

Beijing's windy bet

After spurning wind power, China has swung around and embraced this clean energy. But the nation's love affair with wind may be spinning out of control, finds **David Cyranoski**.

As he drives along a two-lane highway skirting the Gobi Desert, Hubert Beaumont sees nothing but wind. The road in this part of China's Gansu province runs completely flat — a monotonous route past grey rocks, a few shrubs and some 100 sleek turbines towering over the empty terrain. "I can't think of anything else you'd want to do here except wind energy," says Beaumont, a Beijing-based wind specialist at Ecofys, a green-energy consulting firm.

Indeed, the region is pegged to become the core of a 'mega wind-power base', a massive collection of wind farms with 5 gigawatts of capacity by 2010. Even considering that wind turbines generally produce only about a quarter of their advertised capacity, these would still generate enough juice to satisfy about a million energy-guzzling US homes. It will be the biggest wind-power development in the world.

For a country with such a bad environmental reputation, China is fast amassing green credentials in wind. Wind-energy generation capacity has nearly doubled in each of the past three years, and in 2007 the country surpassed its goal to achieve 5 gigawatts by 2010 (see graph). With plans to build four more mega-bases like the Gansu project, China is poised within the next decade to blow past four other nations, including Germany and the United States, the current number one and two in wind-energy capacity.

China is also manufacturing and, increasingly, designing turbines. Domestic turbine manufacturers numbered just four in 2004. Now there are some 70. Within three years, says Haiyan Qin, secretary-general of the Chinese Wind Energy Association in Beijing, China will manufacture more turbines than other country.

But experts wonder whether the superlatives applied to Chinese wind farms will also include 'least reliable' and 'most inefficient'.

Wind-turbine manufacturers and wind-farm developers everywhere have faced teething problems, but China has perhaps faced more difficulties than most. Its wind farms are

much less efficient than those in other leading countries, manufacturing defects have plagued Chinese equipment and the nation's electrical grid cannot carry all the wind power the country is generating today, let alone the huge amounts planned for the next few years. Some critics, including several from international turbine companies, blame a lack of planning and poor Chinese manufacturing.

Chinese engineers, entrepreneurs and government officials are working to improve



the situation but they have a long way to go. As Beaumont passes the Gansu farm, he sees both the promise and the perils of China's surge in wind power. A strong breeze blows across the desert but half of the turbines are standing still.

Storm chasers

Although China is currently chasing wind power, its leaders had little affection for it just a few years ago. Over the 1980s and 1990s, efforts by the World Bank, the Asian Development Bank and others to get energy from wind in China fizzled out. A goal to have 1 gigawatt of capacity by 2000 passed without notice, or achievement.

"Before 2004, leaders thought wind was too small. They didn't think it was real energy," says



Qin. But the sizzling economy boosted demand, energy prices soared and, in 2004, 24 of China's 27 provinces were hit by blackouts. At around the same time, environmental pressures set in ahead of the 2008 Olympics. The government responded in February 2005 with a Renewable Energy Law and subsequent guidelines that called for all major power companies to create

a percentage of their energy from renewable sources other than hydropower: 3% by 2010 and 8% by 2020. With biomass resources too sparse and photovoltaics too expensive (although China is the biggest producer in the world), most of that renewable energy will be achieved through wind.

Beginning in 2004, farms started to open up in the windy northern and eastern perimeter of the country (see map). Total installed capacity climbed steeply: 1.3 gigawatts in 2005, 2.6 gigawatts in 2006, 5.9 gigawatts in 2007 and, according to early estimates, 10.6 gigawatts in 2008.

But there is a hitch — China's wind farms are underperforming. All power installations have a 'capacity factor', which is calculated by dividing the energy actually produced by what the installations could maximally generate. According to data from the Beijing branch of



enterprises. "The Chinese government cannot be taken as a model of transparency," says Paulo Fernando Soares, chief executive of Suzlon Energy in Beijing, a subsidiary of a major turbine manufacturer in India.

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Spin tactics

Turbine quality is one problem; finding the best turbine for the available wind is another. Every turbine has a 'load envelope' that defines roughly what wind speed, turbulence, wind shear and other conditions it will function best in. Some turbines work better for wind that comes in short bursts whereas others work better with long consistent spells of low wind. Poorly chosen turbines will be more likely to break down. A turbine with a wide blade can catch low winds but could be destroyed by typhoons. If turbines are poorly chosen for a site, their efficiency will plummet. "Decisions made in the first year will affect the 20-year life of the turbine," says Sebastian Meyer, who researches wind-energy resources in China for Ecofys. "Serious companies won't put turbines in sites for which they are not suitable," says Soares. But until now, he says, Chinese developers have too often relied on inadequate wind data.

China is now trying to address this problem. By June, it will finish installing 400 masts to measure wind-energy resources in various regions throughout China. The masts will stand 70 metres, 100 metres or 120 metres tall, to match the height of the turbines. China plans to spend more than 200 million renminbi (US\$30 million) on the four-year project, which started in 2007. "This project is the key to make the national plan of wind-power development work," says Zhenbin Yang, deputy director of the wind-resource laboratory at the Chinese Academy of

Meteorological Sciences in Beijing. Yang will analyse the data provided by the masts.

The plan has its sceptics. Because wind can vary greatly over short distances, even this survey of broad areas of wind flow will be inadequate and 'micrositing' data will still be necessary from the specific regions where the turbines are planned, says Soares.

More scepticism is aimed at a proposed secondary use of the data — to create new standards for turbine design specifically based on Chinese weather. "Wind turbines are not like refrigerators sitting in a house," says Zhang, "China is very different from the United States and Europe." But although it is still not clear what form the Chinese standards might take, some question whether China really needs its own standards. "It's no colder in Mongolia than

To meet its renewable-energy targets, China will need to get 5% of its power from wind farms by 2020.

London's New Energy Finance, a consultancy firm that advises investors on developments in renewable energy, on-shore turbines in other leading wind power countries have capacity factors of around 30%. China's is just 23%.

"China's numbers are not good," says the firm's Justin Wu. "It might not seem significant, but a few percentage points could make the difference between a farm that is economically viable and one that is not."

Wind experts blame several factors, starting with the turbines themselves. When wind-farm developers began gearing up around 2004, they imported turbines from established overseas manufacturers. Recently they have relied more on domestic makers. In 2005, Beijing added a requirement that 70% of turbine parts be made by domestic manufacturers. Major international turbine makers have established manufacturing plants in China, but they are losing out to local firms. According to data collected by the China Wind Energy Association, 2008 will be the first time that the installed capacity of Chinese-made turbines will exceed that of foreign ones. The 3.8 gigawatts already assigned to developers for the Gansu project, for example, does not include a single turbine from a foreign maker.

That's great for China's wind-turbine latecomers, but is it good for the wind farms? According to Wu, Chinese wind farms using foreign models have a 5% higher overall capacity factor than those using domestic turbines. Domestic turbines are especially unproductive when first set up, says Wu.

Because the technology is newer and less tested, Chinese turbines are also more likely to be shut down for maintenance, according to anecdotal evidence. A turbine's average down time is a closely guarded trade secret. But Xiliang Zhang, director of Tsinghua University's Institute of Energy, Environment and Economy in Beijing, says he hears reports that domestic turbines are standing still while foreign models nearby are humming away.

Domestic models are 15–20% cheaper, and the quality has been rising quickly as they have either used proven foreign technology or have hired foreign engineers to help with designs. But as the lifetime of a turbine averages 20 years, the more-productive foreign models would be better buys overall, says Wu. (Representatives of two major Chinese turbine manufacturers did not return phone calls or e-mails requesting comments.)

So why do wind-farm developers in China mostly choose domestic turbines? It is a controversial subject. Despite the mandate to source 70% of parts from domestic manufacturers, turbines used in major national projects, including the recently started wind megabases, are supposed to be purchased through open bidding. But the bidding process is a tricky business and many in the industry assume an opaque policy of favouritism, especially considering that most of the wind-farm developers and domestic turbine-makers are state-owned

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— Paulo Fernando Soares

it is in Minnesota,” says Soares.

Given China's plans to make five huge megabases, the number of turbines in its future is staggering. By 2015, the Gansu project alone will boast 10,000 turbines with a combined capacity of 12 gigawatts. China's four other megabases — in Xinjiang, Inner Mongolia, Hebei and the Shanghai–Jiangsu region — will total 60 gigawatts.

But to make use of all that energy, China's wind hopefuls must tackle an even more intractable problem — the electricity grid. China's energy supply has been hamstrung by a fragmented and underdeveloped grid system that makes it difficult to get energy from coal-rich rural areas to the cities on the east coast. Wind has the same problem: it is produced mostly in sparsely populated regions that cannot use all that energy. The problem is compounded by the unreliability of a power source that is based on the weather. “Grid companies don't like wind. It changes too fast,” says Qin.

Steve Sawyer, secretary-general of the Brussels-based Global Wind Energy Council, says that other countries, particularly the United States, have struggled with their grids. This month, in fact, Democrats introduced a bill in the House of Representatives that allocates US \$11 billion to modernize the grid.

Hurry up and wait

China's rapid expansion has caused delays down the line. Turbines often have to sit idle — on average for four months — before they get hooked up to the grid. The backlog is huge. Of the 5.7 gigawatts of turbine capacity installed by the end of 2007, only 4 gigawatts was plugged into the grid.

Getting connected is just the first hurdle. Many grids are simply too puny to carry all the electricity being made. At peak production times, turbines often have to shut down so as not to overload the electrical networks. Newer turbines can alter the angle of their blades to miss the wind, and will slow to a halt. The only loss is the energy. For older turbines, the operator has to slam on the brakes. Turbines in China wear through their brakes at remarkable speeds, says Meyer. Elsewhere, the brakes are usually used “once a month or less, but in China they're using it every four days”, he says.

The delays and losses could drive people away from wind power, says Qin. “If there is not a serious plan for the grid soon, we will not be able to develop wind energy beyond the next few years,” he warns.

“Grid companies don't like wind. It changes too fast.”

— Haiyan Qin

So why hasn't the Chinese government's legendary ability to get things done kicked in. According to a December 2008 report by New Energy Finance, China's National Development and Reform Commission — the body that oversees national economic and social development — is concerned about the “lack of supervision in China's rapid wind-power growth”, especially when it comes to the grid.

But the government is afraid to do anything that would raise prices, says Zhang. The problem is low demand for the expensive energy. “The solution is to force places, like Beijing, to buy it,” says Zhang. But the government hasn't brought itself to do that. It's easier to let them stick with coal.

Help might be on the way. The megabases have an economy of scale that will make them more attractive targets for grid developers. And in November last year, the country's biggest power supplier, the State Grid Corporation of China, which provides some 88% of the nation's power, announced plans to more than double its investment in grid infrastructure for 2009 and

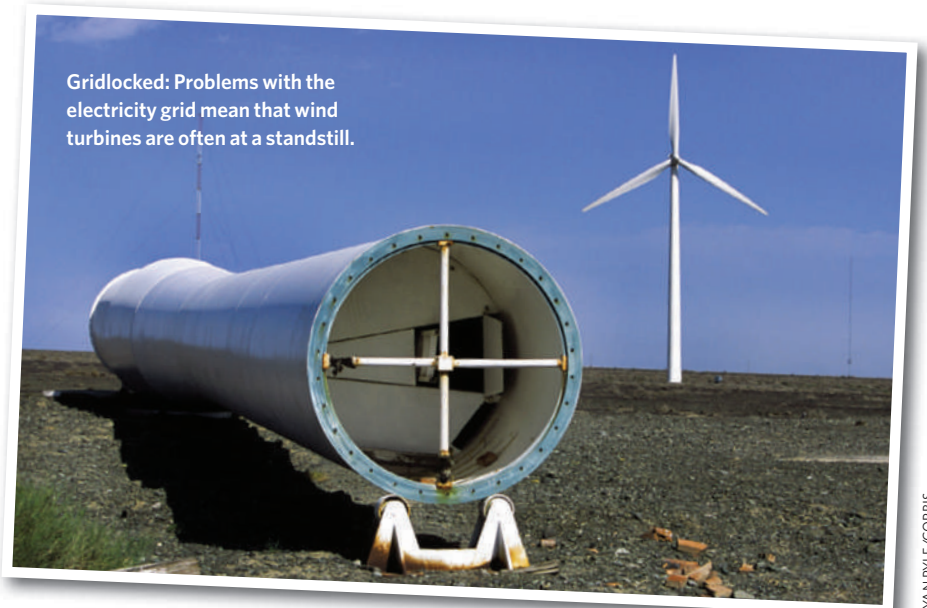
2010 from 550 billion renminbi to 1.16 trillion renminbi. Regional projects will also help. In November this year, Gansu will put 20 billion renminbi into its grid to support its megabase, and Inner Mongolia, also set to get a megabase, plans to add 30 billion renminbi to its grid operations by 2010. These will feed into a scheduled upgrade from 110 kilovolts to 750 kilovolts for a transmission line running from Xinjiang in the northwest, through Gansu, to the eastern metropolises. “It gives a feeling of optimism,” says Beaumont.

Of course, hooking up wind turbines might not be the main thing on grid developers' minds. Wind energy is currently only a drop in the bucket in China's 793-gigawatt energy supply. In 2008, wind accounted for just 0.3% of China's total electricity production, most of which was powered by coal.

But if the five megabases go as planned, their combined capacity would provide more electricity than the controversial Three Gorges dam, even considering the dam's much higher capacity factor. Meeting government targets for renewable energy for 2020 will, according to most estimates, require a prodigious 100 gigawatts of wind energy — about 5% of China's total energy supply. Some estimates note a potential of 500–600 gigawatts by 2040 to 2050.

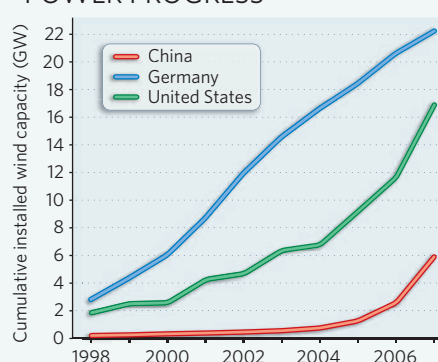
For now, the Chinese government has thrown its considerable weight into exploiting this resource. “It is its flagship renewable-energy industry, so the government is going to support it,” says Wu. But unless some dramatic changes are made soon, China's plans for wind energy might get blown far off course.

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POWER PROGRESS



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