 percent (Meisen, Quéneudec 2006).

Despite extensive coal resources in China, they have been not enough to meet all the growth in its energy needs and in the first half of 2007, China became a net coal importer (IEA, 2007). Besides, since more than 90 percent of the Chinese coal resources are located in inland provinces, but the biggest increase in demand is expected to occur in the coastal region, it will add to the pressure on internal coal transport and makes imports into coastal provinces more competitive. In 1998, coal transport by itself overburdens the national transport system, using 40 percent of the rail capacity in the country (Fang, Lew et al. 1998).

China is the biggest contributor to incremental emissions of carbon dioxide from fossil fuels, overtaking the United States as the world's biggest emitter in 2007 (IEA 2008). It has been estimated that the power sector alone makes a 40 percent contribution to total carbon emissions.

India shows a heavy dependence on coal consumption and production: the Central Government makes no mystery of the fact that coal shall remain India's most important energy source till 2031-32 and possibly beyond.[2] Today India is the third largest producer of coal and one of the major consumers. Given its massive (78 percent) employment of coal for power generation in terms of capacity installed, it is of no surprise that more than a half of Indian CO2 emissions come from the power sector (Ringwald 2008). In this context, India is prospected to become to third largest emitter by 2013 (IEA 2008).

[2] Coal will keep on occupying centre-stage in the energy scenario. Indeed, despite the share of coal-based energy consumption is projected to decline from 85 percent in 2003-04 to 78 percent in 2031-32 (GoI, Government of India, Planning Commission 2006), in absolute terms it is envisaged to triplicate, passing from 67,388 MW to the level of 200,000 MW (in Meisen, Quéneudec 2006).

3 The wind energy path of India and China

In both countries wind power since the 1980s has progressively become one of the main alternative energy sources, not only thanks to a territorial context rich in wind resources[3] (the potential for the development of wind energy has been estimated at 45,000MW in India and 252 GW in China), but also and moreover for the progressive interest in the potential economic, environmental and health benefits associated with this renewable resource.

Despite the constant decline in the average cost of wind power generation in the last two decades, in the stage of its early development wind energy needed heavy government support in order to be able to compete in the market. The history of wind energy has been one of massive government intervention in any country approaching this technology. Compared to other energy sources, such as coal and gas, wind power generation was exposed to higher costs of production, mainly in terms of high initial investment levels, and to greater instability due to the intermittent nature of the generation of electricity. Financial intervention (mainly through public subsidies) has often not been sufficient to guarantee the expansion of the wind sector. In the case of China and India, a programmatic effort was required, aimed at rethinking and restructuring the whole energy sector. The latter was affected, in both countries, by structural and institutional weakness such as difficulties in storage, lack of competition, unreliable grid connections and low

[3]In India, ten states account for the majority of wind installations and provide around 98 per cent of the total wind capacity: Tamil Nadu makes up nearly 45 percent with 4,115.80 MW, followed by Maharashtra, Gujarat, Karnataka, Rajasthan, Madhya Pradesh, Andhra Pradesh, Kerala, Orissa, and West Bengal with 1,1 MW of wind capacity (CWET, Centre for Wind Technology, www.cwet.tn.nic.in).

In China the richest areas of wind resources are located mainly along the South-East coast and Inner Mongolia, Xinjiang, Gansu Province's Hexi Corridor and in some parts of North-East China, North-West China, Northern China and the Qinghai-Tibetan Plateau. Along the south-eastern coast wind complements the seasonal nature of hydropower resource; the wind resource is abundant in Spring, Autumn and Winter but poor in Summer, when the hydro resource is abundant and can provide a local power source which can help alleviate rail bottlenecks from transporting coal from the north. In the North, since most of the areas with abundant wind resources are far away from the power load centres, and the grid network is relatively weak, grid reinforcement is needed to support the development of large scale wind power.

capacity factor,[4] that resulted in incapacity and inefficacy in satisfying the local demand for energy.

Excluding hydro power, wind is the renewable source with the largest share in the total energy mix in both India and China. However, it accounts just for 5.5 percent of the total energy production, with an installed capacity of 7,092 MW in India (GoI, Government of India, Planning Commission 2008), and only 0.8 percent of the country's overall power generation capacity in China according to the data provided by China Electricity Council (Energy China Forum 2008).

Despite wind, and more generally renewable, energy is not expected to rebalance the energy mix dominated by coal in favour of green alternatives, the Indian and Chinese strategies in this sector offer a useful comparison on the way two developing countries have been emerging on the international market as leaders in promoting a new technology such as that of wind systems. Important differences however arise when we look at the institutional framework supporting respective policies. Besides a temporal gap between India and China in investing in wind technology (the latter has entered the market almost ten years later), the differences concern the way the two countries have responded to the twofold challenge of energy security and sustainable growth by giving specific incentives to wind energy.

3.1 ***India***

3.1.1 The evolution of wind policies

India is often pointed to as exemplary for its early and impressive performance in the wind energy sector and for its traditional commitment to use renewable power as an alternative to fossil fuels. This picture is supported by a specific institutional framework and by the presence of a number of important private domestic actors in the sector of renewable energies. India is the only country with a Ministry dedicated to renewable energies (the MNRE was upgraded to the rank of ministry in 1992 from the previous Department of Non-conventional Energy Sources, DNES, operating since 1982). It is also endowed with a specific government company, the Indian Renewable Energy Development Agency Limited (IREDA),

[4] The capacity factor is calculated as the ratio between the total energy the plant produces during a period of time and the energy the plant would have produced at full capacity. It generally varies between 20 and 40 percent. In India wind energy has an average capacity factor of 17 percent. It is common for renewable sources to entail a low capacity factor due to possible unavailability of the resource (wind farms, e.g., are highly intermittent, due to the natural variability of the wind).

which is responsible for promoting, developing and extending financial assistance for renewable energy and energy efficiency/conservation projects since 1987. Moreover, Suzlon Energy Ltd., one of the worldwide leading wind turbine manufacturers,[5] is a private Indian company.

This picture, however, needs to be zoomed in and reconsidered under an historical perspective in order to understand the high stakes and difficulties that the Indian power – and electricity – sectors still face and how these are supposed to affect the future performance of wind power. In particular, important questions concern the extent to which the process of liberalization of the energy sector and that of decentralization of institutional powers will be accomplished, and in what measure they will improve the financial performance and structural situation of the wind energy sector.

From the very beginning, the history of wind development in India is one of massive governmental intervention. The support to power generation from wind turbines dates back to the end of the Sixth Plan, in 1983-84, through the promotion of wind resource assessment activities, research and development support, and implementation of pilot projects, which were the first renewable energy-based projects to be tested in India.

It was clear that these projects needed special financial support in order to be on the market. Indeed, a series of factors such as high upfront capital costs (though lower operation and maintenance (O&M) costs), high credit risk, imperfect capital markets, and still existing subsidies for fossil-based fuels, made it difficult for renewable energy systems to gain ground over conventional energies. The central government responded with different undertakings, such as the creation of the Indian Renewable Energy Development Agency (IREDA), of the Power Finance Corporation and the Rural Electric Corporation, in order to provide availability of highly subsidized debt capitals. The IREDA, in particular, was set up in 1987 with the mandate to grant loans that general financial institutions would have never conceded, not only because of the high risk that projects themselves involved, but also due to the bad financial conditions of SEBs, which were meant to be the exclusive buyers of power from generating plants.

In the early 1990s the liberalisation process of the energy sector brought about important changes in the wind energy market. Wind power generation became the core area of intervention of the IREDA. The period between 1992 and 2003 was

[5] Suzlon Ltd is the fifth largest producer of wind turbines in the world by installed megawatts of capacity and is the leader in the Indian market with a share of 52 percent.

one of crucial reforms in the energy sector. The increase in the yearly number of new wind installations was somehow irregular during these years. Since 1992 two kinds of forces have been operating in the energy sector with the stated objective to boost competition and improve efficiency in energy distribution. One, that of liberalisation, has been pushing in the direction of vertically dismantling state monopolies and allow entrance to Independent Power Producers (IPPs);[6] the other force of deregulation has been thrusting in the direction of horizontally decentralising energy policies and implementation of reforms between the central government, the federal states and new independent regulatory bodies. These reforms were devised to attract foreign, and especially private, investments into a sector that was highly dominated by public utilities both at the central level – e.g. through the Power Finance Corporation Ltd. – and at the state level with SEBs, and that was systematically subjected to financial distresses.

At the beginning of the liberalisation process, wind energy was primarily supported by the central government through a set of fiscal concessions that targeted the generation of additional energy, such as accelerated depreciation (from 100 to 80 percent) on wind equipment during the first year of project installation, income tax holidays, customs and excise duty reliefs, and capital/interest subsidies (today of 10.25 percent) from the IREDA for grid-connected power generation. Moreover, in order to create a context favourable to investments, the federal government allowed domestic and foreign IPPs to enter the Indian market either as independent venture (allowing up to 100 percent foreign ownership on power plants) or through public-private partnerships (PPP). Indeed, between 1992 and 1998 wind energy has experienced important achievements in terms of installations, growing from 41 MW to 968 MW.

However, these incentives were mainly directed to upgrade power generation and fundamentally promoted a situation of "tax-credit seeking" for domestic project developers (Rajsekhar, Van Hulle et al. 1999). The effects of this perverse incentive emerged during the years 1998 to 2003, when a slow down of wind installations occurred due to a combination of reasons of policy nature, such as the lowering of tax benefits, and of more structural problems, such as the inadequate power evacuation facilities and the poor payment of some State Electricity Boards. Only those domestic companies endowed with large capitals were able to invest into wind power projects, notwithstanding their corporate activity. For instance, Suzlon, the leading wind company in India and one of the most successful in the global

[6] IPPs are defined as generating entities selling their power to a grid owned by a third-party (in Perkins 2005).

market, emerged from the diversification of a family-owned business from the textile to the wind sector,[7] in search for easy financing and tax sheltering.

After 2003, the rate of growth of wind installations has been persistently positive (see Figure 1). This can be attributed to important reforms that, started in 1998 with the Electricity Regulatory Commission (ERC) Act, aimed at restructuring the governance of the energy sector by deregulating certain powers from the central to the state level and by creating independent regulatory agencies. The idea was to reshape the relation between the central government and the federal states in two ways: the former would be responsible for setting general guidelines for energy policies through legislative actions and the latter would be charged with their implementation. For instance, the Indian National Action Plan on Climate Change prescribes that power utilities, starting in 2009, should buy 5 percent of their grid purchase from renewable energy and should increase this standard by one percent every year (renewable portfolio standard, RPO). On their part, states follow the guidelines and implement the rule autonomously; Tamil Nadu, for instance, has implemented 10 percent electricity purchase from renewable sources whereas Kerala 3 percent. Moreover, the central government would supplement states' incentive policies, by, for instance, providing grid-interactive wind power projects with a subsidy of Rs. 0.05 per unit (Kw/h) for ten years that would be sanctioned in addition to and independently from the tariff approved by the ERCs of various states (MNRE, 2008).

In this new governance framework, the 2003 Electricity Act prescribed to unbundle SEBs' assets into separate entities for generation, transmission, and distribution, with the intention of pursuing eventual privatisation. Hence, the establishment of independent regulatory agencies – such as state Electricity Regulatory Commissions (ERC) – and the empowerment of states had on the one side the purpose of increasing trust and creditworthiness of private (including foreign) actors investing in wind energy, and on the other it prompted states, competing with each other, to offer specific combinations of attractive conditions for investment.

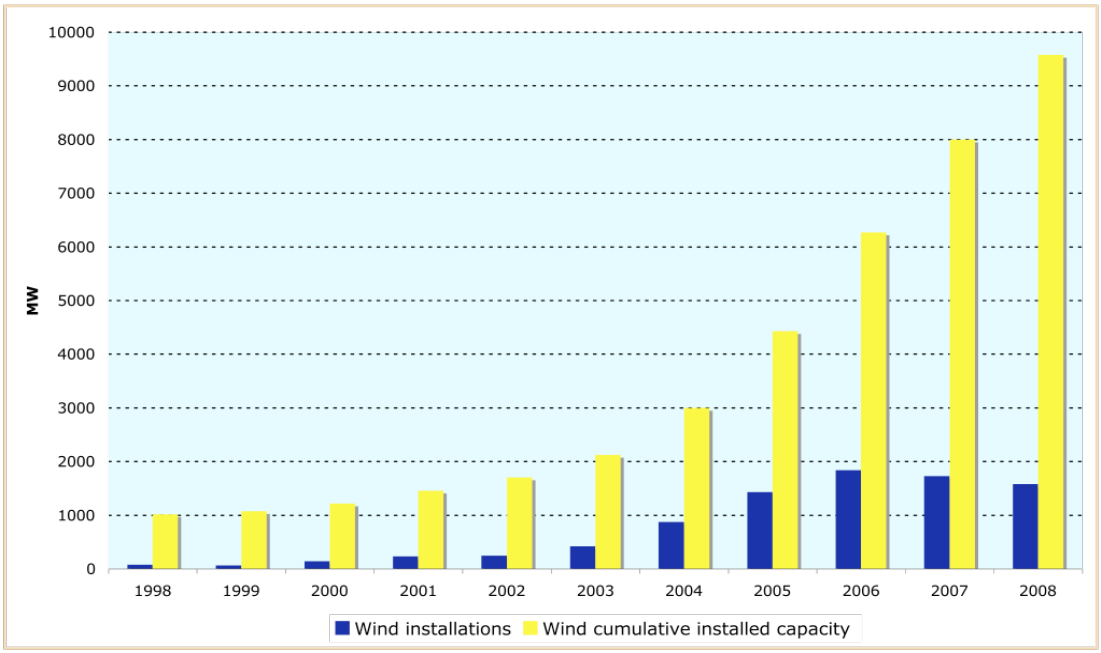
Indeed wind policies now differ from state to state, in terms of energy tariffs, power wheeling and banking facilities (today eight states – Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu – have declared buy-back tariffs); in terms of renewable portfolio standards, prescribing distribution licensees the obligation to purchase a minimum amount of

[7] Following the same logic, in the solar photovoltaic sector, Moser Baer – the world's second largest manufacturer of Optical Storage media – has recently decided to diversify in solar energy.

electricity from specific renewable sources; in terms of feed-in tariffs,[8] capital subsidies, sales tax concession benefits, electricity tax exemptions. Therefore, the 2003 Electricity Act had the merit on the one hand to accelerate the passage from an investment-based to a generation-based system of incentives through specific measures such as feed-in tariffs and the obligation for each state to set renewable portfolio standards, and on the other to promote competition among states that had been entrusted to set preferential tariffs for wind power procurement through independent regulatory bodies.

In 2007, however, the positive trend of wind installations began slowing down (see Figure 1).

Figure 1 Growth of wind installations in India



Source: Authors' elaboration upon the Earth Policy Institute (2008)'s data, and GWEC (2009)

[8] Feed-in tariffs consist in guaranteeing a fixed price for electricity produced from specific renewable sources through long-term contract for renewable power producers. It is strictly linked to the setting of Renewable Portfolio Obligations (RPO).

The number of new installations in 2007 accounted for 1,580 MW down from 1,730 MW in 2006. The country registered a growth rate of 27.6 percent, putting it far behind countries like the US (45 percent), Spain (30.2 percent) and its neighbour China (127.5 percent) (WWEA, World Wind Energy Association 2008). This downward trend was confirmed in 2008, when the rate of growth of wind installations in India did not even reach 20 percent, compared to the world average of 27 percent.

To explain this trend, two major considerations should be advanced. On the one hand, the specificity of the Indian market for wind energy has produced a context where the penetration of foreign investments is subordinated to the complementarity of local actors for partnerships (see section 3.1.2). On the other hand, the Indian market for wind energy is reaching maturity, as confirmed both by the decision of IREDA to raise interest rates to approach market levels and by the phasing out of capital subsidies for wind energy as planned at the end of the 10th Plan (2002-2007).

The Indian performance on wind energy in the last two decades is not an isolated case. According to the president of World Wind Energy Association, "20 of the top 40 markets have decreased the volume of additional capacity and only 18 countries have been able to increase their size".

3.1.2 The Indian market for wind energy: features and prospects

Despite the Indian trend in new wind installations is slowing down, wind energy remains the renewable source with the greatest potential (45,000 MW).[9] As for the 11th Five-Year Plan (2007-2012), its level is targeted to reach 10,500 MW by 2012, besides speculations that that level could be updated at 12,000 MW by 2010. To achieve this target, the Government of India has indicated an investment requirement of 15,530 million dollars (GoI, Government of India, Planning Commission 2008).

[9] This estimate is taken from the 11th Plan (2007-2012), but according to a recent declaration by the Minister for New and Renewable Energy Vilas Muttemwar, the potential could reach the level of 70,000 MW (http://www.indembassy.org.pe/news2009/features5feb2009.pdf)

However, the capacity to attract foreign direct investments is still modest,[10] despite the remarkable efforts by the government to improve the investment climate in the power sector since 1991. The reasons lie in a reinforcing interaction of specificities of the Indian wind sector and issues of institutional nature (on the latter point, see section 4.2.1).

The wind energy market in India is fundamentally domestic and private sector driven. Private investment constitutes a substantial 95.5 percent of the total capacity, while the rest is due to demonstration projects financed by the central government (Ghosh, Shukla et al. 2002). The fact that the majority of wind installations belongs to the private sector is peculiar of the wind energy market. In India, conventional energies installations, such as those of thermal, hydro and nuclear power, are predominantly public-owned, the state and central sectors maintaining a share of respectively 52.5 percent and 34 percent on the total installed capacity. In addition, there is another peculiarity that pertains to the way the Indian wind sector is structured with respect to the rest of the world. This is twofold. First, wind farm programmes did not originate from established power utilities or private companies specialising in the wind sector, but from domestic companies, often structured upon a family-business model, that decided to diversify their corporate activities (see above section 3.1.1) by becoming wind project developers.[11] But attracting tax sheltering seekers was only a side effect of a set of governmental incentives; the intention was to specifically support domestic dynamism in the wind energy sector through well-designed measures, for instance by lowering customs and excise duties on certain wind turbine components than on the whole machines, or by developing a national certification program for wind turbines (Lewis 2007).

Second, and this is very specific of India, project developers are most of the time also wind turbine manufacturers. Indeed, Suzlon Ltd has since 1995 entered technical-collaboration agreements and licensing agreements with foreign companies to acquire wind technology expertise and to develop integrated wind manufacturing capability.[12]

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[10] Despite low foreign investments, India ranked first last year in M&A (merger and acquisition) activity in the renewable space and particularly in wind energy (http://www.milbank.com/NR/rdonlyres/5761D7BB-A014-4B78-BB5B-A27580A59C48/0/US_EXIM_Speech_Feo.pdf).

[11] Moser Baer (see *supra* note 7) and Tata has followed this pattern with solar photovoltaic.

[12] For an extensive review on Suzlon' strategy, see Lewis (2007).

Hence, given this *connubium* between wind manufacturers and projects developers, not only foreign players, but also national ones can hardly enter the wind market as project-based investors (Hauber 2007). In this way, foreign investors can access the market only through partnerships with wind manufacturers, either in the form of joint ventures under licensed production (which concerns the majority of the cases) or by establishing Indian subsidiaries with a proper production license.

A further specificity of the Indian market for wind power generation is that wind projects are mostly developed for purposes of captive consumption, as insulation from costly and unreliable grid power (see later section 4.1.1). Returns on this strategy largely depend on the ability of IPPs to sell their power directly to distribution licensee and final consumers. Despite the 2003 Electricity Act envisages this possibility and eliminates restrictions for construction and operation of captive power plants, selling the power in excess from captive generation still requires ERC's approval.

3.2 China

3.2.1 Chinese wind policies

In the wind energy area, China has pursued a strategy of incremental steps, whose benefits and the limits have started materializing only recently.

The first step toward a policy for the development of grid-connected wind power began in the mid 1980s,[13] during the so called "initial demonstration period", when small wind farms were built by utilising grants from foreign donor countries and loans (Liu, Gan et al. 2002, Junfeng, Hu et al. 2007). In this phase that lasted till the mid 1990s, support from the government was mainly in terms of financial backing, such as investments in wind farm projects or in the development of wind turbines and in the establishment of a regulation about customs duty exemption for wind turbines.

However only in 1994, within the "Provisions for Grid-connected Windfarms Managment" promoted by the former Ministry of Electric Power (MOEP), the government tried to grant better guarantees for investors' security. The provisions mandated that the nearest grid operators facilitate interconnections of wind farms and established a purchase price for wind power, calculated as the sum of power

[13] The first wind farm was built in the Rongcheng County in the Shandong Province in 1986, using equipment imported from Denmark.

generation costs, loan payments and a reasonable profit. In addition, the Provisions set that any incremental cost of wind power over the average electricity price had to be shared across the whole grid.

In 2002, the Ministry of Finance and the State Duty Bureau implemented a new tax policy that reduced by half (to 8,5 percent) the Value Added Tax (VAT) for wind generation (NREL 2004).

Until 2002, the wind power industry developed slowly. Some authors consider that the concomitant reform of the electricity supply system toward a competitive market has partially contributed to explain the slowness of wind power development (Andrews Speed 2004).

The real scaling up of domestic wind production started in 2003 with a series of government-run wind concessions, where both the investors and developers were selected through a bidding process carried out by the National Development and Reform Commission (NDRC), with the aims of expanding the rate of development of wind power capacity at the lowest cost while improving the manufacturing capacity of domestically made parts and maintaining control over development decisions.

The program clearly stated that wind power does not participate in the power market competition; with this kind of approach the government avoided to face the current situation in which wind cannot compete with traditional fossil-fueled units, and preferred to deal with the high price of wind indirectly, starting with making the wind market more competitive, through a bid-mechanism that initially awarded who offered the lowest price.

From 2003 to 2006,[14] the Chinese government conducted four rounds of 25 years-wind concession tendering, with the approbation of eleven project with an installed capacity of 2.45 GW. At present all the projects are under construction and are expected to be fully completed by 2009.

[14] During that period the rules governing the concession have changed in several respects. For example in 2003 it was established that in a public tendering the winning bidder is one that offered the lowest price. Through some intermediate rearrangement of criteria between 2005 and 2006, in 2007 the winning criterion was set as the bid closest to the average bidding price, excluding the highest and the lowest bids. At this point, the provincial grid company must sign a power purchase agreement with the winner and purchase all the electricity generated by the project. Until 2005, the share of the difference between the wind power and that of conventional energy was transferred across the provincial grid, but since 2005 it was moved to the national grid. In 2006, an additional charge was added to the selling price of electricity for all the consumers.

Projects of less than 50 MW should instead be approved by provincial governments,[15] whereas their prices are checked and approved by the NDRC. Some of the projects under 50 MW go through the concession process but are not included in the rounds of national concession tendering.

With the Renewable Energy Law (REL) of 2005, the wind industry hoped to receive a fixed feed-in tariff, that in their view would have supported a more stable growth (Williams, Kahrl 2008). Such hopes did not materialise – the government maintained the competitive tender system, with other complementary measures such as a pricing policy, the obligation on grid companies to purchase renewable electricity, and cost distribution.

Again in 2005, the NDRC released the "Notice on Wind Power Generation Facility Construction and Management Requirements", provided a growth platform for domestic players by mandating the use of at least 70 percent components sourced from the domestic market in wind power projects[16] and establishing that no import tax exemption on imported turbines and only half the normal VAT rate has to be paid on domestic turbines, with the aim of giving sufficient opportunities for further growth of the domestic turbine market and lowering costs thanks to the increased domestic competition.

In 2008, the newly-established National Energy Bureau established wind energy as a priority for diversifying China's energy mix away from coal, and pursued this objective by implementing the 10 GW-Size Wind Base Program (Wind Base). The bureau selected six locations for Wind Base projects; Xinjiang, Inner Mongolia, Gansu, Hebei and Jiangsu, aiming at installing of 10 GW or more of new wind generating capacity by 2020 on each of these Wind Base sites (GWEC, Global Wind Energy Council 2009).

In April 2008, the Chinese Ministry of Finance issued a new regulation on tax refunds for importing large wind turbines (2.5 MW and above) and key components. In this new regulation, the tax revenue for the key components and raw materials for large turbines (2.5 MW and above) will be used for technology innovation and capacity building. The tax rebate is not returned directly to the company, but to the state, which will establish special programs to channel the money back into the wind industry.

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[15] The only exception is the Guangdong province, which makes its own decisions on prices for wind power.

[16] In the initial rounds of the concession, industry, project developers had to prove that more than 50 percent of the turbine was made in China.

In 2008 for the first time the government began to give subsidies to renewable energy manufacturers and created a link between a stimulus policy and a testing and certification system. According to the regulation of the Ministry of Finance for all the domestic brands (with over 51 percent Chinese investment) the first 50 wind turbines over 1 MW have to be rewarded with RMB 600/kW (60 Euro) from the government. The rule specifies that the wind turbines must be tested and certified by China General Certification (CGC), and must have entered the market, been put into operation and connected to the grid. The regulation further requires that the rewarded turbines must use domestic manufactured components and share the awards proportionate with component manufacturers.

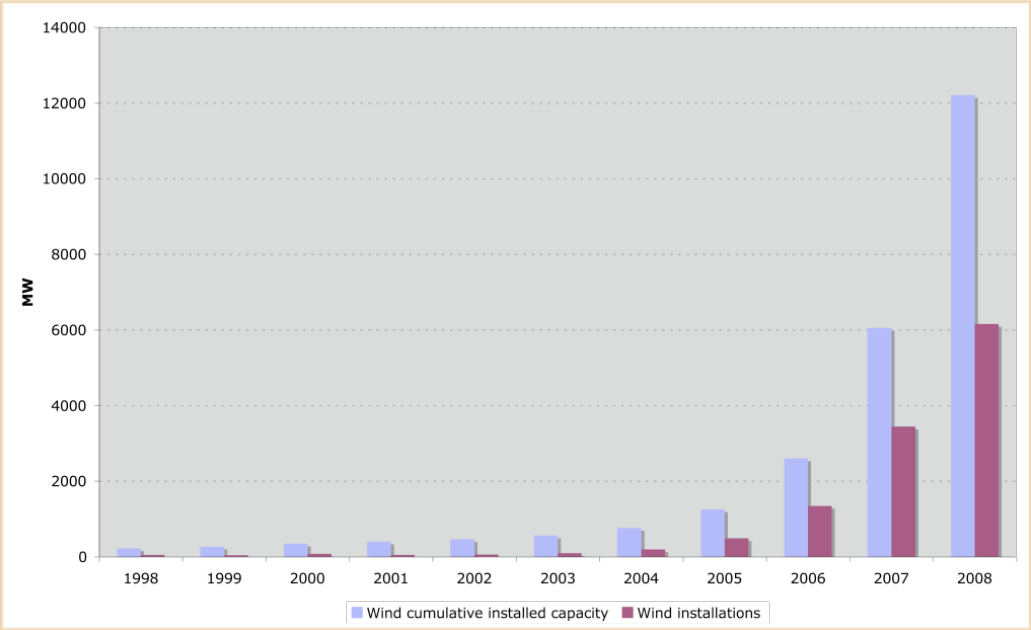
3.2.2 The Chinese boom of wind power sector

The government's legislative developments for wind power energy production (installations) and the wind power generation equipment (turbines) are the main factors that have boosted the development of the wind power generation market in China.

From 0,6 GW in 2003 wind power capacity installation scaled up to more than 12 GW in 2008, reaching well in advance the established goal for installed wind capacity in 2010 (5 GW) (Martinot, Junfeng 2007). Only in 2008, it almost doubled its installed capacity by adding about 6.3 GW, with a 91 percent increase over the 2007 market.

Due to the boom in the wind capacity, instead of the previous (2004) target of 20 GW in 2020, China aims now at achieving by 2010 a target of 20 GW. The NDRC has been discussing the possibility of raising the goal for accumulated wind energy in 2020 from 30 GW to 100 GW.

Figure 2 Growth of wind installations in China



Source: Authors' elaboration upon the Earth Policy Institute (2008)'s data, and GWEC (2009)

By the end of 2007, a total of 158 wind power plants were built in 21 provinces. Inner Mongolia features the largest wind power generation capacity among the autonomous regions and provinces of China, followed by Jilin, Liaoning, Hebei and Heilongjiang. These five provinces account for 60 percent of China's total wind power generation capacity, indicating that the development of China's wind power resources has been concentrating in the three northern regions (Chunchun 2008).

The competitive tender system for wind power generation projects has played a major role in China's introduction and promotion of wind energy power generation. However, no foreign or private companies won concession projects and all winning firms are state owned enterprises (SOEs). They mainly belong to large local energy groups in the coal fire or hydropower sector.

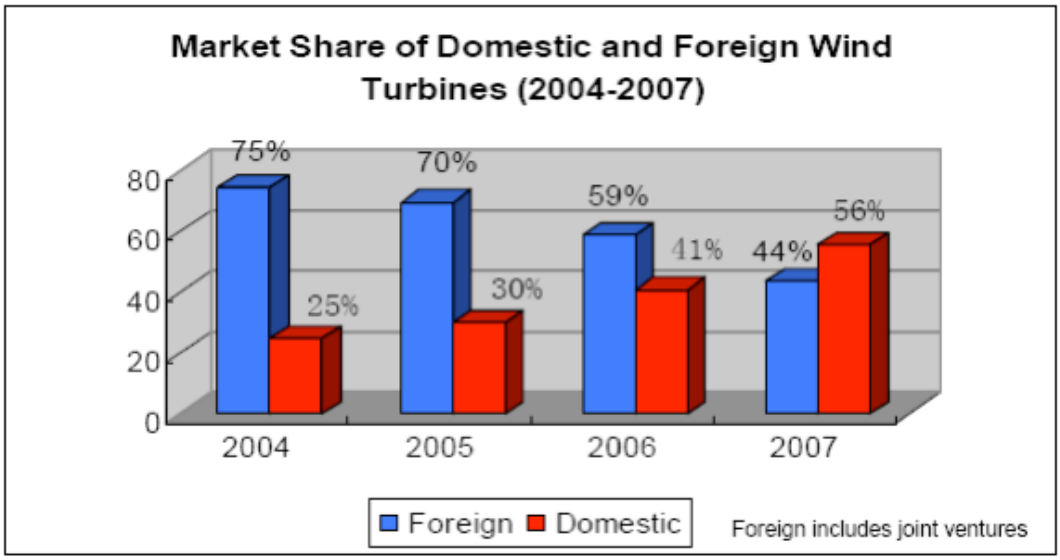
The competitive bidding has not been the only flywheel for wind projects; for instance for wind power project below 50 MW particularly well suited for inland

areas, provincial government agencies have been also important actors in the wind industry.

There is a considerable difference between competitive and provincially fixed wind tariffs, ranging from 0.41 yuan kWh^{-1} for projects won through the competitive tendering process to 0.80 yuan kWh^{-1} in projects approved by local governments. This variation has created tensions between provincial and central government agencies over the question of who pays the premium for wind and how much that premium should be.

In this very short patch, the Chinese manufacturing industry is becoming more mature, aiming at expanding to fill the turbine shortage; in 2007, for the first time the domestic wind turbines manufactures have supplied more than the half (56 percent) of the country's requirement.

Figure 3 Market share of domestic and foreign wind turbines (2004-2007)



Source: "2007 China Wind Power Report," China Environmental Science Press

In 2008 more than 20 new turbine manufacturers entered the Chinese market, bringing the total number of manufacturers in China to 70 (GWEC, Global Wind Energy Council 2009). The strategy followed by Chinese machine builders for entering or gaining ground in the market in general is to join global players such as Vestas (Denmark), Suzlon (India) and local leaders such as Goldwind or to acquire smaller foreign companies experienced in the field. Actually the three main

manufacturers in China, Goldwind, Sinovel and DEC (Dongfeng Electric), own an annual manufacturing capacity comparable to the international brands manufacturing in China (Vestas, Suzlon, GE, Gamesa, Nordex and Repower) and are increasingly interested in foreign markets. While in fact most of turbines are still for the domestic market, some manufacturers have begun also exports for components. For example Guangdong Mingyang Wind Power Technology started shipping turbines to GreenHunter Energy Inc in the United States (Energy China Forum 2008). Probably once exports begin on a large scale, their additional supply will put pressure on wind turbine prices in Europe and the US, deepening the comparative economic advantages of wind energy (GWEC, Global Wind Energy Council 2009).

If on the one hand the adoption of a measure that mandates the use of at least 70 percent components sourced from the domestic market in wind power projects have supported national production, on the other hand, the adoption with the bidding system with a lower than reasonable grid tariff for wind power risks to shift the pressure on costs to the wind turbine manufacturers, strangling an industry that is still in its early stage of development.

A sector where China shows a significant dynamism is small wind systems, with 30 manufacturers selling models with a capacity range from 100 W to 20 kW. By the end of 2006, the cumulated output of these turbines was estimated to have reached 51 MW in China. Turbines are used mainly where making grid extensions is uneconomical for areas without road access and a low electricity demand (GWEC, Global Wind Energy Council 2009).

4 Sustaining the wind path: a comparative analysis of India and China's challenges

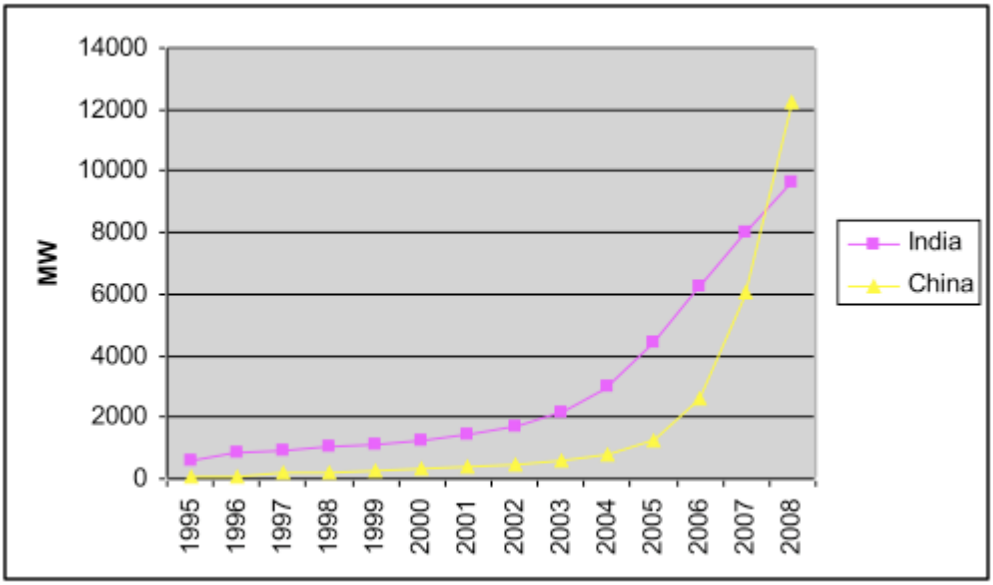
The preceding sections have highlighted similarities and differences between India's and China's approaches to promoting wind energy.

First of all, wind energy started to be supported and developed much earlier in India than in China. While India has been promoting wind technology since the early 1980s and has long established itself as one of the major actors in the international wind market, China has undergone a massive programme of expansion of the wind energy sector quite recently and in concurrence with the boom of wind energy in the international market. Moreover, the strategies of the

two countries have been diverging in terms of public/private participation, while a rather similar role has been played by domestic wind manufacturers. While China has favoured a continuation of the "traditional" state-centred strategies that had been adopted for conventional sources of energy, India has instead devised a strategy, in the case of wind energy, very much at variance with the policies adopted towards the other energy sources. Despite in both countries government intervention has been massive at the beginning of the process, in India the private and domestic sectors have been playing a dominant role in perpetrating wind-based projects. In China, on the contrary, the majority of wind installations are public as a consequence of strict limits that have been imposed on private participation.

The divergence of their strategies coupled with a different degree of maturity for the wind market has produced two dissimilar growth paths. As we can see from Figure 4, the Indian path has been more gradual and has reached now a certain degree of maturity as interest rates on wind energy loans are approaching market levels. In China, instead, wind energy has been quite insignificant until 2003 in terms of financial assistance and number of installations, and has then become one of the sectors absorbing the highest governmental support.

Figure 4 Time series of the cumulative installed capacity of wind energy of India and China



Source: Authors' elaboration upon the Earth Policy Institute (2008)'s data and GWEC (2009)

In 2004, the rate of growth of Chinese wind installations doubled with respect to the previous year. Since then, wind installations kept growing at impressive rates, with a maximum of 127 percent between 2007 and 2008 (WWEA, World Wind Energy Association 2008). In India, the rate of growth of wind installations has never reached such levels and already in 2005 it had diminished from about 47 percent to 41 percent. In the period 2007-2008, it was around 20 percent. The year 2008 represented a divide, with China overtaking India in terms of total wind capacity installed.

A comparative analysis of India and China reveals, however, also important similarities. In both contexts the diffusion of wind energy is crucially affected by the functioning of the whole energy system and the prevailing institutional framework. In both countries, competition among power producers was practically banned and public companies dominated the power supply chain. This has resulted in severe power shortages and disorder in electricity generation (see section 4.1), but most of all it has precluded financial investments in the power sector (see section 4.2).

4.1 Unreliable grid

In both countries the condition of power grids risk to severely compromise the rapid development of wind farms. Indeed, the grid capacity is not big enough to transmit all electricity generated from wind. One common problem is the lack of competition in the system, which is still highly monopolistic. Despite different attempts to dismantle this system by unbundling generation, transmission, and distribution of electricity (in India the process is certainly more advanced than in China), the three segments of the supply chain are fundamentally controlled by public utilities.

4.1.1 India: inadequate tariffs and financial distress

Despite in India wind farms have undergone an intensive development since the early 1990s, the electricity boards have not been able to follow up with the required grid reinforcements. Generally speaking, grid supply is frequently unreliable and of poor quality throughout the country. Power shortages reach average levels of 12

percent with respect to peak demand,[17] and technical and commercial (T&C) losses are estimated to be in the range of 35–45 percent due to frequent theft of power and poor transmission (11th Plan). Specifically for wind energy, the major weaknesses are the evacuation capacity on the one side, which has recurrently created a problem of disconnection between the wind farms and the grid during the high wind seasons, and the low transformer capacity of substations that has further diminished grid availability in the wind farms (Sørensen, Madsen et al. 2000). To explain it better, induction generators are those making wind turbines convert mechanical power into electricity, but to function they need reactive power from the grid. Since in India the demand for reactive power for other purposes, such as agricultural pumps, is very high, the load on the grid is too large (the load factor is estimated at 76.0 percent, CEA 2008), which causes losses in the transmission capacity.

Investments for improving the quality and supply of power through the grid have been long retarded due to the chronic financial distress of the State Electricity Boards (SEBs). Until early 1990s and before liberalisation in the power sector, SEBs were entrusted to distribute power throughout the territory according to a single-buyer model prescribing for generators (IPPs and public utilities) to sell the whole amount of energy to SEBs. Payments were more than once not met by the Boards and this caused many projects to be abandoned by their private sponsors.[18] Recurrent deficits are due to a particular system of cross-subsidisation of power tariffs among different categories of consumers that makes the average cost of electricity supply higher than average tariffs. In this way, SEBs have regularly incurred in negative rates of return on capital investments. As for the system of cross-subsidisation, tariffs for the agricultural and domestic sectors are indirectly subsidized by the industry and commerce that pay up to ten times more for electricity. To understand the proportion of this phenomenon, the average tariff that industries paid for electricity in India in 2002 was 47 US cents per KW per unit

[17] As stated in the 11th Plan, 12 percent is clearly an underestimation of power. Other estimates indicate a level of 13.5 percent (REC, Rural Electrification Corporation Limited 2007) and a level of 18.1 percent as average among the five regions, which the Indian power grid is divided into (CEA 2008).

[18] A notable example is the Enron's Dabhol Power Corporation, that served notice of breach of contract to the Maharashtra State Electricity Board in 2001 after repeated defaults on bills for electricity supplied by the company.

Instead, in case the generation company is public, then a back-up system works for the SEBs, either at the state or the central level, with respective governments committed to secure SEBs dues (e.g., since 2001 a system of tax-free bonds has been devised for guaranteeing payments to the central public utilities).

(in terms of PPP), as opposed to 20 cents in China, 17 cents in Brazil, 12 cents in Japan, 5.5 cents in US and 5 cents in Germany (GoI, Government of India, Planning Commission 2006).[19] Despite the huge costs paid by industries, the rates of subsidies to the agricultural and domestic sectors are so high that the final average revenue for SEBs from electricity tariffs is always lower than the cost of supply.[20]

Independent regulatory commissions (ERC) have been established since 1998 both at the state and federal level to reduce political interference into the process of tariff setting that had disproportionately favoured the agricultural sector. In this sense, it is upon the ERC to determine the price of electricity between the SEB and the generator according to both central policy guidelines and considerations specific to the state, such as for instance the geographical location of the power resource and its availability.[21] In addition, in order to better preserve SEBs' creditworthiness and attract private investments for grid-connected projects, the contract between the SEB and the generator is made in the form of a long-term power purchase agreement (PPA) through multi-year tariffs.

Despite these improvements, for long time high power tariffs and unreliable grid supply have forced industrial and commercial establishments to seek captive and standby generation, thus causing even more harm to the current system: around 80 percent of the electricity generated from wind installations is for captive consumption, while the rest is sold to the grid (Ghosh, Shukla et al. 2002).[22] Given the grid instability and the huge costs of extending it to remote areas, the

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[19] The rate of subsidy for electricity tariffs to the agricultural and domestic sectors are respectively 59 and 93 percent (Karki, Mann et al. 2005).

[20] The average cost of supply/kWh in 2005 was 5.6 cents, while the average revenue/kWh was only 4.62 cents or about 82.5 percent of the cost of supply (Annual Report of the Central Electricity Authority of India for FY 2005-2006, www.cea.nic.in).

[21] The Central Electricity Regulatory Commission (CERC) regulates tariffs of generating companies owned or controlled by the Central Government or those serving more than one State; for transmission tariffs, it discharges its function only for inter-states transmission. On the other side, at the state level Electricity Regulatory Commissions (SERCs) regulate tariffs of intra-states transmission.

To date, eight SERCs have already issued their wind tariffs over different periods.

[22] True, the tendency to produce energy through on-site systems is extended to other sources of power, as insulation from costly and unreliable grid power. As estimated by Expert Committee of Integrated Energy Policy (GoI, Government of India, Planning Commission 2006), there is good reason to believe that the official estimation of 19,000 MW of such captive and standby capacity in India be actually replaced by real 50,000 MW, accounting for more than 61percent of the firms.

Government of India is all but hampering this tendency, especially for renewable energy sources that are more suitable for exploitation within a decentralized, off-grid system of power supply. For this purpose, the Electricity Act of 2003 has opened the access for IPPs to directly sell the electricity in excess to end consumers, and has eliminated restrictions for construction and operation of captive power. However, returns on this strategy largely depend on the ability of IPPs to sell their power directly to distribution licensees and end consumers.[23] Indeed, captive power generation projects still require ERC's approval and the sale of electricity from these installations depends upon whether state ERCs have implemented full retail distribution.

4.1.2 China: the institutional weakness of the grid system

The ability of China's grid system to incorporate wind-generated electricity is one of the main problems faced by the industry. Actually in China, the developers of wind farms are not well connected to the national grid operator responsible for moving wind-power to end users. As a matter of fact, through Chinese law, with the REL, requires the two state-owned power grid operators (State Grid Corporation of China and China Southern Power Grid Corporation) to provide connections and buy up all renewable energy, they have been slow, especially in the case of wind farms, due to the physical constraints of grid capacity.

Most of the new wind farms built during the boom in wind development are concentrated in north-west China, where the existing grid structure is weak.

So far the slowness in providing grid connections has been partially justified by the lack of spatial correspondence between wind supply and electricity demand. The consumption of electricity coming from wind does not occur locally. Chinese wind resources are rich in the North West, where the population is sparse and the electricity demand is low, while in the east of the country, poor of wind resources, the electricity demand is high.

The Wind Base projects of 2008 are posing huge challenges for transmission and grid construction with the aim of filling this gap by building large scale, centralized projects, with high voltage and long distance transmission.

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[23] On the way to institute a system of trade in power, the 2003 Electricity Act has introduced a multi-buyer scheme for which generators are allowed to directly sell electricity to any distribution licensee or end consumer, hence to bypass State or Central ERCs by not selling the power directly to SEBs.

The variability of wind, related to the power generation instability depending on the weather, also poses challenges to grid operation, and China needs to solve the associated technical issues, such as grid dispatching.

To ensure a stable functioning of the grid, there is a need to improve the quality of electricity generated by wind, especially for large-scale wind farms. Grid connection for wind energy requires additional services and therefore increases the operational cost and risks for grid companies, which in China are state-owned monopolies.

Without market competition and proper incentives, the two grid operators, with basically an oligopolistic position in their region, have little motivation to expand the service to match the rapid development of wind energy. Besides, since in China, local utilities usually perform the functions of power production, power distribution and grid management simultaneously in the market,[24] practically wind energy producers are hostages to their distributors, because they have to depend on grid connections to supply as well as to intake power. The reasons behind Chinese grid's structural weaknesses are clearly traceable in its institutional framework.

4.2 The need of foreign investments

In both countries the required investments are too large to be met by public finances alone. Hence, the need of foreign investments is all the more crucial to sustain the process of wind energy development. However, both China and India are endowed with peculiar market and institutional structures that have long hampered the attraction of foreign capitals. The dominance of domestic participation in the wind market is common for China and India. However, the composition of investments is highly skewed in favour of private participation in the latter and public participation in the former. These structures have produced the same effect but upon different logic: whereas in India foreign capitals have stayed down because of the special venture between wind turbine manufacturers and projects developers, the high credit risk and the little privatisation in the energy supply chain, in China the problem lies upon the unsustainable competition that private investors must face against the public sector, which is able to guarantee lower tariffs, hence to be awarded wind project upon competitive bidding.

[24] With the electricity reform started in the 1980s, within the process of reforming the State Owned Enterprises System (SOEs) China has maintained public ownership of the power industry, whereas most countries, both developed and developing, have privatized their power industry. Nonetheless, the reform project that was meant to break monopolies and foster competition has resulted in the creation of an oligopoly.

4.2.1 India: structural and institutional barriers to foreign private investments

The inadequacy of foreign direct investments into the Indian power sector has already been ascribed, in the section above, to a high credit risk related to SEBs' recurrent deficit. Specifically, aggregate technical and commercial (AT&C) losses of state power utilities has long precluded inflows of foreign capital to Indian power utilities both for reasons of unsecured payment and internationally non-competitive tariffs.

Today, SEBs remain the dominant units in the electricity market. Improvements in the direction of securing payments have been already made by establishing independent regulatory agencies entrusted with the task to set tariffs – possibly multi-year tariffs established under a PPA – and to specify a minimum amount of electricity to be purchased from renewable sources. These reforms ought to reduce uncertainty for IPPs. Reforms are under way also in the direction of instituting a system of trade in power. The 2003 Electricity Act introduced a multi-buyer scheme for which generators are allowed to directly sell electricity to any distribution licensee or end consumer. This should provide better creditworthiness compared to the single-buyer SEB model. However, those IPPs who want to bypass State or Central ERC's tariffs by not selling the power directly to SEBs must sustain a surcharge as a form of compensation for the forgone cross-subsidy effect.

Institutional design is not the only reason for which foreign investments are late to come. As already specified in section 3.1.2, the unique market structure of wind energy, characterised by the overlapping between wind manufacturers and project developers, has created an important barrier to entrance to all those investment capitals that would have been directed to develop wind projects.

The peculiarity of the Indian wind market is further reflected in another vehicle for foreign investments. Under the Kyoto Protocol, industrialised countries are allowed to gain emission credits (the so called Certified Emission Reductions, CERs) by abating corresponding carbon equivalent emissions in developing countries, where the abatement cost is generally lower. This system, called Clean Development Mechanism (CDM), has attracted the international attention toward growing economies such as India and China. In India, over 23 percent of the totality of CDM projects are destined to the wind sector: over a total number of 1254, 286 CDM projects target wind installations and 69 of these are already registered. In terms of new installed wind capacity, this accounts for a total of 5273.1 MW up to

2020, and 1726.2 MW have been already established under the CDM (UNEP Risoe 2009). Now, despite the importance of these numbers, developed countries invest in different ways under the CDM: through equity investment (i.e., via joint venture, wholly owned subsidiaries); through purchase of CERs; and through CER trade in secondary markets. The majority of the Indian CDM projects for wind energy fall into the second category. This means that the penetration of foreign equity investments is still very low, whereas the specific structure of the Indian wind market, coupled with large availability of domestic equipment, makes foreign investors prefer to purchase CERs. These CERs are issued from local projects that are 100 percent Indian. The rest of the wind projects that are in the form of equity investment are most of the time multilateral investments through funds,[25] rather than bilateral. Again, this data confirms that foreign countries are reticent to investing into the Indian market, where credit and project risks are still perceived as high.

This being said, the government has not been able to exploit the system of CDM as a viable channel for attracting foreign investments.

4.2.2 China: difficulties in attracting foreign investment while at same time strengthening the domestic industry

The choice of the Chinese government of not developing a fixed feed-in tariff at the national level for wind power, preferring instead to maintain it out of the market by offering a fixed price and a long term contract on a project specific basis, has achieved a rapid diffusion of wind technology. The consequent distortions and weaknesses are however becoming apparent.

The formation of prices through competitive tenders has prevented both private sector and foreign companies from participating in the wind power generation.

If theoretically the aim of the concession scheme has been to encourage a reduction in the price of wind power in China, practically, as a result, a number of wind projects are not currently economically viable; the pricing of wind projects winning the bids, that won the bid, despite the innumerable rearrangements[26], has been too

[25] Many funds have been established under the World Bank's control.

[26] During the fifth national concession round, in order to remedy this situation the rules for evaluating bids were modified to discourage unreasonably low bids. The weight of the price in the overall evaluation of the bid has been reduced to 25 percent, which means that pricing is no longer the foremost criteria to win a bid.

low for a private developer to cover their costs and make a reasonable profit (Junfeng, Hu et al. 2007) and only large state run companies have been able to shoulder a small profit or even a loss, in the attempt of securing resources and markets for the longer term.

At present, in both national wind concession projects and projects initiated by local government, the developers are all state-owned companies.

This mechanism, probably due to the uncertain status of property rights in the country and unfamiliarity with market competition, has thus created a market dominated by the government, with too high investment barriers for private and foreign companies and no diversification among wind power developers (Chunchun 2008).

Also the Clean Development Mechanism projects under the Kyoto Protocol come up again the distortions created by the government intervention. According to the database at the UNDP Risoe Center, a total of 1696 Chinese project were registered with the CDM Executive Board as of March, 31st (2009) including 319 wind power generation project, which account for 19 percent of total CDM projects. However, most of these projects are conducted by Chinese companies and foreign companies enter as mere buyers of CERs generated by the domestic ones (Schroeder 2009). The main reason is related to the Chinese CDM rules that require that each CDM project be 51 percent owned by a Chinese company, restricting foreign ownership to 49 percent. This rule ensures that Chinese firms keep controlling market, but it limits risk management possibilities and repatriation of profits for foreign partners. Another policy measure that hampers the full potential of CDM for technology transfer in China is the already cited local content requirement of 70 percent for wind equipment within a poor intellectual property rights framework.

5 Conclusions and future perspectives

The path for wind energy in China and India has attracted utmost attention in the literature for the rates of growth it has experienced in these countries. Despite the priority to keep boosting economic growth at the lowest cost – namely through the exploitation of coal sources – China and India have undertaken the challenge of renewable energy through the development of wind technology. True, this is not expected to revolutionise their energy patterns, nevertheless it is an important index of their intention to both sustain their growth by securing energy needs and promoting a development path that could be environmentally sustainable.

China and India has responded to this twofold challenge by undertaking different strategies to develop wind energy. Despite their similarity as for the initial massive public support, China has kept on relying on the same scheme, while India has embarked on a divergent trajectory. In the former, the wind energy sector is almost completely dominated by public utilities; while in the latter private domestic companies cover the majority of wind-related projects.

On the way to prepare the wind sector to compete first with other domestic conventional energies and later on the international market, the outcome for both countries has finally not matched initial purposes. India has somehow followed a standardised approach of supporting a non-competitive energy through public subsidies and fiscal incentives, but that finally went in favour of private domestic business and kept away foreign investors; China, on the other way, has enacted commercial norms such as competitive bidding, but has finally created a situation where it became impossible for private actors (both domestic and foreign) to compete with public suppliers.

One probable explanation for these different wind strategies is to be found in the temporal lag that has separated the inception of the development of wind energy in India and China. While in the former the attention to wind technology dates back to the early 80s, the latter has somehow fiercely entered the international market only recently, when the global competition on wind energy was stronger than twenty years before and that has required China to recover its technological gap through heavily and direct public support. Keeping the focus on the international scenario, the Clean Development Mechanism (CDM) under the Kyoto Protocol reflects the different structure of the wind energy market in China and India. If we consider the projects developed under the CDM as a proxy for the penetration of foreign investments into these two countries, then it can be concluded that this penetration has stayed marginal, since in both cases foreign actors have mainly participated as credit buyers rather than project developers.

The low penetration of foreign capitals is to be kept as a major concern for future development of wind capacity in both countries. In India the marginal trend of new wind installations has already started to decrease. It is not excludable that China will soon face a similar trend once the propulsive boost led by the public-driven bidding scheme will be exhausted.

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