Ecology

IN CONSERVATION

SLIME POWER

GREEN ENERGY THAT'S ACTUALLY … GREEN

by Christopher Dennis

Sun. Wind. Water. Algae? When people think of renewable energy, the slimy green scum lining ponds and sewers is not exactly the first thing that jumps to mind. But the scum of the earth might just be the planet's new hero – algae fuel holds the potential to become a new, carbon-neutral energy source that could replace fossil fuels, greatly alleviating global warming and the world's energy crisis.

Turning green to gold

In this emerging industry, algae is cultivated, harvested and then converted to fuel using a process called transesterification, which is the same process used to convert vegetable oil to diesel engine fuel. It yields roughly 30 times more oil per acre than corn and soybean crops. Using algae as fuel is no new idea – the US Department of Energy studied its feasibility for nearly two decades, beginning in 1978. They gave up in 1996, deciding that it could not compete economically with fossil fuels. Since then, however, the price of oil has gone up substantially, and the incentive to switch to environmentally friendly fuels is growing as rapidly as our ice caps are melting.

Algae can be grown in either closed, indoor systems or open ponds. As it grows, it absorbs carbon dioxide and uses the power of the sun to create lipids or carbohydrates that can then be harvested and converted to many kinds of oil, including biodiesel, ethanol, hydrogen and methane.

Burning algae fuel is carbon-neutral, since the CO_2 it releases has all been sequestered from the atmosphere to begin with. Since the fuel it creates would be a substitute for fossil fuels, carbon dioxide would be cycled through the atmosphere rather than newly introduced to it, as happens when gas or oil is burned.

Moreover, because algae can be grown anywhere sunny – not just on arable land – it would not compete with food production, as do fuels from corn and soybeans (i.e. edible feedstocks). When not carefully monitored, the planting of edible feedstocks can cause famines in areas that already have food shortages (in 2008, rising food costs related to biofuel production caused riots in Egypt, Haiti, Indonesia and Mauritania). Algae even grows very well in sewage water and agricultural runoff, which holds enormous potential for public waste management as well as bioremediation.

> Algae fuel's advantages over other biofuel feedstocks lie in what it *doesn't* do

Hurdles to implementation

Currently, algae fuel is admittedly expensive. The cost of cultivation and harvesting is high, equipment for closed systems is expensive, and open pond systems are susceptible to disease and infection. This results in a price tag much higher than other biodiesel feedstocks or crude oil. Today, algae fuel costs anywhere from two to 16 times more per gallon than crude oil.

However, this is a new and rapidly growing industry, and several large oil companies have acknowledged its potential through recent large investments in the industry. For example, Exxon Mobil has committed USD 600 million to developing algae fuels.

Algae fuel in China

Given China's newfound preoccupation with eco-friendly energy sources, it's not surprising that there is already a movement towards developing algae fuel here. The Chinese innovation group ENN is making large investments in algae bioreactors – not only as a potential source of energy, but primarily to help sequester carbon from China's coal-fired power plants.

There's also foreign investment. Arizona-based Petrosun has recently announced an international venture to establish an algae farm in China. The company says it has an agreement with Jun Ya Yan Technology Development Co. of Shanghai, which will commit USD 40 million to fund the Chinese farm.

Algae's advantages over other biofuel feedstocks lie in what it *doesn't* do. It eliminates the moral dilemma of increasing the price of food crops, and its ability to grow on wastewater means it will effectively treat dirty water while leaving our precious supply of freshwater untouched. Best of all, it introduces no new greenhouse gases into the atmosphere.

It may sound ideal, but algae fuel on a commercial scale is still some years off. Its viability as a renewable fuel depends entirely on how quickly the technology it involves can be made affordable. Hopefully, this will happen before we can't afford for it not to.

PHOTO: MARY DENNIS

Fossil fuel can be hard to afford in rural areas

Positive Energy

Sustainable energy – expensive, but profitable

by Laura Morgan

Alex Westlake, the managing director and co-founder of green investment company ClearWorld Energy (CWE), has a vision for a world that does not exploit its citizens or its environment. Here's how he's turned his vision into a for-profit venture that is creating change around the world.

***the Beijinger*: How can renewable energy help fight poverty?**
AW: Many of the world's poor live in rural areas where traditional fossil energy is expensive (if it's even available), or trees that protect the natural environment are chopped down and burned inefficiently inside people's homes, killing many from smoke-related diseases. A remote energy system can support productive village enterprise, healthcare and education. We are working hard to realize a world where everyone has access to energy – a thousand times more energy hits the earth from the sun than we use everyday.

***tbj*: What projects is CWE involved in now?**
AW: We have four main initiatives, including Camco, which develops greenhouse gas emission reduction projects, and ClearWorld Now, which invests in clean-tech companies here in China. We support 51Give, a microfinance portal for rural clean energy, and we have a CSR (Corporate Social Responsibility) program, where we support vulnerable people directly to get clean energy and water.

> "A thousand times more solar energy hits the earth than we use everyday"

***tbj*: What changes do you hope to see in the next few years?**
AW: I hope to see consumers get more engaged and make more informed choices. I hope to see solar PV really take off in China. I think energy efficiency, using waste resources and wind, will continue to flourish. I look forward to an electric vehicle and grid revolution and policies to support a vision of distributed energy. I hope the world will come to a global agreement in Copenhagen in December this year so that a price is put on carbon emissions that will enable a massive change to a clean energy future.

However, the energy industry has considerable inertia, so in the next few years the most important thing for the industry to do is deliver, deliver, and deliver again. Then, when the government, the banks and the typically conservative investors ask, "Can you really deliver?" – the whole sector will say, "Yes, we can!"

More information at www.clearworld.com.cn. *From the full interview with Westlake, check out* www.thebeijinger.com

MEGA-WHAT?

CHINA'S RENEWABLE ENERGY INDUSTRY GOES LARGE

by Peter Fries

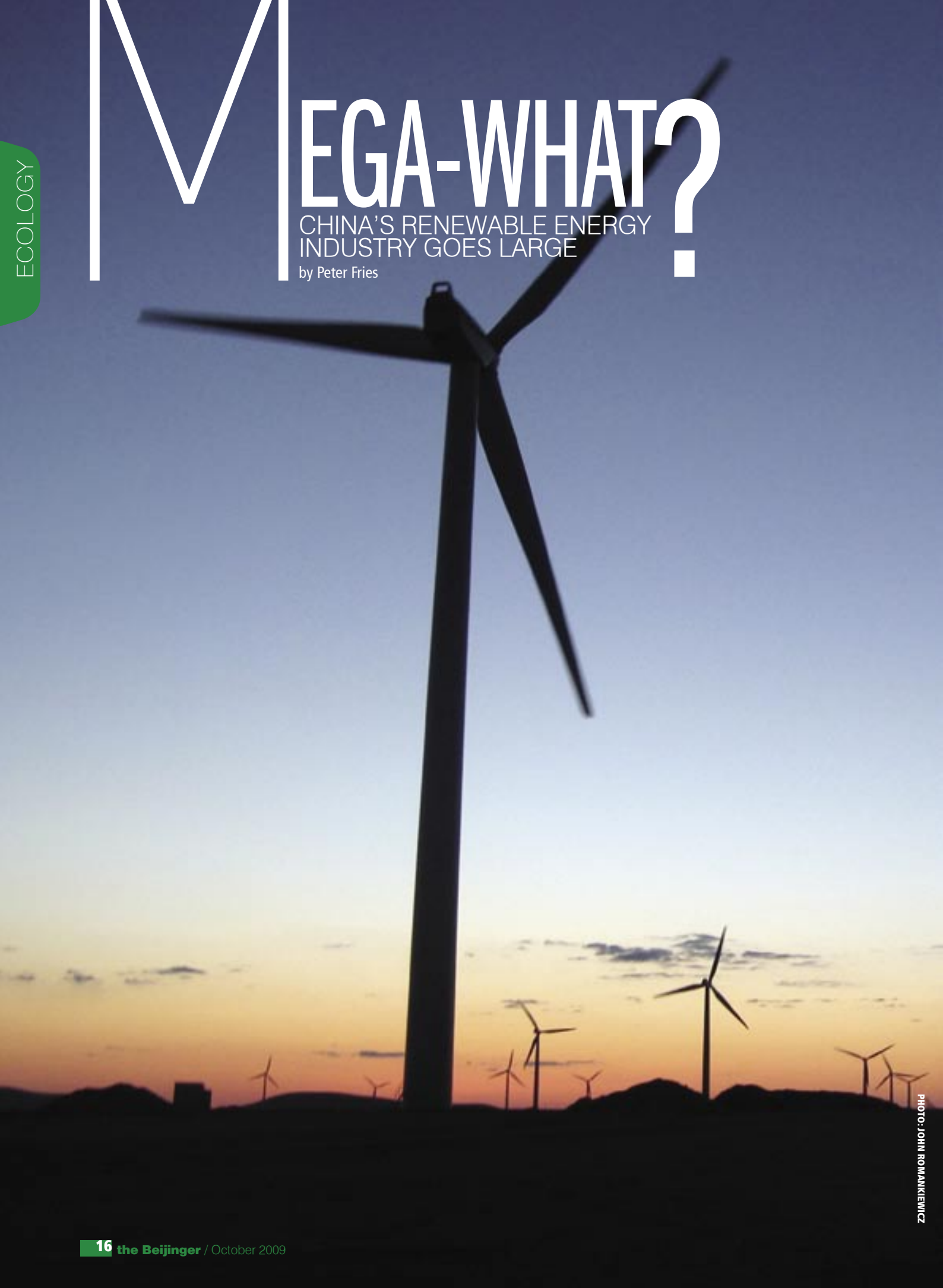

PHOTO: JOHN ROMANKIEWICZ

From his office at the headquarters of Suntech Power Holdings near Wuxi, CEO Shi Zhengrong looks out on the future – literally. The southern facade of his headquarters is covered with hundreds of thousands of solar cells and generates enough power on a sunny day to power more than 1,000 average European homes.

With the help of Suntech and dozens of other new companies, China helped the world increase production of solar electric panels by 90 percent last year alone. Although hit by the world's economic troubles, the sector continues to expand. Suntech, for example, is still on track this year to become the world's second-largest producer of solar cells. In January, the company reached the capacity to produce one million kilowatts of solar panels a year, many of which will be part of the Chinese government's program to generate 20,000 megawatts (MW) of solar power by 2020.

At the other end of China, traditional Inner Mongolian herdsmen also look towards the future, but with an eye on the past. As their tough Mongolian horses graze on rolling green steppes or carry tourists on their backs, hundreds of wind turbines stretch to the sky, their 40-meter blades spinning overhead in a stiff and constant wind, producing the equivalent electricity of a large coal-fired power station. The Inner Mongolian wind farm is just one of many that form the government's "Three Gorges of the Sky" project that will see up to 120,000 MW of wind power installed by 2020.

These and hundreds of other projects have made China the number one producer of renewable energy. Today, China is the leading producer of solar cells, the largest manufacturer of solar water heaters, the number one producer of small-scale hydro systems and number three in wind power.

But it wasn't always this way.

Less than a decade ago, China's renewable energy industry was a mere shadow of its current self. In 2001, for example, China produced just 5 MW of solar cells. Last year, China produced 1,800 MW (more than 300 times the 2001 figure) and in the process reduced the price of solar cells by half – helped in part by an oversupply caused by the financial crises.

Meanwhile, the 470 MW of wind power installed in 2002 has exploded to more than 13,000 MW this year – doubling capacity each year for the past five years. According to the *Renewables Global Status Report: 2009 Update* published by the global policy network Ren21, turbines are being commercially produced by at least 15 Chinese companies, including Goldwind, Dongfang, and Sinovel, while several dozen more are producing components. In 2008, China also increased production of small-scale wind turbines to about 80,000 turbines (80 MW).

"Through all these developments, the Chinese wind industry appeared entirely unaffected by the global financial crisis, according to industry observers, and some expected manufacturing capacity to approach 20,000 MW per year by 2010," says the report.

> "The Chinese wind industry appeared entirely unaffected by the global financial crisis, according to industry observers"

China's explosive growth in renewable energy is in part due to a shrewd combination of government and international support to develop markets and the institutional capacity of the sector. The government has used the economic crises to pour billions of *yuan* into the solar and wind sectors, including a recent subsidy of 50 percent of the cost of solar photovoltaic (PV) installations tied to the national grid, as well as a "feed-in tariff" that will pay solar pioneers up to RMB 1.3 per kilowatt-hour for their clean electricity – the same rate as other providers.

At the international level, support from the Global Environment Facility (GEF) and the World Bank has helped with the nitty-gritty of developing the sector's capacity to expand. In 1999, funded by the GEF and implemented by the World Bank and Chinese government, the Renewable Energy Development Program helped to establish national testing and certification centers and an industry association, while introducing advanced technology.

The program also stimulated market demand, helping more than 400,000 Inner Mongolian yak-herding families access cleaner solar lighting, making solar energy affordable to China's rural poor. In 2006, the GEF and World Bank created the USD 40 million China Renewable Energy Scale-up Program (CRESP) to further develop the clean energy sector.

The rapid expansion of China's renewable energy capacity is critical if the country is to have any hope of eventually relinquishing its position as the number one global emitter of greenhouse gases. With China's almost insatiable demand for energy to fuel its economic growth, the rest of the world too has an interest in its renewable energy sector.

Although many energy industry observers are convinced coal will play a leading role in China and the world's energy future, others see solar and other forms of renewable energy as "disruptive technologies" that could "flip" traditional approaches to energy and power within a decade. The building-integrated photovoltaic system at Suntech company headquarters is an example of a new industrial "skin" that may eventually do away with conventional power lines when combined with advanced energy storage systems.

In ten years – the time it takes to build a nuclear power station – the high cost of solar power "will not be an issue," says Suntech's Dr. Shi. He is confident that solar will compete with all generation technologies while advanced energy storage technologies will be commercial and reliable.

"I truly believe solar will be able to provide all the energy we need," Shi says, adding that governments should put all the necessary resources into making this happen.

"The answer," he says, "is already there."

Peter Fries, a freelance journalist and filmmaker based in Australia, recently made a documentary film on China's renewable energy sector for the Global Environment Facility.