SPECIAL REPORT
OPPORTUNITY AND RISK IN CHINA

NOVEMBER 2008
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MARKET OVERVIEW

Not much room for outsiders
China’s government intends for the biggest wind power market in the world to be mainly supplied by Chinese technology

QUALITY ISSUES

Lots of turbines but not enough electricity
Remove the profit motive from any market and something must replace it if quality is to be maintained. Plenty of wind turbines are going up, but production of electricity is not meeting expectations. Poor project quality is at fault

INVESTMENT CONCERNS

Financing rule changes take their toll
A tightening of fiscal regulation to combat inflation in China has collided with a global credit crunch making financing of wind projects a lot more difficult

DOMESTIC SUPPLIERS

Three leading lights way out in front
Chinese technology makes up more than half of all that installed in China and nearly 94% of that was supplied by the top three wind turbine manufacturers. The Chinese grip on the market is accelerating fast

INTERNATIONAL SUPPLIERS

Not a level playing field for foreigners
The Chinese government’s determination to build its own wind turbine industry means that nearly all the foreign turbine suppliers in China are losing market share, but sales figures are still growing

COMPONENT SUPPLY

Big opportunities in technology transfer
Chinese companies are doing their bit to meet demand for key components, but the country continues to be entirely dependent on imports for specialist equipment

LAST WORD

China leads on exceeding expectations
Steve Sawyer, secretary general of the Global Wind Energy Council, reflects on the astonishing growth he has witnessed in China’s wind market over the past five years and on what needs to be done to maintain the momentum

Cover: Assembling a Sinovel 1.5 MW turbine in Inner Mongolia

This special report on China is published by Windpower Monthly, an independent magazine reporting on the global wind energy business since 1985. Our special reports, whether on specific markets or specific topics, are distributed to all subscribers, with a bonus distribution of each report to target audiences.
Well over 100 GW of wind power is now in the pipeline for development in China. The government expects domestic companies to build nearly all of it, using Chinese technology.

China’s wind power market is on fire. By the end of this year, installed wind capacity will have topped 10 GW, two years ahead of the official national plan. More than 9 GW of that has been achieved within the past three years, a growth rate that puts China on track to overtake the United States in 2012 as the biggest national wind power market in the world. It now lies in fourth place. By 2012, the country will have more than 42 GW of wind, 5 GW of that offshore, forecasts Denmark’s BTM Consult, a wind market information provider.

The next likely target, unofficial as yet, is 100 GW by 2020. That is only a little less than the entire global total for installed wind capacity in mid-2008. Even at 100 GW, China’s wind potential will be far from exhausted. The technical potential on land is 250 GW, with another 750 GW available offshore. By 2050, China could have 600 GW of wind turbines turning, says BTM.

Driving the market is the government’s climate change policy. With the country now producing more carbon emissions than even the United States, offsetting at least some of the growth in coal fired generation in China is a key aim, with renewables playing a significant role. A 2006 law sets a target for 15% of primary energy to come from renewables by 2020, requiring $251 billion in investment, according to China’s National Development and Reform Commission. London-based market analyst New Energy Finance believes more will be required, putting the cost at $398 billion, or $268 billion if large hydro is excluded. At least $91.1 billion (34%) is

LACK OF GRID CAPACITY A GROWING BARRIER

The main obstacle slowing wind power development in China is lack of transmission line capacity and distribution wires, according to Shi Pengfei of the Chinese Wind Energy Association. In a country of 9.56 million square kilometres, with a coastline stretching 32,000 kilometres, huge investments in the electricity network are required. The government is willing to shoulder the bill for getting electricity generated in remote windy regions to centres of population, but getting wires into place is a logistical nightmare considering the potential to adversely affect countless communities along the way. It all takes time.

China’s two best wind resource areas are the north-west and the south-east. The coastal areas of the south-east are densely populated, with load centres relatively close to the wind resource. But most wind investment has been in the less economically developed and poorly populated north-west wind resource areas, such as Inner Mongolia, Xinjiang, Gansu, Ningxia, Hebei and the Qinghai-Tibet Plateau. Here wind farms are often built at the weak end of power grids, far from where the power is needed, Shi says. “It creates a huge problem in grid connection and transmission for wind power.”

The government has issued strict instructions to its grid companies that they must accommodate all approved wind development by improving and expanding the current electricity network. “China’s government has recognised the problem, but policy wise, the measures it has put in place are not enough to address grid connection and availability,” says Sebastian Meyer from Azure International, (main story).

The most significant problem, he adds, is lack of resources at county level. “Nowhere is there a firm county level means of reward for having wind in its backyard. The compensation level is at a national level.” Levies are waged on end use electricity consumers to pay for wind development, but the money raised goes straight to national and provincial authorities, including the grid companies, which are then expected to feed some of it back to the local county authorities, but that rarely happens with any urgency, he says.

“China is reluctant to release funds directly to anyone other than national or provincial authorities. This is a big cultural administrative issue,” explains Meyer. The compensation system needs to be transparent all along the chain, he says. It is not enough for counties to know they will eventually get some level of payment for increasing grid capacity. “This is incurring a real cost at the local level. In the long term it will lead to resistance,” Meyer warns.
expected to go into wind development, it says. Last year, investment in Chinese wind power was around CNY 24 billion ($3.28 billion).

**RELIANT ON WIND**

Of all the renewables, China is expecting wind to provide by far the largest contribution to electricity generation. Under a plan from last year to implement the renewables law, all generators operating more than 5 GW of power plant must ensure that at least 3% of their capacity is non-hydro renewables by 2010, rising to 8% by 2020. In terms of energy delivery, at least 1% of electricity is to come from non-hydro renewables by 2010 and at least 3% by 2020. The 6 GW of wind power installed at the end of last year represented no more than 0.8% of total power capacity and provided just 0.2% of China’s electricity. Coal-fired plant provided 83%.

Meeting the 1% renewables target in 2010 requires 40 TWh of renewable energy, given a projected annual electricity production by then of 4000 TWh from 900 GW of generating plant. By 2020, 200 TWh of renewable energy is needed to reach the 3% target. Solar and biomass are unlikely to make significant contributions to these goals, so that leaves wind, says Shi Pengfei of the Chinese Wind Energy Association (CWEA).

What it means is that the wind industry must install at least 5 GW each year in China for the next two years, on a par with expected additions for 2008, and around 8 GW a year in the decade to 2020. Industry analysts estimate the country’s big generation firms alone will spend at least CNY 20 billion ($2.9 billion) annually buying wind turbines and components to meet the law. Taking the lead is Longyuan Electric Power, the renewable energy subsidiary of China Guodian Corporation. So far it has installed over 1600 MW of wind capacity, says Zhu Junsheng of the Chinese Renewable Energy Industries Association (CREIA). Longyuan is targeting 5000 MW by 2010. In China, not meeting government targets is unthinkable.

It will all be paid for by China’s electricity consumers, backed by an assortment of government subsidies. The National Development and Reform Commission has set current purchase prices at CNY 0.51-0.61/kWh ($0.074-0.088/kWh) depending on the region and its wind resource (*WINDPOWER MONTHLY*, July 2008). In deciding the price range, the government was guided by bids submitted by wind project developers for power purchase contracts under government development concessions.

WHERE WILL IT COME FROM?

From a standing start in 2005, it took just two years for China’s domestic wind turbine makers to outgun their foreign rivals. In 2007, Chinese turbines made up 56% of all new wind capacity installed in the country, up from 41% in 2006. At the end of the first quarter of 2008, domestic suppliers were sitting on 86% of the nearly 20 GW of wind on order across China, up from 8.6 GW at the end of 2007, says Sebastian Meyer from Azure International. Foreigners held 11%, with 3% in the hands of joint venture firms. Azure is an industry consultancy based in Beijing, owned by the Dutch Econcern group.

“We see a continued decline in market share for foreign companies,” says Meyer. “The end of the first quarter may have been the historic tipping point in which the market has shifted from majority international to majority domestic.” In that period, foreigners supplied 39% of new installations, reports Azure.

Up to the end of March, international wind turbine suppliers such as Gamesa, Vestas and GE Energy, the leading foreign players, had supplied 48% of all wind capacity installed across China. So had their domestic counterparts. Sino-foreign joint venture companies accounted for the remaining 4%. But come the end of December and domestic players will dominate Chinese wind power, both in terms of cumulative capacity and annual installations. Increasingly, too, turbine components are of Chinese rather than foreign origin. “A strong domestic supply chain is being formed,” says BTM Consult, noting that at the start of the year, 66 companies were covering the
FEW FOREIGN DEVELOPERS

The business of wind power project development in China is dominated by domestic companies, even though the number of foreign developers showing an interest in the sector is growing. Participation in wind power development by international players currently amounts to about 30 companies holding 5% of the market, a figure unchanged from last year, reports Beijing consultancy Azure International.

If Chinese companies with international interests are included in the count of “foreign” wind power investors, however, their total market share moves to 7% as of June this year, or 545.6 MW. These companies include the likes of Hero Asia (part of China’s massive Longyuan Group), Euro China Power (part of Farsighted) and China Resources Power (state controlled but Hong Kong listed).

Around 15 fully domestic companies, led by the five state owned utilities, Longyuan, Guohua, Datang, Huadian and Huaneng, hold around 78% of the near term market and 81% of the long term. The big five account for more than 50% of cumulative capacity installed by the end of 2007, with Longyuan leading the pack.

That market dynamic may be changing, however. While the current top ten hold a 72% share of the long term development pipeline, this shrinks to 66% for mid-term plans and tumbles further to 52% for near term development, says Azure’s Sebastian Meyer. “There have been some slight changes in the top ten shares, with some of the big China companies slipping down or indeed out of the rankings, but it is not something talked about in China,” he says.

MARKET LIMITS

Installing wind turbines, however, is just part of the story. Getting electricity to the customer is becoming an increasing challenge. This year, around 5-6 GW of wind turbines will go up in China. Only the US could install more. “We’ve reached a critical growth point,” says Meyer. Grid availability now becomes a limiting factor to Chinese market growth, he says.

Even China’s ability to rapidly expand its grid network is no match for the speed at which the wind industry can get turbines in the ground. At the end of last year, 2 GW of the 6 GW installed was waiting to be connected to the network. Although that is now all online, much more grid capacity is needed (box, page 4). “Preliminary grid connection statistics suggest around 2 GW is still unconnected,” Meyer says. “Eventually this will become more and more of a pressing issue.”

In the first three months of this year, 635 MW of wind capacity was installed, representing 122% year-on-year growth. By the end of June, new installations had hit 2 GW to take cumulative capacity to just over 8 GW, says Shi. He believes around 22 GW will be installed by end 2010 and 80-100 GW by 2020. Azure’s statistics support these projections. The volume of megawatts newly built, under construction or in the pipeline doubled in the first three months of 2008, rising from 65 GW at the end of December to 134 GW.

Most of the new capacity is going up in the northern areas of Inner Mongolia, Jilin, Liaoning and Hebei, which already account for the bulk of installed capacity to date, and coastal areas in the south-east like Jiangsu, Shandong, Guangdong and Zhejiang. Some of it is earmarked for offshore development. Around 35 GW of that pipeline, up from 17 GW at end 2007, is deemed “imminent” by Azure. The 35 GW includes the landmark Gansu development, a project driven by the government’s determination to become the leading wind power nation in the world. The northern province of Gansu, with 338 MW of...
wind capacity installed at the end of 2007, will become China’s first so-called “wind power base.” By 2011, 10 GW of wind power capacity is to be installed there. More will follow. The first phase of Gansu, just one of several regional bases the government wants developed, got under way earlier this year, with 3.8 GW of capacity awarded to Chinese project developers.

**GANSU AND BEYOND**

This project, more than anything else, has perhaps defined China’s wind market for 2008 and the future. Its sheer size leaves no doubt that the government is backing its good intentions with action. But the tender process for Gansu also reveals China’s determination to shut out foreigners where they are not needed, just as it has done in awarding previous concession contracts for large wind farms.

The Gansu tender was the subject of a government special policy order designed specifically to foster domestic wind industry growth. International suppliers were left to watch in envy as the whole lot was awarded exclusively to four domestic turbine suppliers, including the leading three, Goldwind, Sinovel, and Dongfang (page 12). “We are not satisfied with the preferential treatment given to local companies, be it project developers or turbine suppliers,” says Paulo Soares of India’s Suzlon, with particular reference to Gansu. “This sets a dangerous precedent.”

China’s overt support of domestic companies is a step beyond the approach seen in the wind industry to date. China, like Spain, Brazil and Quebec, already demands a high percentage of locally made content if wind power stations are to qualify for power purchase contracts. At least 70% of all wind farm equipment must come from local sources. Wind turbine suppliers from abroad have had no choice but to quickly set up shop in China if they are to share in the huge market.

China has also made it difficult for foreign project developers to succeed in the country. With wind power purchase prices allowing for only a marginal profit, developers have to register projects under the Kyoto Protocol’s Clean Development Mechanism (CDM) to reap additional income from sale of carbon emission credits. To be eligible for those CDM credits, a company must be majority Chinese owned.

Gansu, it is feared by the international wind power industry, is the turning point where China’s government has dropped all pretense of providing anything close to a level playing field. Along with the award of the first 3.8 GW to local companies, the government has this year introduced a number of significant new policy measures that again favour domestic firms, including research and development subsidies and new import duty rules.
Lots of turbines are going up, but production of electricity from them is not meeting expectations. Poor quality is at fault.
ment is very strict,” points out Shi. “The successful manufacture of highly reliable, high quality, large turbines requires the process of technological accumulation. These turbines also need to pass operational tests. So it is necessary for enterprises to build up their R&D ability. Simple purchase of foreign technology will not work.”

Pan Weiping of Garrad Hassan agrees. Many new companies, most without any prior experience of designing or producing a complete wind turbine, have simply bought a production license from an overseas firm and jumped straight to making utility scale turbines. As long as they can manufacture planes, ships or trains, they also believe they can make a wind turbine, says Pan. “They jumped over the process of basic research and technological accumulation, so they are short of practical experience, skilled technicians and basic technology.”

CHINESE AND CHEAP

Chinese wind turbines are reportedly some 20% or more cheaper than foreign turbines made in the country, making them an attractive choice for developers looking to meet government targets for installed capacity. Imports are out of the question: the Chinese government requires that 70% of all wind plant components are made locally. Some of the bigger and better known Chinese companies are working hard to improve quality while also ensuring new turbines attain international standard certification from the likes of Germanischer Lloyd to reassure the global community they are ready to stand shoulder to shoulder with world leaders like Vestas, GE Energy, and Gamesa. Other companies are paying scant attention to turbine quality, which is becoming an increasingly serious problem, says Shi.

At many existing wind farms, the operational availability of turbines is low, with a high number failing to meet the required availability of 95%, he says. Even when operating, they are inefficient. Capacity factors are woefully low. “In China, the average capacity load factor for a wind plant is around 22%. In the US it is 35%,” says Sebastian Meyer from Azure International. “Some discrepancy can be put down to the fact that bigger turbines are typical in the US and because the US has more experience in building and operating wind plant. What we know for sure, though, is that wind power in China per kilowatt hour costs more than it needs to. The focus on cheap assets has led to an under performance of the market.”

CREIA’s Zhu agrees. The cost of building a wind farm in China is fairly reasonable, currently pegged at around CNY 8-8.5 million/MW ($1.17-1.24 million/MW), according to Garrad Hassan. Operational costs are relatively high, however, due to the frequency of turbine quality problems, says Zhu. “Both manufacturers and project developers are paying a high price for turbine repair,” he adds. Poor wind resource assessment, project management and maintenance of wind farms also piles on extra costs he says. “Some investors started projects hastily based on outdated data. As a result, performance
of some wind farms is not as good as expected and investors continue to suffer losses.”

“Of course the Chinese state companies are interested in profit, but they have more pressing concerns such as targets,” says Meyer. Shi agrees. In China, failure to meet renewable energy capacity targets comes with severe penalties. For this reason, electricity generators and local governments are focused on raising installed wind farm capacity rather than wind power production.

“At the heart of the problem is that the top leaders and government officials in China tend to be the top engineers, not economists. So they see the solutions to their problems as engineering solutions. In some ways this is a good thing, but it may also be China’s greatest weakness,” Meyer says. China believes that closing the technology gap with the West is the solution to its problems, he continues, and co-operating with foreign companies is the means to achieving that end. But that is not the same as welcoming foreign companies with open arms. “It means: you hand over the blue prints and we take it from there. China is not yet interested in introducing fiscal measures such as generation-based incentives,” says Meyer.

“The question is: is China destroying wealth by simply deploying hundreds of cheap prototypes as opposed to creating and fostering wealth in the long term by building up an industry with quality products for export? We simply cannot answer that question at this time and it is a great concern,” he adds. It is a concern shared by many in the international wind community. Poor quality will lead to poor performance and the failure of wind power. At risk, if Chinese wind power goes belly up, is the technology’s current status globally as a realistic alternative to fossil fuel and nuclear generation.

Engineer on ice: Commissioning at Caoduozi, near Quahar Youqi Zhongqi in Inner Mongolia of the prototype of a 2 MW Aerodyn designed turbine built by the wind turbine division of the China Shipbuilding Industry Corporation

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NEW FINANCING RULES TAKE THEIR TOLL

INVESTMENT CONCERNS

New policies designed to stem inflation in China are combining with the impact of the global credit crunch to make life increasingly difficult for many in the country’s wind industry. Changes in the bank financing rules means it is harder for some developers to secure finance as quickly as in the past. “It has been a really rough year for developers to get investment for solid business plans, particularly those using the independent developer model,” says Sebastian Meyer of Azure International. “I have seen a number of ventures with reasonable business plans trying to get equity investment which have not achieved their aims.”

“Some manufacturers have nacelles piling up in their lots waiting for their customers to scramble to make new arrangements for finance,” says Steve Sawyer of the Global Wind Energy Council. Turbine suppliers have been particularly hit, with clients that have placed orders finding they can no longer make payments on schedule because expected bank loans have yet to be approved. Suzlon is one such supplier. “This situation is a continuing source of concern,” says the company’s Paulo Soares. “There have been improvements lately, but we are still far from an acceptable situation.”

The problem took hold in June, when as part of its anti-inflation policy, China’s central bank announced that the commercial bank reserve requirement ratio (RRR)—the percentage of deposits a bank must hold in reserve—was being increased to 17.5%. This is up from 10% in the first quarter of 2007 and 7.5% in 2006. The decision effectively put a freeze on CNY 400 billion ($57.8 billion) in the banking system. The result is the government has removed CNY 3 trillion from the system in a year, says Soares. In addition, the lending ability of general banks has been stemmed, with quarterly limits imposed by the central bank. Combined with the problems in the global credit market, the impact has been significant.

DOLLAR CRUNCH

There has been a “drastic liquidity change since late 2007,” says Soares. “This has been especially driven by US liquidity issues, because China’s central bank requires all the reserve by banks to be made in US dollars.” Bank funding costs are much higher than 2007 and inter-bank rates are likely to keep rising due to tightening liquidity, he says. Banks are more cautious, which “makes financing difficult for the developers and delays the project.”

That China’s big utilities are also the leading wind developers is no help. Their profits are already being squeezed as coal prices surge, while prices paid by consumers for electricity are kept unchanged. In the first half of 2008, the big five state utilities posted a net loss of some CNY 7 billion ($1 billion), notes Soares. Developers must prioritise investments,” he continues. “Since wind has no impact in the current power generating mix and coal is what drives power production, the wind business is the first to suffer with lack of financial resources. This is a problem that affects all wind business, not only turbine suppliers.”

Meyer agrees, but thinks an enforced slow down in the pace of development could actually be of benefit. “These changes do give some sense of stability. Companies just know they are on a list. It is a way of slowing down the plans of developers. That is not necessarily a bad thing,” he says.

Until now, the market in China was typically characterised by on-balance-sheet lending, so project finance has effectively been a refinancing of existing project deals with existing customers. “But to be clear, to date, or certainly up to the beginning of 2008, all debt that has been used to finance the wind capacity installed was secured without a power purchase agreement,” he says. “Now banks are likely to require them.”

The bank rule changes could, he says, be seen as a positive indicator of maturity in China’s financial market. “Yes, the environment is forcing some delays, but those delays should, in the long term, be a positive development. It should result in international standard due diligence practices being conducted, with full risk factors examined and so forth,” he insists. “This should result in improved quality of projects and thus it means then the capital market is doing what it should be doing.”

What credit crisis? Shepherds enjoying a break at the Shiren wind farm in Tuoqizhuang near Shangyi in Hebei province

ARTICLE BY
GAIL RAJGOR
Senior Editor

Changes to bank financing rules in China and the global credit crunch are making it difficult for some developers to get the investment they need. This has had a knock-on effect on turbine manufacturers and other suppliers.

WINDPOWER MONTHLY SPECIAL REPORT · NOVEMBER 2008
Chinese made turbines now make up more than half the total installed wind capacity in China, with 94% of them supplied by just three companies. Goldwind leads with 57% of the Chinese share, followed by Sinovel with 28% and Dongfang with 9%. A huge new government order is set to keep the three out in front, at least for the time being.

**Domestic Suppliers**

China’s three main domestic wind turbine manufacturers—Goldwind, Sinovel and Dongfang Steam Turbine Works—are having a prosperous 2008 on top of a good 2007. Last year, the three companies installed more than 52% of the 55% share of the wind turbine market secured by Chinese companies. This year they have won a 3.75 GW government order, which even though split among them has not only boosted current order books, but also bodes well for the near term.

The order, placed by the government of Gansu and approved by the National Development and Reform Commission (NDRC), is for most of the first 3.8 GW stage of a huge 10 GW Wind Power Base development in the province, scheduled for completion by 2011. The NDRC has further earmarked Inner Mongolia as another possible location for a wind base and the coastal intersection of Jiangsu and Shanghai in east central China for a third.

The 3.8 GW ordered so far for Gansu will be split across 20 wind farms around Jiuquan, the far-flung Gobi desert city famous as the nation’s space satellite launch centre. The various project developers, which includes State Grid Xin Yuan Company and China Huadian New Energy Development, have a 25-year franchise to build, own, and operate the wind farms. Construction on the projects has begun, with completion due by the end of 2010.

Sinovel and Dongfang both trounced their key rival Goldwind, the main Chinese turbine supplier for over a decade, in gaining bigger shares of the first Gansu turbine order. Sinovel bagged 1789.5 MW, valued at around CNY 11.47 billion ($1.68 billion), Dongfang is supplying 1149 MW, valued at CNY 7.32 billion ($1.07 billion and Goldwind is to deliver 811.5 MW for a value of nearly CNY 5.2 billion ($760 million). All three are supplying 1.5 MW machines. The remaining 50 MW of the 3.8 GW order went to CSIC (Chongqing) Haizhuang Windpower Equipment, a subsidiary of China Shipbuilding Industry Corporation, which will supply 25, 2 MW turbines. All turbines are due for delivery between 2009 and 2010.

Today, around ten Chinese manufacturers are capable of supplying megawatt class turbines, largely thanks to licence agreements or design partnerships with international companies (table page 16). Goldwind, Sinovel, and Dongfang have led the way. For these three, who

**Chinese Turbine Exports**

A growing number of Chinese turbine manufacturers are eyeing the export market. Overseas orders have been placed or tentatively agreed over the past year for machines produced by Mingyang, Goldwind, Sewind, and Hewind. Others, such as Sinovel and A-Power, have said they will pursue export opportunities next year.

One of the most high profile orders, for 900 MW of turbines, was placed with Mingyang by US newcomer to the wind development business, GreenHunter of Grapevine, Texas. But the schedule for delivery of the first 1.5 MW units, designed in partnership with Germany’s Aerodyn, is slipping significantly (Windpower Monthly, June 2008).

It seems more likely that Goldwind will be the star player internationally following its acquisition of 70% of German wind turbine designer Vensys. The company is to start manufacturing turbines in Germany soon. Hewind was an early exporter. In 2007 it delivered three of its 780 kW units to South America. The client in Chile was Ecoingenieros. Competitor Sewind is eyeing markets in eastern Europe, Southeast Asia and South Africa, it says. The company is a subsidiary of Shanghai Electric.

“We have just supplied to the UK and Thailand,” says the company’s Feng Li. “These are our first exports.” Both involve delivery of 1.25 MW machines, two to the UK and three to Thailand. “There has been lots of interest from companies from southeast European countries, like Bulgaria,” she adds.

Sewind’s production capacity this year is for 200, 1.25 MW units, with that set to rise to 400-500 next year. The company expects to offer a 2 MW unit, jointly designed with German consultancy Aerodyn, by the end of 2009, hoping to produce 40 initially, and a 3.6 MW model for offshore development a year later.
also won a combined 950 MW order from a central government concession tender this year (WINDPOWER MONTHLY, July 2008), Gansu is a thick layer of icing on what has become a substantial cake. Shi Pengfei of the Chinese Wind Energy Association expects them to capture around 60% of China’s wind market during 2008-2010. Their biggest customers are the big five state owned utilities.

SINOVEL

For Sinovel, the Gansu and concession orders bring it closer to achieving its ambition to overtake Goldwind as the Chinese wind industry’s top dog. Last year, the company crept into tenth place, two slots below Goldwind, in the global ranking of wind turbine suppliers in BTM Consult’s World Market Update. Two years ago it did not even rank in China’s domestic top ten. Sinovel was also awarded more capacity than Goldwind in the 950 MW tender, securing two projects, one in Inner Mongolia and one in Hebei, totalling 450 MW. Goldwind got 300 MW in Inner Mongolia.

Sinovel, based in Beijing, was established in 2004 as a subsidiary of the massive Dalian Heavy Industry. At that time it secured a licence agreement to produce a 1.5 MW unit based on technology from small German wind turbine maker Fuhrländer. As a result, Sinovel became the first Chinese firm to offer a megawatt size machine.

Now it is China’s largest supplier of 1.5 MW turbines, meeting about 60% of the demand for them last year. It has a strong supply chain in place, it says, with about 90% of components made in China. Its factory in Dalian for the 1.5 MW unit has an annual capacity of 1500 MW. Three further factories are in the works, planned for Jiangsu and Inner Mongolia. These will help it achieve its target to produce 2250 MW of its workhorse turbine next year and 3000 MW in 2010. It also hopes to begin exports next year.

Sinovel also intends to add larger turbines to its production line, with its sights set on a 3 MW unit and a 5 MW machine, both designed in partnership with AMSC Windtec. Sinovel will own the intellectual property rights. Earlier this year, Germanischer Lloyd (GL) in Germany was contracted to certify the 3 MW turbine, with Sinovel hoping to bring it to market this year, with mass production starting next year.

Sinovel’s rise to the top has hit the headlines several times in recent years, largely due to its huge orders for electrical components from AMSC. The most recent was announced in June, just after it won the Gansu contracts, and worth $450 million. “Sinovel is the epitome of business success in China and is one of the fastest growing wind turbine manufacturers in the world,” said AMSC’s Greg Yurek at the time.

Despite it all, the capacity of Sinovel wind turbines in the ground was no more than 750 MW at the end of 2007, less than 1% of the global total. The AMSC order was for electrical components for more than 10 GW of wind power capacity, according to Yurek. The contract calls for shipments to begin in January 2009 and increase in volume year-on-year through the contract’s comple-

Life among turbines: Mongolian tents provide seasonal homes in a shepherds’ settlement between the Huitengxile and Dadonggou wind farms on the Huitengxile plateau near Quahar Youyi Zhongqi in Inner Mongolia
CHINA AT A GLANCE

The wind power map is steadily getting filled in with development activity spreading out of the far north and south-east and into ever more regions.

Wind capacity by province
Size of circle is proportional to total 2007 capacity, broken down as follows:

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AR - autonomous region
M - municipality

Top suppliers in China
Wind turbine installations 2007

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</tr>
<tr>
<td>Goldwind</td>
<td>830</td>
<td>25.1</td>
</tr>
<tr>
<td>Sinovel</td>
<td>680</td>
<td>20.6</td>
</tr>
<tr>
<td>DFSTW*</td>
<td>222</td>
<td>6.7</td>
</tr>
<tr>
<td>Winday</td>
<td>65</td>
<td>2.0</td>
</tr>
<tr>
<td>Others</td>
<td>50</td>
<td>1.5</td>
</tr>
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Joint venture and foreign

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>NEW CAPACITY 2007</th>
<th>MARKET SHARE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MW</td>
<td>%</td>
</tr>
<tr>
<td>Gamesa</td>
<td>560</td>
<td>17.0</td>
</tr>
<tr>
<td>Vestas</td>
<td>369</td>
<td>11.2</td>
</tr>
<tr>
<td>GE</td>
<td>213</td>
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<td>Suzlon</td>
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<tr>
<td>Nordex</td>
<td>56</td>
<td>1.7</td>
</tr>
<tr>
<td>Ningxia (JV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASC Wanyan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acciona (JV)</td>
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</tr>
<tr>
<td>Others</td>
<td>51</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Total Joint venture and foreign: 1475 MW (44.1%)

Total domestic: 3322 MW (55.9%)

Joint venture and foreign: 3239 MW (52.2%)

Rise of domestic manufacturers
Breakdown by manufacturer of new capacity

The Chinese government has picked Gansu province as the location for the country's first 10 GW Wind Power Base to be completed in 2011. The first 3.8 GW is already ordered.
Top ten leading developers
Ranking by equity weighted development activity

2005
**TOP TEN TOTAL**
1078 MW
(85% of total activity)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<tr>
<td>2</td>
<td>State Grid</td>
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<tr>
<td>3</td>
<td>Ningxia Power</td>
<td>112</td>
</tr>
<tr>
<td>4</td>
<td>Datang</td>
<td>77</td>
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<tr>
<td>5</td>
<td>Huaneng</td>
<td>63</td>
</tr>
<tr>
<td>6</td>
<td>Guangdong Yudean</td>
<td>52</td>
</tr>
<tr>
<td>7</td>
<td>Shenhua</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>Inner Mongolia</td>
<td>44</td>
</tr>
<tr>
<td>9</td>
<td>HLJ Huafu</td>
<td>41</td>
</tr>
<tr>
<td>10</td>
<td>Jilin Wind Power</td>
<td>34</td>
</tr>
</tbody>
</table>

Big five state owned utilities and the State Grid Company are highlighted in white.

2006
**TOP TEN TOTAL**
2125 MW
(80% of total activity)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>Datang</td>
<td>316</td>
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<tr>
<td>4</td>
<td>Ningxia Power</td>
<td>157</td>
</tr>
<tr>
<td>5</td>
<td>CECIC</td>
<td>129</td>
</tr>
<tr>
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<td>Shenhua</td>
<td>124</td>
</tr>
<tr>
<td>7</td>
<td>Huaneng</td>
<td>104</td>
</tr>
<tr>
<td>8</td>
<td>Guangdong Yudean</td>
<td>100</td>
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<tr>
<td>9</td>
<td>HLJ Huafu</td>
<td>71</td>
</tr>
<tr>
<td>10</td>
<td>HK Constructions</td>
<td>58</td>
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</table>

2007
**TOP TEN TOTAL**
4348 MW
(73% of total activity)

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<thead>
<tr>
<th>Rank</th>
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<th>MW</th>
</tr>
</thead>
<tbody>
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<td>4</td>
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</tr>
<tr>
<td>5</td>
<td>Huadian</td>
<td>380</td>
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<tr>
<td>6</td>
<td>Ningxia Power</td>
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<td>Shanghai</td>
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<tr>
<td>10</td>
<td>Shandong Luneng</td>
<td>135</td>
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</table>

2007
**TOP TEN TOTAL AND ORDERS**
11,529 MW
(68% of total activity)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
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</thead>
<tbody>
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<td>State Grid</td>
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<tr>
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<td>8</td>
<td>CFI</td>
<td>778</td>
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<td>9</td>
<td>Guangdong Nuclear</td>
<td>728</td>
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<tr>
<td>10</td>
<td>Hebei Construction</td>
<td>628</td>
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</table>

2008–2012
**TOP TEN NEAR-TERM DEVELOPMENT TOTAL**
17,313 MW
(57% of total activity)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
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<tbody>
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<td>Datang</td>
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<td>4</td>
<td>Huadian</td>
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<td>Huaneng</td>
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<td>6</td>
<td>Shandong Luneng</td>
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<td>Guangdong Nuclear</td>
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<td>CFI</td>
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<td>Beijing Energy</td>
<td>1100</td>
</tr>
<tr>
<td>10</td>
<td>State Grid</td>
<td>1005</td>
</tr>
</tbody>
</table>

Champions: Olympia wind farm on Guan Ting Lake in Hebei province.

Source: Azure International; data as known on 10.03.08
tion in December 2011. For the US firm, which also has a deal to supply components for Sinovel’s 3 MW unit, the Chinese firm’s success has been the backbone of its own in the wind market.

**GOLDWIND**

Active in China’s wind market for a decade, with around 1500 MW installed by end 2007, Goldwind will not give up its long standing crown as China’s leading turbine supplier easily. While its market share in China has diminished in recent years, falling to 25.1% last year from 33.37%, its annual revenues have increased 100% for seven consecutive years, starting in 2000. Its sales in 2007 totalled CNY 3.1 billion ($454 million), with the profit on that amounting to CNY 630 million ($92 million). The company, which has been a big winner in other government sponsored concession projects, including racking up over 1 GW of concession contracts this year in addition to Gansu, says it expects to maintain a minimum 25% share of its home market this year.

The company’s first machine was a 600 kW turbine produced under a licence agreement with German firm Jacobs Energie, now part of Repower Systems. It also produces a 750 kW unit, again under a Repower licence. Its...
flagship 1.5 MW unit is a direct drive turbine, with the rotor turning the generator without the intermediary of a gearbox, designed in co-operation with Germany’s Vensys, a company Goldwind now controls. The two are also working on bigger turbine designs.

Goldwind’s €41.24 million acquisition of 70% of Vensys, a wind turbine design company, completed early this year, is one of a number of key initiatives over the past 12 months with the purpose of upping its game and branching out onto the world stage. It closed 2007 with a listing on the Shenzhen Stock Exchange, the first Chinese renewable energy company to do so. The initial public offering sparked a surge of interest, exceeding analyst expectations and breaking stock market records (WINDPOWER MONTHLY, February 2008). Goldwind raised CNY 1.75 billion ($256 million) as a result, money it said will be used to diversify into wind project development, expand manufacturing operations and further invest in research and marketing. Vensys was its first big expenditure.

Goldwind currently has three production bases, one in its home region of Urumqi, and the others in Beijing and Baotou. In coming years, production of the 750 kW unit is to be scaled down. The combined production capacity for its megawatt scale turbines is of 900-1000 units a year, it says. This year the company expects to produce 500 of its 1.5 MW turbine and 1500 of the 750 kW machines. Next year it plans to turn out 2000 of the bigger machines and 1000 of the smaller, while in 2010 it is aiming for 2500, 1.5 MW units and 500, 750 kW units.

To boost its production capability, Goldwind is building four further manufacturing facilities, including one in south-west Germany at Neuenkirchen, near Saarbrücken. Here Vensys will assemble about 30 turbines for the European market in 2009, ramping up to at least 50 units in 2010. They will be a mix of the 1.5 MW unit and a 2.5 MW machine. A prototype of the 2.5 MW model, designed primarily for offshore use, will be installed near Saarbrücken at the start of 2009. The expansion overseas has driven Goldwind’s market value to over $6 billion, notes China’s Clean Revolution, a report published by The Climate Group earlier this year.

With an eye to the offshore market in China, Goldwind is also working with Vensys on a 2 MW unit. The company installed China’s first offshore turbine, a modified version of its 1.5 MW model, for the China National Offshore Oil Corporation (CNOOC) at Liaodong, Bohai Sea, late last year (WINDPOWER MONTHLY, January 2008). A few months after the turbine was commissioned, CNOOC confirmed it is proceeding with plans to build a 1000 MW wind farm offshore near Shandong province. The CNY 21 billion ($3 billion) project will be developed over the next ten years and Goldwind is widely expected to be the supplier.

**DONGFANG**

Compared to its bigger rivals, China’s third largest domestic turbine supplier, Dongfang, lags some way behind. It had just 237 MW installed by end 2007, but orders secured this year alone, including Gansu, mean it will have at least 2000 MW on line within the foreseeable future. The company, based in Deyang in Sichuan province in the south-west, is a subsidiary of Dongfang Electric Corporation, a listed company which is one of the world’s largest power generating equipment manufacturers. It produces 1.5 MW turbines under a licence agreement signed with German turbine design company Aerodyn to develop a 2.5 MW machine for which it will own the intellectual property rights.

Some 276 MW of its order pipeline comes from two contracts the company secured shortly after Sichuan province was hit by an earthquake (WINDPOWER MONTHLY, July 2008). While the disaster in May affected Dongfang’s main operations severely, the turbine division was relatively unscathed and back in operation within a week. It expects to meet its target to produce up to 800 machines this year, said the company’s Zhang Zhiying at the time.

It expects to close the gap on Goldwind and Sinovel, predicting its market share will increase from less than 7% of new capacity installed in 2007 to 15% in 2008. Its performance in the first six months of this year seems to support that assertion—and makes Goldwind’s 100% year-on-year revenue increases look small. Dongfang’s wind turbine sales revenue for the period totals CNY 1.39 billion ($204 million), up 206% over the same period last year, says the company. As well as a factory in Deyang, it has production bases in Tianjin and Jiuquan. Next year it expects to increase its wind turbine output by 75%, with 1400, 1.5 MW units coming out of its factories.

**KNOWLEDGE TRANSFER**

The four winners of this year’s largest Chinese government concession contract, for the first 3.8 GW phase of its 10 GW Gansu project (main story) all started batch production of wind turbines through licence agreements with international manufacturers. For most Chinese firms it has been a common route, says Shi Pengfei of the Chinese Wind Energy Association. “Most Chinese manufacturers have introduced, digested and absorbed foreign technical knowledge either by buying production licences from foreign turbine producers or by hiring foreign engineering firms for joint design,” he says.

It has been the only way they can catch up with the rest of the world. “Even before Chinese companies could start batch production of 200 kW turbines, the world market was dominated by 600 kW class turbines,” he says. Domestic firms accounted for just 15% of China’s installed capacity in 2003, increasing that only slightly to around 18% in 2004. Goldwind, he notes, accounted for 80% of the capacity installed by Chinese firms in both years. The technological difference between the turbines produced domestically and those produced by international companies was akin to that between a black and white television and a colour one, he says.

How times have changed. With the introduction of China’s renewable energy law in 2006 and regulations to support implementation of the law, domestic turbine manufacturers have been shooting up. At least 40 companies are now making wind turbines, though less than a handful of those are doing so in serious numbers.

Chinese companies in conventional machine building industries see the wind power industry as a new growth area, says Pan Weiping, head of the China office for Garrad Hassan, a wind energy consultancy based in the UK. These newcomers, like the original group of domestic producers such as Goldwind and Windley, took a shortcut and chose to acquire foreign technology, he says. So far around ten domestic companies can provide megawatt size machines.
The Chinese government’s determination to build its own wind turbine industry means that nearly all the foreign turbine suppliers in China are losing market share, but sales figures are still growing.

INTERNATIONAL SUPPLIERS

When China announced its renewable energy law in 2005, the global wind power industry hailed it as the opportunity of a lifetime. International turbine suppliers were already dominating a fledgling market, which in that year raised its installed capacity from 769 MW to 1264 MW. The technical potential in China is for 250 GW, not counting offshore. With Goldwind as the only Chinese firm of note to compete against at the time, foreign firms were expected to dominate for years to come.

How wrong they were. “Business is difficult,” admits Paulo Soares of Indian turbine supplier Suzlon. His company supplied the seventh largest volume of installed wind capacity in China last year—200 MW of the 3300 MW that went up, or 6.24% of the market in 2007, well up on its 0.94% share in 2006. As such it was one of the few foreign turbine suppliers to make real headway in China in recent years.

Thomas Richterich of German firm Nordex, which supplied just 55 MW in 2007 and saw its market share fall from around 3% to 1.68%, shares Soares’ view. “It is very difficult,” he says. Even though nearly all foreign turbine suppliers installed more capacity in China last year than previously, it is a widespread sentiment. World leader Vestas saw its China share plummet from 23.44% in 2006 to 11.16% in 2007, relegating it to fourth slot overall and second among the foreigners. The 2007 leading overseas firm, Gamesa, recovered some share, up 1% on 2006 to 17%, but less than half the 36% it held in 2005.

Chinese competitors, which have grown significantly in number since 2005 and offer turbines at prices well below those international firms are prepared to consider, easily dominate the market (previous story). For international suppliers, China is an increasingly tough market to penetrate. “Protectionism by the government toward local suppliers and local project developers is the main problem. We are not being allowed to compete on equal terms,” says Soares. “Give us the opportunity to compete on equal terms and international suppliers can be as competitive as local suppliers.”

STATE BIAS

Around 19 GW of wind turbines are currently on order for installation in China. “About 6.5 GW of those orders were placed via national level concession projects and special policy orders, with no access to international players,” Soares says. “This sets a dangerous precedent, because international suppliers were the ones who started the development of this industry in China and have always supported its policies, investing heavily in new factories, training, and product development.”

An “excessive amount” of orders are being placed to “inexperienced and unproven turbine suppliers, without proper qualification,” he continues. “The problems those suppliers are facing regarding machine quality and low availability are kept far from the public eye.” Many of the Chinese turbines being made under licence agreements with foreign firms “do not have proper certification, be it from Germanischer Lloyd or elsewhere,” Soares says. “Having a licence for a certified turbine does not mean the localised turbine is also certified.”

New subsidies and import duty rules (page 11) that serve to benefit Chinese wind companies are adding salt to the wound. Chinese wind turbine makers are able to pass the subsidies and cost savings down the chain and offer machines at lower prices, says Richterich. “We are not satisfied with the clear preferential treatment given to local companies,” agrees Soares. “It is unfortunate that international turbine suppliers located in China, which have invested in infrastructure to comply with the localisation requirements of the government, do not unite to take any action to protect their interests.”

As well as government protectionism, the global credit crunch and new bank finance rules in China are also making themselves felt (page 11). “Many customers are facing difficulties reaching financial closure for their projects,” says Soares. Suzlon admits it has completed turbines languishing in factories still waiting to be delivered for lack of payment. A silver lining to that cloud is that this year Suzlon’s component suppliers can keep up with demand, says Soares.

Both Soares and Richterich insist they have no re-
gets about entering the Chinese market, which has seen them and their main competitors on the global stage, including Vestas, Gamesa, and GE Energy, spend millions building manufacturing plants in the country. “China is one of our key markets, and being successful here is important for the overall success of the company,” admits Soares, who hopes Suzlon can secure 8-10% of China’s market this year. Deliveries for the company so far in 2008 total 285 MW, he says. Suzlon has facilities in Beijing, where it employs 120, but its main production works, employing over 1000 people, is in Tianjin, where most of the other global leaders have also set up shop.

Suzlon produces 1.25 MW and 1.5 MW units in China, suitable for both low and standard temperature climates. “We can produce 600 turbines a year,” says Soares. “We are expanding our blade factory at the moment, but this is what we have planned for this year.” At present, Suzlon gets 80% of its components from inside China, using “the main suppliers everybody else has.” Towers have proved the most difficult item to source, he says.

For Nordex, there is no question of not being in China. “We firmly believe China will be the biggest market, certainly within the next five to ten years,” says Richterich. “Our first interest is to grab our part of the market and sell machines into China. There is huge potential.” Nordex is investing heavily to that end and is on course to install 200 MW this year. “Our €50 million expansion plan is on target,” says Richterich. The company already has a nacelle assembly factory in Yinchuan and a blade facility at Dongying. “We are just now investing €15 million to increase our rotor blade production in China and we are very close to finding a solution for nacelle assembly. Here we will either rent or invest in our own production facilities, but either way we are close to making that final decision. With those complete, we will double our capacity. We will be able to produce 300 megawatts on the blade side and the same for nacelles in 2009.” By 2011, Nordex expects to produce 800 MW a year in China (WINDPOWER MONTHLY, December 2007).

PRICES TOO LOW

If wind power purchase prices, which are set by government in China, do not improve, Nordex may export some of its Chinese production to other Asian markets, such as Vietnam. Like Soares, Richterich stresses that many Chinese companies are offering “unproven technology at low prices against our proven technology.” All of Nordex’s customers, the country’s big utilities, are buying turbines made by domestic and foreign companies, he says. “Say they buy 500 megawatts of Chinese technology, they are then also buying 100 to 150 megawatts of international technology so they can compare performance,” he says. “We hear from some of our clients that our turbines are performing better than the Chinese ones.”

Nordex employees 450 people in China and has set up training programs, with all Chinese employees expected to spend some time learning at the company’s German facilities. “We have also set up a knowledge academy in China with teachers from Germany,” he says.

Nordex is aiming to increase its market share in China to 15% by 2011 from 3% in 2006, a figure almost double what it managed in 2007. “In terms of market share, let’s be clear. Two years ago, when we first announced our plans and strategy, no one expected China’s market to grow so fast,” says Richterich. “It has been growing at 50-100 percent year on year. So yes, of course our market share per se will have inevitably decreased this year. But we feel we should not focus on market share. Our target is business volume.”

Nordex is only offering its 1.5 MW machine in China at present. “We believe it is very good for China, most notably with the transport issues there,” he says. “If we offered the 2.5 MW now, then we would have problems on this front to deal with. The better strategy is to build up a good supply chain for the 1.5 MW and then use that for the 2.5 MW eventually, but I do not think we will reach that stage for at least three years.”

THREE-PART STRATEGY

Once it has managed to establish a secure quality supply chain “we will look to sell some Chinese made turbines to some of the smaller up and coming Asia markets such as Vietnam and Taiwan, as well as Japan, Pakistan and even
India,” he says. “The third part of the strategy is then to use the structure in China to supply components sourced from China for units being assembled in Europe or elsewhere.” It is a strategy most international firms are now banking on when it comes to China, he notes.

Building up a quality supply chain is critical for the strategy to work, he says. “To do that, you need at least two suppliers for each of the critical components. These suppliers need to be tested and certified to international quality standards. At present there are just not enough companies in China that meet those standards.”

Gearboxes are one of the most difficult bottlenecks, he says. “Being able to produce one gearbox of quality is no good; they need to be able to supply 100 or more of consistent quality. So we have to look very closely at the production processes of suppliers to ensure sufficient standards.” Only one Chinese gearbox company, China High Speed Transmission, is in the process of implementing rigorous quality production processes, he says. “They are making great progress on implementing a quality mechanism throughout their operations. Others have come into the market but still have a long way to go.”

Nordex is hoping to convince European gearbox suppliers to set up in China, but Richterich fears it can take three to five years. “Even then there is still a lot to do to get the same kind of supply chain quality that we have in Europe. It is not just Nordex but some of our European competitors are also working to this end.”

Neither Vestas nor Gamesa responded to interview requests.

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**TOP FOREIGN SUPPLIER**

Spanish firm Gamesa was the top foreign turbine supplier to China in 2007, ranking third overall behind China’s Goldwind and Sinovel. Gamesa installed 560 MW to take its cumulative tally in the country to 1044 MW. The only company to have installed more megawatts in China by end 2007 was Goldwind, with just under 1500 MW. Orders received this year have increased Gamesa’s pipeline of committed projects in the country to around 1500 MW. The last addition was a €200 million agreement announced in July to supply 344 MW to China’s leading developer, China Longyuan Electric Power Group Corporation, a long-standing Gamesa client.

The company has four production plants in China, all located in Tianjin. Here Gamesa produces nacelles, gearboxes, generators and blades for its 850 kW machine, with an annual capacity of 700 MW. Investment in China amounts to nearly €40 million and has created 1000 jobs, it says. Chinese sales represented 15% of Gamesa’s total 2007 sales, up from 11% in 2006. Of the 8000 MW Gamesa had committed to customers at the end of 2007, China accounted for 1120 MW, or 14% of the total.

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For foreign companies, one area of China’s market where opportunity is strong is component supply. Chinese competitors are growing in number and strength, but so is the demand for wind equipment. “While downstream wind capacity has been growing at nearly 96% per annum since 2005, upstream suppliers have not been able to expand at the same pace,” according to Lehman Brothers, an investment bank, before its recent collapse.

So far, supply has met demand, according to Denmark’s BTM Consult, an information provider to the international wind industry. In 2007, Chinese component suppliers met 90% of the demand for 600-750 kW machines in the country and 70% for 1.5 kW models, it reports in its World Market Update for 2007. Globally, China’s expanding wind equipment business is also doing its bit to alleviate shortages, with production of castings in China meaning that supplies worldwide are just keeping pace with demand, says BTM.

A leader among Chinese component suppliers is China High Speed Transmission (CHST), a company with big overseas ambitions and the dominant gearbox supplier for wind turbines made in China, serving both domestic and international companies alike. Formerly known as Nanjing High-Speed & Accurate Gear Group, CHST produced more than 1300 gearboxes in 2007, with that rising to 2400 this year. With a market capitalisation value of $2396 million, in July it became the first Chinese gearbox firm to list on the Hong Kong Stock Market.

“As the dominant supplier of wind gearboxes, which are facing a severe shortage of supply globally, we believe CHST is the best positioned to capture the tremendous potential of the wind sector in China,” says Lehman in its report, “China’s Great Transition: Taming Inflation, Cleaning up the Environment; Building Infrastructure,” released in August. “Backed by its strong bargaining power along the value chain, we believe CHST can pass through increases in steel costs and maintain stable margins.”

The other main Chinese gearbox supplier is Chongqing Gearbox, a company affiliated to China Shipbuilding Industry Corporation (CSIC). In combination, CHST and Chongqing met nearly 80% of demand for gearboxes for wind turbines made in China last year. Hangzhou Advance Gearbox Group rounds up the domestic top three in component supply, with an annual manufacturing capacity of 500 gearboxes for 1.5 MW machines.

BTM notes though that for gearboxes “current production capacity in China can only meet half of its growing demand.” This year, Hansen Transmission, a Belgian gearbox supplier owned by Suzlon, took the bait, announcing plans to build a €200 million factory in Beichen Hi-tech Industrial Park in Tianjin (WINDPOWER MONTHLY, April 2008). From a production start next September, it will reach full capacity in 2011, providing gearboxes for 3000 MW of wind power capacity.

Meanwhile, UK gearbox specialist Romax Technology is working with Dalian Huarui, the gearbox sister company to Chinese turbine manufacturer Sinovel. Together they are designing gearboxes for 3 MW turbines being developed by Sinovel. “This collaboration will bring a global perspective to our business and we are very confident that Dalian Huarui will become a significant player in the production of gearboxes worldwide,” says Dalian’s Chen Lixin. Romax is particularly active in China. Earlier this year it completed a joint project with turbine manufacturer Baoding Tianwei to design the main rotor bearing housing for a 1.5 MW wind turbine.

Rotor blades supply in China has increased rapidly. “China has mastered the technology of blade manufacturing and has seven companies able to mass produce blades for turbines of up to 1.5 MW capacity,” says BTM.

Most of the leading global turbine manufacturers have established blade facilities in China, as has world leader LM Glasfiber. It has two factories, one in Urumqi in Xinjiang and the other in Tianjin, where a large proportion of China’s international wind turbine industry is based. In 2007 LM signed a strategic agreement, lasting a minimum of six years, with China’s leading turbine sup

**Team work:** Erecting the prototype of the Guodian United Power 1.5 MW turbine at the Shiren wind farm in Tuoqizhuang near Shangyi, Hebei
plier, Goldwind, for its 1.5 MW machines and eventually for its 2 MW or bigger models.

The leading domestic blade firms are CCGC Lianzhong Composites Group Corporation, Sinoama Science and Technology Wind Power Blades Joint Stock Company, Shanghai FRP Research Institute and Zhonghang (Baoding) Huiteng Windpower Equipment. CCGC, Sinoama and Zhonghang Huiteng are working to expand their annual production capacity to 1000 blade sets by the end of this year. Shanghai FRP expects to expand its annual production capacity to 550 sets in 2009. By the end of 2009, Chinese blade factories will have the capacity to produce blades for more than 6 GW of turbines, according to a recently released global supply chain assessment by BTM.

BEARINGS, GENERATORS

“For main bearings, China is almost entirely dependent on imports,” says BTM. It also notes that this is the component that globally is in short supply. International companies SKF, FAG and Timken, the wind industry’s three major bearing suppliers, will continue to do well in China, agrees Lehman. With the construction of its own production facility in Shenyang province, SKF is a step in front.

In sharp contrast to the bearings industry, domestic suppliers dominate China’s wind turbine generator market. The leading companies are Yongji Electric Machine Factory, Lanzhou Electric Corporation, Harbin Electric Machinery, XEMC Xiangtan Electric Motor, Shanghai Electric Motor and Zhuzhou CSR Electric Motor.

CONTROL SYSTEMS

“Electrical control systems are the weakest sector in terms of domestic supply, even though at least six suppliers have entered the market,” says BTM. “In terms of electrical control systems, China has little experience and many enterprises are still doing research on the road to producing mature products,” agrees the 2007 China Wind Power Report, produced by the Chinese Renewable Energy Industries Association with the Global Wind Energy Council and Greenpeace. “Enterprises currently in the research process include the Institute of Electrical Engineering Chinese Academy of Sciences, Hefei Sunlight, Xuji Electric Company and Nanjing Automatic Research Institute.”

China’s suppliers

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>NO OF SUPPLIERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blades</td>
<td>7</td>
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<tr>
<td>Gearbox</td>
<td>4</td>
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<tr>
<td>Generator</td>
<td>9</td>
</tr>
<tr>
<td>Bearings</td>
<td>4</td>
</tr>
<tr>
<td>Towers</td>
<td>10</td>
</tr>
<tr>
<td>Control items*</td>
<td>6</td>
</tr>
<tr>
<td>Cast iron items</td>
<td>16</td>
</tr>
<tr>
<td>Forged items</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>66</td>
</tr>
</tbody>
</table>

*Electronic control equipment

SOURCE: BTM CONSULT

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- Wind shear
- Flow inclination angle
- Fast linear flow model
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- Visual Basic scripting
- Windfarm Assessment Tool

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**WAsP 9 highlights:**

- Nested wind farms
- Reference site in wind farm
- Wind farm power curve
- Spatial image overlay
- Resource grid masking
- Resource grid performance improvements
- Grids of ΔRIX values
- Obstacle effects in resource grid calculations
- Annotations in workspace
- Enhanced Map Editor with complete roughness map consistency checks
- New Climate Analyst tool

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**Rise DTU • Wind Energy Division • Roskilde • Denmark • Phone +45 46 77 50 97 • wasp@risoe.dk**
Steve Sawyer, secretary general of the Global Wind Energy Council, reflects on the astonishing growth he has witnessed in China’s wind market over the past five years and on what needs to be done to maintain the momentum.

“"The history of the wind power industry has been one of very optimistic projections which are then promptly exceeded by reality." When the Prime Minister of Schleswig-Holstein, Peter Harry Carstensen, uttered these words at a forum on the New Energy Economy, organised by the Global Wind Energy Council (GWEC) on the margins of Germany’s recent Husum Windenergy trade fair, he could have been talking about China. Nowhere does his description fit better. Driven by a tremendous increase in electricity demand, a desire to create a domestic industry, energy security concerns (China has recently become an importer of oil, gas and coal), the need to reduce the dreadful air pollution that plagues so many Chinese cities, and the recognition of the looming threat of climate change, government officials in China have created the conditions to allow the industry to take off.

On my first trip to China five years ago, it had less than 500 MW of installed wind power capacity. We visited a small wind farm on Nanao Island, comprising a collection of turbines ranging from under 100 kW to 500 kW in capacity. They looked almost quaint compared with the megawatt scale machines hitting the mainstream in Europe at that time. Large scale development seemed a long way off. Four years later, total installed wind capacity had increased by more than a factor of ten, and by the end of 2008 it will have increased by 20 times in five years. Talk about exceeding even the most wildly optimistic projections.

When GWEC launched a Chinese translation of Wind Force 12 in May 2004, we didn’t know what to expect in response. The press conference was held in conjunction with an expert consultation on the new Renewable Energy Law, then at the drafting stage. Much to our surprise, we had a positive response from government officials and the press response was overwhelming. While the support and enthusiasm for wind power was palpable, when it came to our projections, the officials were polite, but in the end totally dismissive. More than 100 GW of installed capacity in China by 2020 at that time seemed an impossible dream. The official government target was 20 GW by 2020.

FASTER THAN HIGH GROWTH

In late 2005, we launched another set of projections resulting from a study done, on our behalf, by experts in China’s National Development and Reform Commission. They came up with a target of 40 GW by 2020. That same week, the government increased its 2020 target to 30 GW. We knew 2005 was going to be a good year, but we were not aware it would be the year the market was going to start taking off in earnest, increasing by almost 500 MW in a single year.

Despite a last minute decision by senior government officials to suspend the implementation of the fixed power purchase prices identified in the new Renewable Energy Law, its entry into force at the beginning of 2006 sparked a new round of development. During the course of that year, installed capacity more than doubled, reaching almost 2600 MW. After increasing installed capacity by 65%
in 2005 and 106% in 2006, the market recorded more astounding growth in 2007. It chalked up an astonishing 127% increase, reaching almost 6000 MW.

China has not only grown its wind market faster than any other, but also its domestic wind industry. Already by 2007, a group of Chinese wind turbine makers, headed by Goldwind, Sinovel, Dongfang, Windey, and Shanghai Electric, took about 55% of the entire market, with most foreign competitors losing market share as a result. The question now is not if, but when, Chinese manufacturers will become players in the global market. In fact, it is already happening.

From just under 1.5 GW in 2006, manufacturing capacity in China tripled to about 4500 MW in 2007, and it is expected to double again this year. This means that by the end of 2008, China will be host to the largest wind turbine manufacturing industry in the world, attracting massive investment by sub-suppliers, both domestic and international. By the end of 2010, existing plans for plant construction and expansion mean there will be more than 13 GW of annual manufacturing capacity in the country. The question is, how much of this will go to feed the apparently insatiable domestic market and how much will be destined for overseas?

GWEC released its latest set of projections in the margins of Wind Power Shanghai in late 2007, showing a “high growth” scenario which would see the industry reaching just over 13 GW installed capacity by 2010, about 49 GW by 2015, and 122 GW by 2020. Less than a year on, it appears the industry is outstripping that pace yet again. While the government has just raised its 2010 target from 5 GW to 10 GW, it seems clear that milestone will be reached before the end of 2008, implying our 2010 target will be reached by mid 2009. Further, the once apparently impossible dream of over 100 GW by 2020 is getting close to becoming government policy. An August 2007 Renewable Energy Development Plan calls for 3% of total electricity generation to come from non-hydro renewables by 2020. The clear implication is that somewhere in the vicinity of 100 GW installed capacity of wind power would be required.

ALL IS NOT ROSES

None of this will come to pass automatically. All is not roses in this booming market. As this Special Report documents, getting wind power onto the electricity network is increasingly difficult in some areas (page 4). Serious problems have also been caused to the big five major Chinese utilities by the government’s freeze on electricity prices. Profits are down and some even lost money in the first quarter, primarily because of significantly increased domestic coal prices. While the government revised electricity prices upwards in response to the concerns of the Big Five, with their profit margins under continuing pressure they have little incentive to invest more in wind project development or encourage further grid investment. Meanwhile, the government’s effort to combat rapidly rising inflation has had a direct effect on financing wind projects (page 11).

There has been some improvement in prices paid for wind power, with the central government approving what amounts to fixed power purchase prices on a province by province basis. But the pricing system is still far from transparent and new rules with “unwritten” operative clauses threaten to skew the market even further. Another barrier is the restriction on foreign ownership of projects before they can receive approval for carbon market funding. The rule makes it all but impossible for international developers to get profitable projects off the ground without a 51% Chinese partner.

Wind power in China is one of the great success stories of the Kyoto Protocol’s Clean Development Mechanism (CDM). Globally, at the end of September there were 235 projects accounting for more than 19 GW lined up to offset emissions in the West, with about 12 GW of those in China. The aggressive posture of the Chinese government to make the CDM work for China includes making sure that without CDM credits, a wind project cannot be profitable. This is exactly what the CDM was in-

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### Projected wind development

#### Predicted scenarios to 2050

<table>
<thead>
<tr>
<th>YEAR</th>
<th>SCENARIO</th>
<th>CUMULATIVE (GW)</th>
<th>NEW INSTALLED (GW)</th>
<th>CAGR (%)</th>
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<tbody>
<tr>
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<td>Low</td>
<td>2.6</td>
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<td>8.0</td>
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<td></td>
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<td></td>
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<td></td>
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<td>6.40</td>
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<td></td>
<td>High</td>
<td>611.3</td>
<td>18.21</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Source: GWEC/CHINA WIND POWER REPORT 2007

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## Annual average compound annual growth rate
tended for: to defray the marginal costs of less carbon intense production.

The complexity of the mechanism’s application and reporting requirements, however, as well as the controversial and methodologically difficult “additionality” requirements, have created calls for China to take the next step and consider a crediting mechanism for the electricity sector as a whole. Under such a mechanism, the emissions of the whole electricity sector would be taken into account. A “no lose” target would be established, which the Chinese electricity sector would aim to meet via national policies and measures. Emissions reductions below that would be eligible for carbon credits. This would provide an incentive for all forms of clean electricity production, with the bonus of a built-in incentive for increasing energy efficiency, simplifying the system and creating the opportunity to ramp up the scale of investment substantially.

STEPPING OUT ON CLIMATE CHANGE

China has in fact stepped out internationally on climate change and has taken some serious domestic measures to back this up. Beyond a target for 10% of primary energy from renewables by 2010, increasing to 15% by 2020, it intends to increase the energy efficiency of the economy by 20% during 2006-2010. As part of this effort, 13 GW of old, inefficient coal fired power plant will be shut down during 2008 alone, with a total of 50 GW of old plant to come offline during the five year period. China now has the most rigorous automobile fuel efficiency standards in the world and some very progressive energy efficiency legislation on the books, although enforcement seems to be a problem in some areas.

China has passed the United States as the largest emitter of CO$_2$ and is under increasing pressure internationally on this front. Its package of domestic policy measures, however, combined with enhanced carbon market mechanisms under a post-2012 UN climate agreement, make China look pretty good when stacked up against other major emitters. It is not yet enough, of course, and a step change in global efforts in this area is required. China seems prepared to do its part. That can only be good news for the wind industry.
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