

中國腳踏車的天堂再現

## CHINA'S CYCLISTS TAKE CHARGE

ELECTRIC BICYCLES ARE SELLING BY THE MILLIONS DESPITE EFFORTS TO BAN THEM **BY PETER FAIRLEY**

It's 8 a.m. and Shanghai is moving.

For the cars and trucks crammed together on the elevated highway cutting through downtown, it's a slow crawl. On the smaller roads below, traffic is rolling at a steady 10 to 15 kilometers per hour in what looks like a more traditional Chinese street scene. Vying with the cars and trucks for the same strip of pavement are a motley assortment of two- and three-wheeled vehicles—everything from simple steel-frame bikes and heavily laden pedal-powered carts to motorized scooters.

Hidden within this stream is an entirely novel, homegrown class of commuter vehicle: electric bikes and scooters [see photo, "Moving"]. There are an estimated 1 million electric two-wheelers on Shanghai's streets; yet to the Western observer it is only what's missing that gives them away. Some look like scooters, but they have no tailpipe spewing exhaust, no sputtering engine. Some look like fanciful bicycles, but their pedals are oddly still as riders relax and let the battery-powered electric motor whisk them to work.



**MOVING:** A man rides an electric bike along Sichuan Road in Shanghai, near Nanjing Road. Sichuan is one of the few crosstown roads in Shanghai that still allow bicycle traffic.



For all the talk of China's growing infatuation with automobiles, the world's most populous nation continues to roll primarily on two wheels—and, increasingly, an electric motor drives them. The China Bicycle Association, a government-chartered industry group in Beijing, estimates that last year manufacturers sold 7.5 million electric bikes nationwide—nearly double the sales in 2003—and they are likely to ship more than 10 million this year. That's three times as many as the most optimistic projections for auto sales in China.

There's a powerful desire for motorized personal transportation in China as its cities sprawl. The electric bicycle is an attractive option for commuters, service people, and couriers [see photo, "Pizza! Pizza!"]. At 1500 to 3000 yuan (US \$180 to \$360), an electric bike is buyable at a small fraction of the cost of an automobile. It

propulsion-technology firm WaveCrest Laboratories LLC, in Dulles, Va., and an authority on electric-bicycle markets. "The question is: what are we going to do with them? I'd say we don't know yet."

**A BLEND OF NECESSITY AND OPPORTUNITY** kick-started China's first electric-bike manufacturer, Shanghai Cranes Electric Vehicle Co., based in the Pudong section of Shanghai. The company descends from a venture-capital arm of the Shanghai government that had been investing in electric-drive technology in a bid to lead a new national electric-automobile R&D program. When Shanghai lost the automobile research bid to Guangzhou in 1994, Shanghai's EV team turned to electric bikes, a type of vehicle that had begun to pop up on Japan's streets the year before.

A beta test of 100 of Shanghai Cranes' prototype bikes in 1995 revealed that a lot more development work would be needed. In barely three months of use, the motors burned out and the lead-acid batteries—designed to be removed from the bikes and taken inside for plug-in charges—no longer could take a charge. But the beta testers found the bikes a blast to ride and handy for carrying parcels, suggesting that a more durable product would find a ready market. When Shanghai banned sales of gas scooters (and their polluting two-stroke engines) in 1996, Cranes was spun out of an R&D incubator to fill the market void.

Zhang Min Wei, Cranes' reserved general manager, becomes animated when recalling the 1997 rollout of the company's first products. They were conventional bike frames outfitted with a 150- or 180-watt hub motor in the front wheel, a 24-volt, 7-ampere-hour lead-acid battery on the rear rack, and a simple electronic controller on the handlebars.

Performance was much improved from the beta bikes: the motors went well beyond the three-month mark, and the batteries,

now rated for about 300 charges, could carry the bike as far as 50 km on a charge with minimal pollution. Joule for joule, electric bikes carry a single driver with 15 to 20 times greater efficiency than that of an average small car. As a result, a Chinese bike generates just a fraction of the air pollution and carbon dioxide emitted by a car. "People were very curious," says Zhang, who recalls extensive media coverage, including a Japanese TV news report citing Cranes' electric bikes as proof that China was finally tackling its air pollution problem. The company's three dozen employees felt like heroes cleaning up the city. "We were very proud of the product," he says.

Sales mounted, and Cranes' success attracted competition, bringing both start-ups and conventional bike manufacturers, such as T & D Continental Dove of Nanjing and Shanghai Forever Co., into the market. Today the China Bicycle Association estimates there are an astounding 800 companies manufacturing electric bikes, many of them local operations producing a few thousand bikes per year.

Producing 50 000 bikes a year with a workforce of 210, Cranes is one of the few businesses that can sustain an R&D operation. But because of China's weak protection of intellectual property, the innovations made by companies like Cranes spread quickly, lifting the entire industry. While Taiwanese competitors complain of



**PIZZA! PIZZA!** Electric bikes equipped for deliveries are lined up outside a Pizza Hut franchise in Shanghai. This kind of transportation is increasingly favored for deliveries in cities and towns.

is also exhilarating. Hop on and crank the throttle, and an electric motor built into the hub propels you to speeds of 20 km/h or more.

Despite the obvious appeal of electric bikes, some Chinese cities have banned them altogether, alleging environmental drawbacks and concerns about public safety. But that hasn't stopped millions from buying electric two-wheelers in China—an astonishing development for advocates who have struggled for a decade to build a market for electric bikes in the United States and Europe.

"It is the dawn of a new era in electric bicycles," says Frank E. Jamerson, a former leader in electric vehicle R&D at General Motors Corp. whose Naples, Fla.-based consultancy recently completed a worldwide review of developments in light electric vehicles. "The electric bike is now a real player." Jamerson says China's electric bicycles accounted for roughly three-quarters of the electric vehicles (EVs) sold worldwide last year.

"Courtesy of the Chinese domestic market, we now have very cheap electric propulsion systems that will move a human being," says Ed Benjamin, vice president of the Light Transport Division at electric-

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patent infringement, Chinese managers such as Cranes' Zhang take copying of their designs in stride. More R&D is the only solution, he says, because fighting the smaller companies and the local governments that protect them is futile. Since jobs and taxes depend on the prosperity of the patent-infringing firm, the local authorities always "will find a way to protect this kind of factory," he says.

The net result is on display at Shanghai's Crown Bike Shop, the city's leading outlet for electric bikes. On a chilly Monday morning in February, customers filter into Crown's storefront in northwestern Shanghai, its sales floor crammed with shiny new battery-powered bikes and scooters from a dozen manufacturers. Walking



**COMING OFF THE LINE:** A worker inspects an electric bicycle just assembled at the Luyuan EV factory in Jinhua.

the floor, general manager Liu Da Wei points to the improvements he has seen since 1997: geared and usually brushless motors that deliver higher torque, electronic controllers that have outgrown their reputation for frighteningly erratic behavior, and lead-acid batteries that deliver a range of up to 60 km and last up to two years.

The look of the electric two-wheelers has changed even more. In the early days, the electric bike looked like, well, an electrified bike, and flashier renditions of that design are still available at Crown. But the bigger sellers now are lower, wider models reminiscent of a Vespa scooter, with a large platform handy for resting feet as well as packages; minimal pedals (or none at all); and, in some cases, more powerful batteries and motors that boost the top speed from 20 or 25 km/h to close to 30 km/h. Liu says these electric scooters accounted for roughly two-thirds of the 6000 EVs Crown sold last year.

Who is buying Crown's electric bikes and scooters? Liu says it's a healthy slice of Shanghai society: commuters whose trips have extended as the city has swelled during the last decade, delivery and salespeople who crisscross neighborhoods, elderly men and women

running low on pedal power, expectant mothers, and even students (with help from their families). They all want a faster, easier ride than they get with a conventional bike.

Why don't they use Shanghai's extensive bus and subway lines? Liu says electric bikes beat subways for convenience, buses for speed, and both when it comes to health concerns: the overcrowded transit system is feared for its potential to spread disease. Liu says Crown's sales spiked during the SARS epidemic that emerged in China in the spring of 2003.

As a rule, disruptive technologies provoke resistance from other market players and their government supporters. Electric bikes fit that mold. Automotive and motorcycle manufacturers, transit operators, and government officials have slowed or stopped the growth of the electric bike in such major cities as Beijing and Guangzhou. Even the China Bicycle Association, which purportedly represents bike makers, has sought to discourage manufacturers from adopting faster scooter designs.

Despite the electric-bike industry's decade-long history and commercial success, it was only last year that China's National People's Congress amended the national road safety law to officially give electric bikes a right to use the roads. The legislation legally equated them with conventional bicycles. Wherever bikes can go, electric bikes can follow. But the amendments included an important caveat: municipalities have the final say on whether to give electric bike permits to their residents, and some have refused to do so.

**IN REJECTING ELECTRIC BIKES**, the municipalities cited such concerns as the threat of pollution from spent lead-acid batteries, interference with automobiles resulting in accidents or slowed traffic, and the impact on the viability of public transit systems. Advocates for green transportation say these arguments amount to thinly veiled attempts to protect the electric-bicycle industry's competitors. "The real reason is competition from interest groups," says He Zuoxiu, a renowned theoretical physicist and academician at the Chinese Academy of Sciences.

An outspoken figure in public debates around environmental and energy policy, He says none of the arguments against electric bikes has merit. Lead-acid batteries, he points out, are used in cars, too. "The real pollution source is not the electric bikes, it's the automobiles," he adds. And he says transit operators and manufacturers should be forced to compete with the electric bikes by offering more efficient services and cheaper, cleaner vehicles. The problem, he explains, is that electric-bike manufacturers are insignificant next to the other interest groups, particularly the car makers that are attracting billions of dollars of foreign investment. The automotive industry is identified as a "pillar industry" in China's official five-year plans.

Although the odds against them are daunting, electric-bike manufacturers are pushing back, with surprising success. The mastermind of one of the most high-profile battles is Ni Jie, president of Luyuan Electric Vehicle Co., a privately owned manufacturer that has a pragmatic approach to the market, a sizable R&D effort, and an ambitious vision for Chinese EV technology.

Luyuan EV, like Cranes, was a government venture-capital spin-off. Building from a prototype put together nine years ago by Luyuan's general manager, Hu Ji Hong, Ni's wife, Luyuan went private after Ni, Hu, and other principals bought out the initial investors. They have built a dynamic company that sold 120 000 electric bikes and scooters last year and expects to sell 300 000 this year [see photo, "Coming Off the Line"].

To find Luyuan EV, you must head off the beaten track to Jinhua, an industrial metropolis of 1 million people that is tucked into the





**THE BASIC BIKE:** The electric motor is in the rear wheel hub, and the removable battery is in the platform between the wheels. The electronic controller is between the handles.

unbroken sprawl south of Shanghai that is Zhejiang province. In the chairman's spacious corner office (one of the few heated rooms at Luyuan on a cold February day), Ni chain-smokes, sipping from a seemingly bottomless jar of well-steeped green tea. He says traffic is the top concern in many Chinese cities, and the electric bicycle fills a void by offering an affordable alternative to sitting in a stationary car or bus. "If governments don't have the solution, the people will behave in their own ways," says Ni. "There's no way to stop that."

Ni took people power to surprising limits in 2003 when officials in Fuzhou, the capital of neighboring Fujian province, decided to ban electric bicycles—shutting off what until then had been one of Luyuan's best markets. The city not only ceased issuing licenses for electric bicycles but also seized 20 electric bikes from a bicycle shop in the summer of 2003. Ni gathered a coalition of 126 electric-bike manufacturers and filed suit against the city in its own municipal court. The coalition scored a partial win against the city government, forcing it to return the seized bikes.

Far more valuable, says Ni, was the sympathetic coverage they received from national media and the warning that attention sent to other municipalities. "What we told other governments is that if they do the same as Fuzhou, there will be some trouble," he says.

Conflict over electric bikes isn't limited to the municipalities and the manufacturers. Even the China Bicycle Association has been clashing with some companies, including Luyuan, over what types of electric two-wheelers should be on the road [see photo, "The Basic Bike"]. The bike group enforces a national standard for electric bicycles, and whichever parameter you choose—weight (no more than 40 kilograms), width (220 millimeters for the pedal shaft), speed (20 km/h, maximum)—many of the latest electric scooters either flunk or thwart the standard.

Lots of electric scooters, for example, are outfitted with non-functioning pedals and with speed-limiting devices designed for easy removal after purchase. Luyuan's latest machine doesn't just skirt the electric-bike standard; it rumbles right over it. Luyuan calls its new product the LEV, short for light electric vehicle, and Ni

openly admits that it's more than a bicycle. Luyuan's Web site calls it an *electric motorcycle*, and that seems fitting: the LEV weighs in at 95 kg; its 48-V, 20-AH battery packs double the energy of the standard bike; and its 500-watt CPU-controlled motor propels it to 35 km/h.

The LEV has no official status in China. Nevertheless, on what should be a slow sales day at a Luyuan retail outlet in downtown Jinhua, the LEVs are flying out the door. In the space of an hour, one is snapped up by a 25-year-old man, and a working mother rolls out with another. Why did she choose an LEV? She drives her rather big-boned son to school and prefers an LEV to a gas-powered scooter, pointing to the endemic air pollution hanging over the city.

Ni is betting that governments will sanction the LEV if it proves popular. He says he believes that Luyuan has addressed the one concern municipalities could level against the LEV that

might have stuck: reduced safety due to the cycle's greater weight. The LEV employs an electric drum brake that, Ni claims, stops it faster than the cantilever brakes used on garden-variety electric bikes could. A regenerative braking system is also in the works that would boost braking power by using the in-hub motor as a generator to pull energy out of the wheels, extending the vehicle's range by simultaneously charging the battery.

Ever the entrepreneur, Ni sees the success of the LEV as a step toward bigger and better things. He already has his eye on the market for small delivery vehicles, and he even imagines Luyuan making electric cars and challenging the major automakers. "They are investing money, saying we are going to change the gasoline system to electric," he points out. "But will the big companies really be willing to destroy their own factories to build the new ones?" In Ni's view, small, aggressive Chinese companies like Luyuan are more likely to drive the EV revolution, because they have nothing to lose.

Wang Feng-he, executive director of the China Bicycle Association, has little patience for Ni's vision of the EVs' future. Wang says his association's mandate is to represent the bike industry's interests, and in his view, vehicles that violate the standard could do damage. He fears a regulatory backlash if riders of powerful two-wheelers like LEVs suffer serious injuries in accidents, which would hurt the entire industry by undermining the electric bicycle's right to the road. "If the electric bicycle moves toward the motorcycle, we will lose the ability to be classified as a bicycle," he says.

Wang is pushing for amendments to the national electric-bike standard to close its loopholes. But Luyuan and other manufacturers have other ideas, advocating revisions that would boost the electric bike's top speed to reflect current consumer demand. At the moment, the debate is gridlocked, and vehicles such as the LEV keep rolling off assembly lines and onto China's buzzing, teeming streets.

**THE BIGGEST CHALLENGE** facing electric-bike makers may not be municipal bans, conservative standards, or even technology. It may be the roads. China is following the development path of

Western countries like a map, rapidly redesigning its cities around the automobile. Across China, cities are rejecting a mixed-use model and redeveloping along a strict zoning model, razing residential buildings in center cities to make way for shiny office towers and paving farmland on the periphery to create large industrial parks. Displaced from the urban centers, houses and other residential buildings are springing up in sprawling suburbs, just as they did in the West decades ago. The automobile is king in this model, because in the absence of extensive public transit, cars are the only way to get from distant suburbs to offices and industry parks.

To make way for more cars, China's cities are widening their main roads and building highways. The result has been a rapid increase in automobile use that, just as it does everywhere else in the world, almost instantly absorbs the extra roadways. The resulting gridlock has been especially acute in China's capital. Beijing had 1 million cars in 1997 and was once expected to reach 2 million in 2008. Instead, it hit 2 million last year and now expects 3.5 million to be in use in 2008. "All over the country, they believe that wider roads are more efficient for traffic. They're wrong," says Yu Kongjian, an urban planning expert at Beijing University.

Car culture is a disaster for the bicycle. Road widening often comes at the expense of bike lanes, while highways are off-limits to bikes and nearly impossible to cross. On the smaller roadways, rush-hour traffic blocks the bike lanes and intersections, prompting outbursts of road rage from frustrated cyclists. Yu used to cycle 20 to 30 minutes between work and home, but he now drives—a 10- to 60-minute trip, depending on the traffic. "It's too dangerous to bike, so people give up. I gave up," he says.

Yu is confident that, in the long run, it is the gas guzzlers that will be forced to give way. One reason is gridlock. Another is China's endemic urban pollution [see photo, "Pea Soup"]. On all but the best days in Jinhua, for example, the city skyline disappears behind a dense haze of smog and particulates; more and more of that atmospheric soup is pouring out of tailpipes.

It's the strategic cost of petroleum that inspires professor He's confidence in the electric bike. China's oil imports are on the same exponential growth path as its car fleet. China has eclipsed Japan as the second-biggest importer of oil, bringing it into direct competition with the world's leading consumer of petroleum: the United States. With import dependence and environmental burdens in mind, China has promulgated fuel-efficiency standards that are stricter in principle than those currently in force in the United States, and it is considering imposition of a 20 to 50 percent national tax on retail gasoline and diesel.

**IF CHINA CAN FIND A WAY** to make relatively efficient electric bikes a significant part of its transportation system, it could have major repercussions elsewhere in the developing—and developed—world. That includes the United States, which has the world's most car-dependent culture. Unlike Japan and Europe, where bicycles, trains, and other forms of transportation still thrive, the United States is one of the few places where people move almost exclusively by car. As WaveCrest's Benjamin puts it, "We live in a bubble."

That bubble has been unkind to electric-bike promoters like Benjamin. The big roads and vast distances that many Americans navigate are a hindrance—so much so that they have altered the way people perceive the bicycle. Electric-bike consultant Jamerson says that to most U.S. drivers, a bicyclist on the road is just a nuisance. And to most bicyclists and bike dealers, the bike is an exercise machine or a toy. Why would they want one with an electric motor?



**PEA SOUP:** Pollutants from factories, buildings, and—increasingly—automotive traffic make smog more the rule than the exception in China's cities.

Still, there are some hopeful signs. Some U.S. cities are installing bike lanes and paths in a bid to woo drivers to bicycles. And at U.S. specialty vehicle shops, electric bikes are increasingly available, including bikes from Cranes and other Chinese producers. In Canada, Luyuan distributors recently secured changes to the Motor Vehicle Safety Act to allow electric bikes traveling at less than 32 km/h to use the road without license or insurance.

Another promising sign is that U.S. and European technology developers are increasingly offering high-end bikes in a bid to redefine motorized bikes as muscular machines. WaveCrest's snappy TidalForce bikes have electronically modulated motors that supply an incredible 90 newton meters of torque (compared with 10 for the average Chinese bike's motor).

Meanwhile, Vectrix Corp. of Newport, R.I., says it will soon introduce an electric motorcycle that will put the LEV to shame. According to Vectrix, the vehicle will sell for about \$8000, cruise to 100 km/h, and have a range of more than 110 km. It will require a motorcycle license, at least in the United States.

Benjamin says these are early days for the electric bike—the equivalent of 1903 or 1904 for the auto industry, when people still doubted that cars would replace the horse and buggy. Eventually, he says, the electric bike will have its day in the West, thanks to the same forces cited by professors Yu and He. In fact, in Benjamin's view, the transition has already begun: "I tell people that the human race is going to buy a hell of a lot of two-wheeled electric vehicles, and they ask, 'When is it going to happen?'" Well, it's happening right now in China. ■