

WORLD RIVERS

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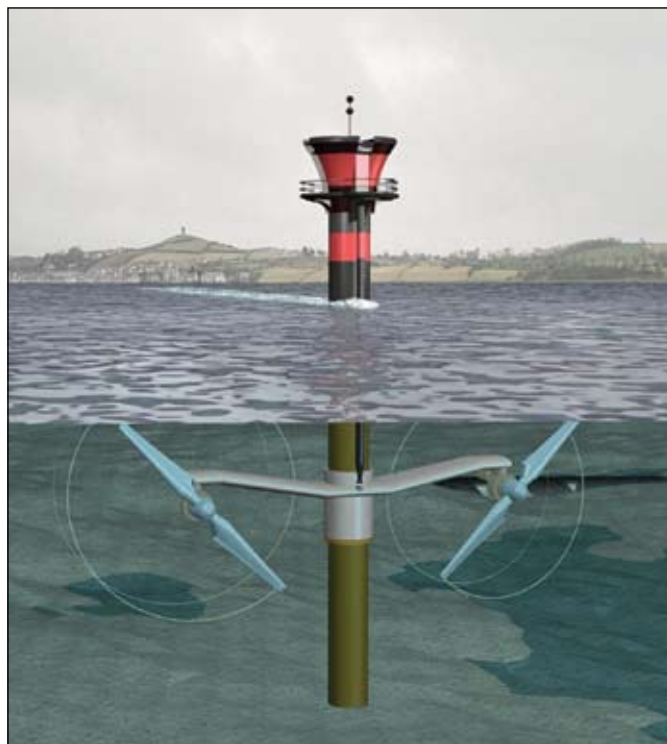
A Bright Future for Hydro – Without Dams

by Patrick McCully

A quiet revolution is underway in the world of hydropower. An emerging non-dam hydro industry holds the promise of economically viable technologies that do not deplete resources or warm the planet, and do not wipe out species, ecosystems and cultures. With supportive policies from governments, non-dam hydro could become a key part of the world's energy mix in coming decades, and could, as wind power already has, overtake big-dam hydro in terms of its share of new capacity additions.

Non-dam hydro comes in a diversity of forms. It includes all technologies to generate electricity using water without dams. The two sectors receiving the most attention are wave power and “hydrokinetic” turbines that capture energy from the flow of water in rivers, estuaries and ocean currents, and even irrigation canals and water supply and disposal pipes. (Hydrokinetic turbines are also referred to as “instream,” “stream” or “free-flow” turbines. They should not be – but frequently are – confused with “run-of-river” hydropower which includes a dam, but usually not a large reservoir).

Not all non-dam hydro technologies may be benign and environmentally appropriate at all sites, but it appears likely that many of the technologies could be



A tidal turbine. Photo: SeaGen

very low impact compared with dam-based hydro and other conventional generation technologies. While the output of river flow hydro will, like run-of-river dams, be reduced in dry seasons and droughts, tidal and ocean power is highly dependable and can help reduce the vulnerability of electrical grids to climate change.

Funding for R&D of non-dam hydro has been meager until very recently, but is now being rapidly ramped up from both public and private

sources, especially in Europe and North America.

“We’re at the stage of needing to see which of these technologies works and whether they can be scaled up,” said Neil Kermod of the European Marine Energy Centre, in a December interview with the BBC. “That requires steady investment. Look what the Danes did with wind: investments year after year paid off and now they earn billions in exports. There is huge potential

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In Memory

GLENN ROSS SWITKES



Glenn in Patagonia.

International Rivers is mourning the loss of our Amazon program director Glenn Switkes, a dear friend, respected colleague, and a river warrior of unbreakable passion. Glenn died on December 21 in a São Paulo hospital of lung cancer. He was 58.

Glenn was a man of rare integrity, great humor, and political savvy. He was a much-loved inspiration and teacher to river defenders, and an effective thorn in the side of river-wrecking politicians and bureaucrats.

Glenn devoted most of the last two decades of his life to the cause of keeping the rivers of South America, especially in the Amazon, flowing free of dams and shipping channels.

Glenn first went to the Amazon on the urging of his Colombian first wife, Monti Aguirre. Inspired by the beauty of the Amazon, the culture and wisdom of its Indians, and horrified at the impacts of deforestation and dam-building, Glenn and Monti together made the award-winning documentary

"Amazonia: Voices of the Rainforest." The film was sponsored by Rainforest Action Network. After its completion Glenn joined RAN as its Western Amazon oil campaigner.

Glenn joined International Rivers Network in 1994. Together with his second wife, Selma Barros de Oliveira, he soon moved to Mato Grosso, Brazil, to help put together a coalition to save the Paraguay-Paraná river system, and especially the Pantanal, the world's largest tropical wetland, from the threat of a huge channelization project. The multinational Ríos Vivos coalition was a textbook example of effective NGO strategizing and action. The Pantanal's wildlife and traditional, tourist and ranching economies are still vibrant today thanks to the success of Glenn and Ríos Vivos in fighting off the "Hidrovia" waterway.

As the danger to the Pantanal receded, Glenn became involved in numerous struggles against dams and for the rights of dam-affected people, especially along the Tocantins and Tapajós rivers in the Brazilian Amazon; the Uruguay and Paraná basins in southern Brazil, Argentina and Paraguay; and in Chilean Patagonia.

In recent years, Glenn's focus was on stopping the damming of two of the great Amazon rivers, the Madeira and Xingu. Cynical political maneuvering from the Brazilian government has meant that construction on the two Madeira dams has begun. Glenn coordinated the production of two books exposing the high social and environmental costs and distorted justifications of the Madeira and Xingú dams.

Glenn had a rare capacity to work closely with and gain the respect and friendship of academics and policy wonks, as well as grassroots movements of peasants and fisherpeople, and Indian tribes. He was an expert on Brazilian energy and environment policy, and had a keen understanding of Brazilian politics, on both the government and civil society levels. His political analysis – and his sharp wit – can be seen through his excellent blog on our website.

Glenn and Selma have a seven-year-old son, Gabriel. Gabo was Glenn's biggest joy, and in recent years the driving force behind his passionate defense of the environment. The first thing Glenn would do on visits back to our Berkeley office was to pull out the latest photos of Gabo.

Glenn was the soul of International Rivers. He leaves a gaping hole in our organization and in the international movement of river activists. We will miss his songs (often with mangled words) booming through our office during his visits to Berkeley, his irreverent humor, his boundless energy, his infectious and tumultuous personality. We will honor and celebrate his life with a renewed fighting spirit for the rivers of the Amazon and elsewhere.

Patrick McCully

MAKING WAVES

In the News

“The dam-building industry is greenwashing hydropower with a public relations offensive designed to convince the world that the next generation of dams will provide additional sources of clean energy and help to ease the effects of climate change. In some of the world’s last great free-flowing-river basins, such as the Amazon, the Mekong, the Congo, and the rivers of Patagonia, governments and industry are pushing forward with cascades of massive dams, all under the guise of clean energy.”

“Greenwashing Hydropower,” by Aviva Imhof and Guy R. Lanza, *World Watch Magazine*, Jan./Feb. 2010

“Some analysts see the seeds of international conflict in the rush to dam the river. Civic groups in Thailand say they are frustrated that China does not seem to care how its dams affect the lives of people downstream. In August, the Vietnamese province of An Giang began a ‘Save the Mekong’ campaign that opposes the construction of the dams in the lower part of the river, according to Carl Middleton, the head of the Mekong program at International Rivers, an organization campaigning against the Mekong dams.”

“Dams and Development Threaten the Mekong,” *New York Times*, Dec. 17, 2009

Good News in El Salvador

Communities in El Salvador had a reason to celebrate in January when the government announced it was scrapping the proposed El Cimarron Dam. Community activists and environmental groups had fought the dam for years. The project would have displaced nearly 35,000 people. El Cimarron would have dammed the Lempa River, the longest in Central America, and one shared by three countries.

President Mauricio Funes said the dam would not be built as currently designed because of the environmental and social problems it would cause. El Cimarron would have been the sixth largest hydroelectric dam in El Salvador. Project costs have tripled in the 12 years the dam has been in the planning stages. Financing for the project had not been identified.

The communities that would be affected by the project are not singing victory songs just yet. President Funes asked the National Energy Council to work on an energy plan for the country that would include a recommendation on whether this dam is needed or not.

“We will continue to resist damaging projects like El Cimarron,” said Ricardo Navarro of the group CESTA. “This is a permanent struggle.”

Welcome, Pai and Samir!



Pianporn Deetes, a Thai activist with years of community organizing experience, joined International Rivers’ Southeast Asia team in January. Pai spent the past seven years working with Thai NGO Living River Siam (SEARIN), working to empower riverine communities in the Mekong and Salween basins to stop destructive river infrastructure projects, and protect their rights and livelihoods. At International Rivers, Pai will work to stop dams planned for the Mekong Mainstream. Pai is also an Ashoka Fellow. We all look forward to working closely with Pai in her new role.



Also in January, Samir Mehta joined International Rivers as the director of our new South Asia office in Mumbai. He supports dam-affected communities and NGOs throughout South Asia, and particularly the Himalayas. Previously, Samir worked with the renowned Bombay Environmental Action Group for more than 17 years, and developed expertise in the declaration and planning of ecologically sensitive areas. Samir has a Master’s degree in public administration from Harvard University. He comes to the job brimming with new ideas and enthusiasm.

China's Green Leap Forward

World's biggest energy user on track to become world's best energy-saver

by Peter Bosshard

It is a cold winter morning in Beijing. As I prepare to write this story about energy efficiency in China, I wonder how efficient my own day will be. I enjoyed a quick shower with warm water from the solar tank on our roof, and prepared our breakfast with appliances that carry energy performance labels. All our lighting fixtures are energy efficient, and none of the electronic equipment is on standby.*

Our apartment is heated by a coal-fired plant in the neighborhood, which belches thick smoke into the sky. Our heating bill doesn't reflect the energy we use but the size of our apartment, so we have no financial incentive to save energy. As on most mornings, the concentration of particulates in Beijing's air is an unhealthy 300 microgram per cubic meter – a level that US cities only reach during wildfires. Our situation is quite typical for a middle class family in Beijing, and reflects the progress and challenges of China's energy policy.

Massive investments

China is the world's factory, and is developing its infrastructure and urban centers at breakneck speed. The country produces more steel than any other economy, and half the world's cement – a fact that is illustrated by huge construction sites in every neighborhood. The industrial sector takes up an astounding 72% of China's energy to feed this demand.

The China Energy Group at the Lawrence Berkeley Laboratory in California has advised China on how to use energy more efficiently for more than 20 years. Lynn Price, a staff scientist with the Berkeley Lab, tells me that many new factories – for example in the steel sector – are world leaders in energy efficiency. Yet China still has thousands of inefficient local steel mills and cement kilns, some dating from the ill-fated Great Leap Forward in the late 1950s. And because China has limited domestic natural gas resources, much of its industry and power sector rely on abundant but polluting coal.

The Chinese government is making great strides to clean up its industrial legacy. It has defined mandatory efficiency improvements for the 1,000 biggest energy consumers, and installed officials in the respective factories who can enforce cuts in energy consumption. The government is also closing down hundreds of old, inefficient factories and thermal power plants. On average, coal-fired power plants are more efficient in China today than in the US.

With transmission losses of close to 7%, China's electric grid is comparatively wasteful. But the state-owned grid companies are making big efforts to build efficient high-voltage transmission lines. In 2008, investment in the electricity network was for the first time higher than in power generation. The Chinese government plans to

*Many appliances use power even when off. Standby power now accounts for 5-10% of total residential electricity use in developed countries.

develop a smart grid – a super-efficient, flexible transmission network that helps to integrate widespread development of renewable energy – by 2020 at an estimated cost of almost US\$600 billion.

The government has promoted energy efficiency at home and in the office through financial incentives (for example, subsidized efficient light bulbs and rebates for efficient air conditioners) and mandatory standards. David Fridley, a staff scientist with the Berkeley Lab's China Energy Group, comments that China has “the most dynamic energy efficiency standard program in the world.” The country already

has 31 mandatory standards for household appliances, lighting and commercial equipment such as copiers. Since it is a major exporter of many of these products, China's efficiency standards spill out to the rest of the world. The Chinese government will introduce seven additional standards this year, including products not covered by mandatory standards in industrialized countries, such as computers and vending machines.

The government has also strengthened building codes for new construction. While these efficiency standards are strictly enforced on the new construction sites, China's existing

apartment and office buildings still tend to be leaky. Tenants have little incentive to retrofit their apartments to save energy for heating and cooling.

An ongoing challenge

Price is a key factor that influences energy efficiency. While China has liberalized prices for coal and petroleum in recent years, electricity prices are still tightly controlled by the government. On average, retail electricity prices are slightly lower than in the United States, but with big variations according to sector and province. Farmers, residential users and large industrial companies tend to pay lower prices, while other industrial and commercial users pay higher rates. The government has slapped a variety of surcharges on electricity fees, including for the promotion of renewable energy sources. It has added a punitive surcharge on the electricity fee of companies that it wants to merge or close down, particularly in energy-intensive sectors such as cement, steel and aluminum.

The low power prices for many consumers can encourage wasteful consumption. The government counteracts this with regulations and sometimes heavy-handed interventions. It installs energy commissars in factories, shuts down old plants, and enforces mandatory efficiency standards. Market reforms in the early years of the new century brought about a lapse in China's energy efficiency, which the government quickly reversed. “China has realized that the market will not deliver everything you need, at the time and scale you need it,” comments the Berkeley Lab's Fridley.

In 2006, the Chinese government set a target of improving the country's energy intensity – the energy used for producing one unit

Continued opposite



Shanghai at night. China's rapid growth makes improving energy efficiency imperative. Photo: Wikimedia Commons

of economic output – by 20% during the current Five-Year Plan. The China Energy Group has calculated that due to its strenuous efforts, the country is on track to meet this ambitious goal. This will not only cut down pollution, but also save the country a lot of money. The challenge will be to keep up the pace of improvements through a new set of mandates and incentives during the next five years. The scientists of the Berkeley Lab will continue to assist China in this task through research, advice and training.

Improving its energy intensity by one-fifth would be a proud achievement for any country. Yet in China, such gains are not sufficient to outpace growing demand. From 2005-2020, the country's urban population is expected to grow from 564 to 895 million. As people become more prosperous and move to the cities, they require new apartments, buy more appliances and even cars. China's impressive efficiency improvements will not be able to offset the growing energy needs of a country that grows at 8% and more per year. If China's rivers are to get a break from damming, and if we are to breathe healthier air in Beijing ten years from now, this gap needs to be filled by renewable energy sources. ●

Fast Facts: Renewable Energy in China



As the following figures attest, China is fast becoming a renewable supermarket and superpower. The country is on track to achieve the world's most ambitious renewable energy targets. By doing so, it will reduce the demand for destructive coal and hydropower projects at home, and set a model for other countries.

Targets under China's Renewable Energy Law for 2020: **75 MW of small hydro, 30 GW of wind, 30 GW of biomass, 2 GW of solar**

Total target for all renewables: **137 GW, or 15% of the country's total power capacity**

Expected cost of this expansion: **\$270 billion**

Exploitable wind power potential: **>500 GW onshore, 750 GW offshore**

Exploitable hydropower potential: **379 GW**

Total installed wind power in China as of 2008: **12.2 GW**

Percent increase in wind power generation in China in 2008: **100**

Solar water heating capacity, 2007: **84 GW thermal (67% of world total)**

Capacity of solar cells produced in China (mainly for export), 2008: **3,300 MW (48% of world total)**

Percent that renewable energy and environmental protection contribute to China's Gross Domestic Product (2008): **5**

Target for 2015: **10% of GDP**

Number of people employed in these fields in China: **25 million**

Sources: *EF China Sustainable Energy Program; LBL China Energy Group; REN21 Renewables Global Status Report; Global PV Industry Report*

More Displacement at Three Gorges

The *China Daily* reported in January that an additional 300,000 people will be displaced to mitigate the severe environmental and geological impacts of the Three Gorges Dam. This is on top of the 1.3 million people already displaced by the world's largest hydropower project.

The announcement confirms warnings by Chinese experts and international organizations who cautioned that geologic hazards posed a serious risk to people living around the reservoir.

A 2007 survey by authorities found 9,324 sites potentially threatened by geologic hazards, including nearly 4,000 new ones that emerged since 2003. The report stated that over 53,000 people had been resettled to avoid the hazards.

The report said collapse of riverbanks and landslides will continue for the next 20 years.

According to Hu Jiahai, a government official in Chongqing (one of the main cities on the reservoir), "A buffer belt is waiting for

approval to be built alongside the reservoir to improve the water quality of the Yangtze River and reduce contaminated runoff."

According to Hu, ecological protection and hazard prevention are just two major tasks of a proposed dam follow-up project, which also has to address legacy problems from the early migration period, and economic development of the area to create new jobs. The State Council is pushing the Yangtze River Water Resources Commission to draft a general plan for the next 10 years to take remedial action.

The government agencies, companies and funders that promoted the Three Gorges Dam should acknowledge past errors and learn from them. Affected people must receive sufficient support so they can build up a new economic future, and must be allowed to protest abuses in the resettlement program by corrupt officials. Future dam projects must be evaluated more thoroughly, and the capacity of the Ministry of Environmental Protection to do so must be strengthened. ●

Renewing Africa with Community Energy

by Terri Hathaway

African countries are making some important strides toward a green energy sector. According to the Global Renewables Status 2009, Northern Africa boasts more than 500 MW of installed wind power, while Ethiopia, Kenya, and Tanzania are all planning their first wind farms. Mauritius, Uganda, Kenya, and South Africa have all enacted feed-in tariffs (pricing policies that encourage renewable electricity's access to the grid). Renewable energy targets have been set by Rwanda, Tunisia, Kenya, and Madagascar. But the energy divide between urban and rural areas remains a major challenge, with too few resources being put toward the problem. Here we highlight just a few communities who have taken matters into their own hands.

Small Wind in The Gambia

When the villagers of Batokunku set up a 41-meter-high wind turbine, they broke more ground than they knew. Led by Peter Weissferdt, whose German NGO works to bring renewable energy to The Gambia, the community began building its own electricity system in 1999 by laying a ground cable network, installing light sockets in homes, and laying a water-pipe system. "The basic idea was to produce green electricity with the wind turbine, supply its energy more or less free of charge to the people of the village, and sell the surplus energy to the national utility's consumers in surrounding villages," Weissferdt recalls. In 2007, the Gambia Public Utilities Regulatory Authority (PURA) received Batokunku's application for a license to distribute electricity, prompting a field visit by PURA authorities to evaluate the situation.

After years of laying the groundwork, the village's power supply "went pro" in 2008. In May of that year, a power purchase agreement (PPA) was signed between the community of Batokunku and the national utility. In August, PURA approved the distribution license – a final and key milestone in the project's inclusion in the national grid. Since August 2008 more than half the village has had continuous power around the clock. In December, work began to erect the refurbished wind turbine, which had arrived in pieces in 2006.

The village's wind project is managed by an elected committee, which is technically and commercially responsible for the village-owned electricity system. Batokunku Wind now serves 1,000 consumers.

Microhydro in Kenya

Africa's untapped small hydro potential is estimated to be over 60,000 MW, but only a few hundred megawatts of capacity has been installed. Barriers to wider adoption include low tariffs and the monopoly position of national power utilities.

Two community hydropower schemes in remote areas of Mount Kenya are helping to change that situation, paving the way for more community-driven electricity projects. Power from the two schemes serves over 200 households in Kathama and Thima, saving an estimated 18 tons of kerosene each year.

The biggest barrier to scaling up microhydro (and other renewables) in Kenya was governmental policy that prohibited independent power producers, even off-grid ones. This government monopoly on power supply meant that the Kathama and Thima microhydro projects required special permission from the government. By directly involving the Kenyan Ministry of Energy from the start, the project was able to influence national policy, and the new national energy policy will not require special permission from microhydro projects in future.



Africa's most famous wind turbine was built out of bicycle parts, scrap wood and assorted junk by William Kamkwamba, at his family's homestead in rural Malawi. The story of the self-taught renewable energy engineer got international attention, and resulted in a book. Learn more: williamkamkwamba.typepad.com

The East Africa branch of the UK-based group Practical Action, which specializes in decentralized technologies to reduce poverty, partnered with the communities to bring the project to fruition. The communities provided building materials, land for the turbine house, labor and financing. After two years of construction, the community power grid was up and running. A power committee elected by the community oversees each system. Consumers now pay less than they did for kerosene, and get better quality lighting, as well as radio and telecom for households. The project has been financially self-sustaining for the past three years.

This project led to other changes critical to expanding microhydro in Kenya. First, it helped build capacity to manufacture system components locally. Second, it has initiated a process to establish standards for component manufacture and installation.

Barefoot and Solar

African grandmothers are the target of a unique approach to rural electrification. Since 2004, the Barefoot College in India has trained 110 rural African women, mostly grandmothers, as solar engineers. To date, these women have solar electrified 5,500

Continued opposite

Honduras Communities Explore Small Hydro Development

by Monti Aguirre

No one knows for sure if the idea of a community-owned small hydropower project will work, but Lenca indigenous peoples in the Municipality of Tomalá in Honduras are not afraid to try. And they have nothing to lose.

“Eighty percent of the region’s population lives in extreme poverty, and malnutrition rates are high,” said Fabricio Herrera from the Pro-Development Committee for the Mocal Hydroelectric Project. “We see this small hydroelectric project as a way of getting out of poverty for our communities.”

The project is planned for the Mocal River, a tributary to the Lempa River, which is shared with El Salvador, and was developed communally by municipal organizations. According to Herrera, this 8MW run-of-river project won’t impact fertile lands or areas of high biodiversity because it is located in a desertification zone, and no people live in the area of the reservoir. The project is estimated to provide electricity to 10 municipalities, or about 100,000 people. Grid expansion to surrounding rural areas is also being considered.

Honduras’ Natural Resources Environmental Agency granted the site permit based on a project pre-feasibility study, prepared by UNDP. Communities are working on getting funding for the feasibility study, but the big hurdle will be obtaining financing for the project. “Several entrepreneurs have contacted us to offer to develop the project for us, but we want this to be a community-owned project,” said Herrera.

Privately developed medium-sized and small dams in Honduras receive tax breaks, and private electricity producers benefit from fiscal incentives, tax exemptions and the recognition of 10% of the short-term marginal cost per kilowatt-hour as a premium.



A community surveyor on the Mocal.

“What is innovative about this project is that the profits generated by the electricity sales will be invested in social and economic development projects in the area, and on the conservation of the basin,” said Herrera. The community plans to set up a company responsible for the promotion, construction and operation of the plant. The company would be connected to a non-profit foundation, also comprised of community members, which would be responsible for investing the profits. ●

Renewing Africa *continued*



Fatou Kuruma from Sierra Leone learns to assemble a solar lamp at Barefoot College in India.

remote rural houses in 15 African countries, saving 30,000 litres of kerosene per month. Families paying into one of the graduates’ village solar systems receive up to four hours of light every night.

Barefoot College invites new trainees, most of them mothers and grandmothers, to come to India for a 6-month training. No written materials are used and trainees generally speak different languages. “The College often relies

on sign language and gestures,” explains founder Bunker Roy. The hands-on training is conducted by Indian women who have completed the same training. “With each passing day their level of hesitancy decreases and confidence and ‘technical dexterity’ increases,” Roy says. After returning to their villages, the women

are able to fabricate, install, maintain and repair residential solar lighting systems.

Barefoot College started training rural women in India to be solar engineers in the 1990s. The trainees came from all over India. Because of language barriers, the women learned by following mimed instructions, and executing technical tasks by example. The college works on the premise that the very poor have the right to have own and have access to the most sophisticated technologies to improve their own lives. “Just because they cannot read and write does not stop them from becoming solar engineers.” The Barefoot College trains only illiterate and semi-literate middle-aged mothers and grandmothers from villages all over the world. “Illiterate grandmothers are humble and easy to teach. Grandmothers have a vested interest in the village and have no desire to leave. Give a youth a piece of paper and he is off to the city to find a better job,” Roy notes.

Before a village is solar-electrified, a Village Energy and Environment Committee (VEEC) is formed. The VEEC is responsible for determining how much each family is prepared to pay for a solar unit or solar lantern per month, and for selecting a woman from the village to be trained as a Barefoot Solar Engineer. Once the village is electrified, the VEEC continues to monitor funds and the performance of the barefoot solar engineer.

It is estimated that a rural family in Africa burns around 60 liters of kerosene a year to light their home, causing health problems, fires, and air pollution. Barefoot Solar Engineers are transforming lives and bringing light, one lantern at a time. ●

SCIENCE NONFICTION

The Future of Energy is Getting Greener (And Closer)

by Berklee Lowrey-Evans

Renewables are booming around the world, but they still have a lot of catch-up to do. Installation of solar PV systems has been nearly doubling every two years in both the US and Europe. The cost of producing solar-generated energy fell by over half in just a decade and a half. Wind power capacity rose nearly a third last year, to a total power capacity of 157.9 gigawatts (China accounted for a third of that, doubling its wind capacity). Some 150 companies worldwide are working to commercialize algal biofuels, which could cleanly fuel cars, planes and other engines while feasting on the atmosphere's excess carbon dioxide.

It's been said there will be no silver bullet to fix our current dirty energy supply, but many hope that the "silver buckshot" approach could do the trick – in other words, try many different things at once, and see what works best. Here we look at some intriguing recent advancements in the world of green energy.

BEAM ME DOWN, SCOTTY

While most of us think of space as a black void dotted with distant stars, some engineers see it as a great place to capture solar power. After all, our sun shines more intensely out there in our solar system. So why not take advantage of it to bring clean power on Earth?

That's exactly what Solaren is planning. Based in Manhattan Beach, California, the company signed a 15-year Power Purchase Agreement in December 2009 with California utility PG&E to provide 200 MW of power – 1,700 gigawatt hours per year – beginning in June 2016. A 1-km-diameter concentrating mirror will beam solar waves at high-efficiency solar cells to create energy. A microwave converter will then beam the radio-frequency energy waves down to a receiver in central California, where it will enter the grid. Solaren says it expects to produce 1,000 MW of energy from this solar plant, but has not disclosed who would receive the remaining 800 MW of power.

Japan is also developing a solar space-power station, expected to produce 1GW of power and be in orbit by 2030. Their system would be massive: a 2.6 km x 2.4 km (1.6 miles x 1.5 miles) power generation/transmission panel tethered to a central bus system 10 km away. It's estimated cost is US\$21 billion.

Space solar is a highly efficient and reliable source of energy. Compared to solar power produced on Earth, space solar isn't reduced by particulates or clouds in the atmosphere. And there's no "night" – space solar runs 24-7. Additionally, radio frequency waves can be converted to electricity at a rate of about 90% efficiency (nuclear and coal plants operate at only about 33% efficiency).

One of the barriers to space solar is the high cost of launching the units into space. Solaren has been talking with Lockheed-Martin and Boeing about constructing both the solar plant and the rockets needed for transporting into space; they're also working on ways to decrease the weight of the plant, including using inflatable mirrors.

Still think this sounds like science fiction? Well, like so much of today's technology, it started out that way. Isaac Asimov was the first to propose space solar, in his 1941 book *Reason*. It's only taken 70 years for science to catch up with art this time.

GO FLY A KITE

California firm Joby Energy has created a new airborne wind turbine to harness the stronger, more consistent winds in the upper layers of our atmosphere. Each wind kite has multiple turbines connected to motor-generators that transmit electricity to the ground through a reinforced tether. The components are modular, so kites can easily be built to provide as much or as little energy as needed, and can be easily repaired in the event of a malfunction. The kites will fly over uninhabited areas, out of the path of airplanes, and eventually offshore, too.

Typical wind turbines today operate at about 100 meters above the ground; the wind kites fly on average at 400 meters.



Wind power takes to the skies.

The faster winds found at these high altitudes allow the wind kites to produce nearly twice as much energy as their surface-based counterparts. And because they require about one-fortieth the construction materials, lower production costs could easily make them cost-competitive with our current unsustainable energy sources.

SCALING UP FUEL CELLS



The Hydrofill desktop fuel cell.

Hydrogen accounts for about 90% of the universe's atoms, so it's no wonder that people have been trying to find ways to turn it into fuel for a long time. However, one of the main drawbacks is that it takes more energy to produce hydrogen from water than it creates, so hydrogen is actually better as a form of energy storage than energy creation.

Fuel cells are seen by some as the next great energy source, but they've been slow to develop into a mass market. Some new breakthroughs may signal a change.

Horizon Fuel Cell Technologies just debuted their new desktop fuel cell called the Hydrofill, which extracts hydrogen from water and stores it in cartridges. To charge a cell phone, camera or other portable device, a cartridge is inserted into a pocket-sized unit that pulls the hydrogen from the cartridge and produces electricity. The company already has larger versions of the same hydrogen-creation technology. Both models need an energy source to initially create the hydrogen; it can be plugged into a wall outlet or a solar power system.

On the opposite end of the spectrum, industrial-scale fuel cells are now powering business giants such as Google, eBay and WalMart. A California start-up called Bloom Energy has developed scaleable fuel-cell power plants that are being tested at these companies; the eventual goal is to develop a unit for home use that costs less than \$3,000, and can compete with grid-based electricity. Unlike some earlier prototypes of home fuel cells, the Bloom Boxes (recently introduced to the public on the news show *60 Minutes*) use low-cost materials, and can run on any fuel, not just pricey hydrogen. Some of the test units use natural gas, for example, and consume about half as much gas as a traditional power plant. (They can also run on biogas or methane from landfills.) A box about the size of a milk carton could power an entire US home (and one half that size, a European home).

One big unknown is whether this small, new company can achieve the economies of scale that will lead to truly affordable fuel cells for the home on a mass scale. If it can't, however, dozens of other companies globally are chasing the same goal.

STORING THE WIND

One of the big arguments against transitioning to a renewable energy supply is that many green energy sources aren't constant. The wind doesn't always blow, the sun doesn't always shine (on Earth at least – see "Beam Me Down Scotty"). Efficient ways to store intermittent energy for later use is the holy grail of renewable energy.

Compressed Air Energy Storage (CAES) works like this: off-

peak electricity is used to pump air underground into a storage chamber. When energy demand is high, the compressed air is released, turning a turbine and generating electricity. CAES can usually supply about 100 MW of power for several hours at a time.

The system operates at only about 50% efficiency, and currently requires some burning of natural gas, negating some of the positive aspects of CAES.

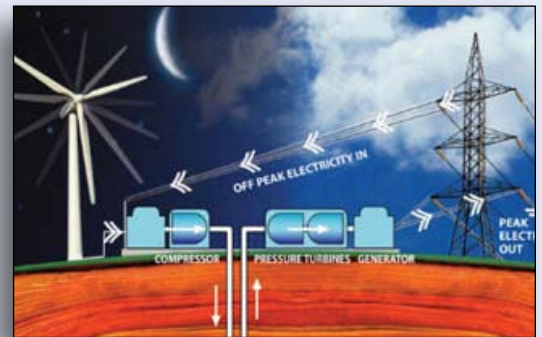
While the geological formations needed for storage – old mines, depleted aquifers and salt caverns – exist all over the world, only two CAES plants are currently in operation: one in Alabama and another in Germany. In the US, several companies are considering CAES projects, but only one is in the design stage. The Iowa Storage Energy Park will have enough storage capacity to supply 270 MW for 16 hours a day.

The most exciting upgrade to CAES is the effort to increase its efficiency and decrease its environmental impact. General Electric and RWE Power, a German utility company, are developing an advanced system known as AA-CAES that captures waste heat from the compression process; this improvement alone bumps a system's efficiency up to 70%.

Another important way to green a CAES system is to use wind power as the initial energy source to pump and compress the air. Wind is one of the power sources being explored for the Iowa system. AA-CAES combined with wind power would produce an energy generation and storage system with zero carbon dioxide emissions.

These systems have more capacity and are cheaper to install than traditional energy storage methods, such as batteries and flywheels.

RWE and GE hope to have a 30 MW AA-CAES project ready in 2012, but their eventual goal is to create an AA-CAES facility able to generate 300 MW.



Compressed air storage.

ALL THAT GLITTERS

New, tiny PV cells give new meaning to the term "glittering in the sun."

Sandia National Lab in New Mexico has come up with glitter-sized crystalline silicon PV cells that outperform today's photovoltaics in efficiency, reliability, cost, performance, and applicability. While today's conventional solar wafers are about six inches square, the new glitter PV cells are only 14-20 micrometers thick (a human hair is about 70 micrometers thick).

In terms of efficiency, the glitter cells use 100 times less silicon than today's PV to generate the same amount of electricity. Commercial cells today run between 13-20% efficiency; the glitter cells to date are 14.9% efficient, and they're still in the R&D stage. A big advantage to their size is that they can be embedded into flexible materials like cloth or plastic.

Some amazing applications can be envisioned – a shirt could charge a cell phone in Africa, an emergency tent in Haiti could provide electricity for light and a radio, or a backpack could charge a laptop in the Andes. Get ready for an energized fashion industry!

– absolutely huge amounts of energy out there – in fact we don't know how much but it is epic.”

Unconventional Potential

In January 2010, consulting firm Pike Energy published the most comprehensive assessment yet of global non-dam hydro potential and possible rate of deployment. Pike estimates that if the European Union and US continue to increase incentives for non-carbon energy, by 2025 the world could have installed 3,000 megawatts (MW) of river flow turbines, 4,000 MW of ocean current turbines, 57,000 MW of tidal stream turbines and 115,000 MW of wave energy. By comparison, current global installed large hydro capacity is around 770,000 MW.

It would be a heroic feat to achieve the Pike forecasts – it would mean adding in 15 years a quarter of what the big-hydro industry took more than a century to install. In any case, the numbers are necessarily speculative given that the technologies are only just being commercialized and the available resource is very poorly mapped. But the Pike estimate is an indicator of what could be done with each technology.

Hydrokinetic technologies include turbines that look just like underwater wind turbines built on the riverbed or hanging upside down from barges anchored in the river; barges with turbines like water wheels on old-fashioned paddle-steamers; “helical turbines” that look like the blades on a hand-pushed lawnmower; and, more experimentally, hollow cylinders placed horizontally across rivers that move up and down as the river flows past them.

There appear to be no significant engineering challenges to installing and operating free-flow turbines in rivers. Research and development efforts are focused on bringing down costs and ensuring that the turbines and associated facilities do not

harm fish or other aquatic life. So far it appears that the environmental impacts of the technologies will be low, although as their use is scaled up it will be important that their cumulative impacts are carefully monitored and that they are sited to avoid environmentally sensitive areas and disruption to river navigation and recreation.

The drawback to river-flow technologies compared to conventional hydro is that the potential energy from a given volume of falling water, which is what is exploited



Underwater turbine

by an old-fashioned dam-based plant, will always be far greater than the kinetic energy from flowing water. So the laws of physics dictate that non-dam systems can never extract as much energy from rivers as can dams.

The first river flow turbine to enter commercial operation in the US came fully on-line in August 2009. The small turbine, capable of producing just a tenth of a megawatt, and looking something like a household blower fan, hangs beneath a barge immediately downstream of a navigation dam on the Upper Mississippi River at Hastings, Minnesota. Initial monitoring reportedly shows that the turbine is almost completely safe for fish.

A 2007 report from the Electric Policy Research Institute (EPRI) estimates the US river hydrokinetic potential at 10,800 megawatts (around a sixth of the existing installed capacity at US

big dams). A 2009 study for the National Hydropower Association by Navigant Consulting projected that with current incentives for renewables in place, 500 MW of hydrokinetic turbines could be installed in US rivers by 2025. With a clear policy commitment to this new energy source, 2,000 MW could be installed.

There is also a small, but useful, potential for “conduit hydro” – kinetic turbines installed in pipes and irrigation canals. The beauty of conduit hydro is that it has almost zero environmental impact. The California Energy Commission estimates that the state has the potential to generate 255 MW from existing pipelines and canals. In neighboring Nevada, wastewater from Las Vegas will soon be flowing through two 8 MW turbines on its way from a new treatment plant into the reservoir behind Hoover Dam.

Since 2005 the water piped down from a nearby mountain reservoir to supply Bogotá has flowed through a 13 MW hydro project. Areas with extensive canal irrigation networks such as the Indus valley in Pakistan and the plains of northern India should have considerable conduit-hydro potential.

A Sea Change

Worldwide, the bulk of hydrokinetic power potential – and investor interest – lies not in rivers and pipes, but in tidal streams and ocean currents. Navigant Consulting predicts that over the next 15 years the US could see the installation of 250 MW of ocean current power (all from the Gulf Stream flowing past the southern tip of Florida); and 400 MW of tidal stream power. With improved policies, three times more ocean current power could be exploited, and ten times more tidal power. Marine hydrokinetic power is particularly attractive as currents and tides are very predictable and reliable.

Extracting energy from the seas does pose unique challenges given the harshness of the ocean environment, the remoteness of some of the best sites, and the expense of building reliable infrastructure to bring power from the project to the shore. The potential for these technologies, however, is extremely high and the challenges are mostly ones that engineers are already familiar with in other contexts (e.g., installing and maintaining offshore oil platforms, and delivering power from offshore wind farms).

Seagen, the world's first commercial tidal stream turbine, was installed in 2008 near the narrow mouth of Strangford Lough, a coastal inlet in Northern Ireland. (It's an appropriate location for this first – Strangford Lough is also the site of the world's oldest excavated tidal mill, built by eighth century monks to grind their grain, showing the venerable history of tidal power technology). Seagen has a capacity of 1.2 MW, enough to power 1,140 Ulster households.

Strangford Lough is legally recognized as an “Area of Outstanding Natural Beauty,” and the impact of Seagen is being closely monitored. So far there have been no reports of significant harm to the marine environment, and as the structure is mostly submerged it has little scenic impact. The same technology is slated to be installed next in a 10.5 MW project off the coast of Wales, and the company behind it is now exploring the potential of the Bay of Fundy off Eastern Canada, site of possibly the world's most powerful tidal current.

Voith Hydro, one of the world's largest suppliers of conventional large hydro turbines, is testing a new tidal turbine design in Korean waters and is an investor in a plan to build “the world's first tidal current power park,” a 600 MW project in Jeollanam-do Province.

While tidal current technology appears likely to be very low impact, the same is not true for the better-established tidal barrage schemes. A tidal barrage is essentially a low dam across an estuary. Tidal barrages can generate very large amounts of power, but can seriously harm estuarine ecosystems by changing their salinity

Continued opposite

India Moves Forward with Groundbreaking Solar Plan

by Anna da Costa

The first phase of a solar mega-project, aimed at expanding India's solar capacity from the current three megawatts (MW) to a reported 20 gigawatts (GW) by 2020 and 200 GW by 2050, was approved in January. The program, called the National Solar Mission, will form the centerpiece of the nation's climate change strategy and cost an estimated US\$20 billion to implement.

With worldwide installed solar-generation capacity totalling just 16.5 GW, and India's power generation capacity at 150 GW, the plan is notable for its scale and ambition.

In 2008, Prime Minister Manmohan Singh said the sun would occupy "center stage" in India's climate strategy and that the success of the solar endeavour would "change the face" of the country.

Already, India's Solar Mission represents one of the world's largest renewable energy plans to date, with promises to establish India as a global solar leader, draw new investment to the country, and spur the creation of new industries and jobs.

In January, *Renewable Energy World* reported that US\$950 million was approved for the first phase. Officials say funding for the rest of the program will come from a mix of sources. "We have kept several options open – budgetary support, taxes on fossil fuels, and international funding or a combination thereof," said Shyam Saran, India's special envoy on climate change.

Several international studies have pointed to the potential benefits of solar energy for India, including lower long-term energy costs, greater energy security, rapid scalability, and job creation, in addition to multiple environmental benefits. But the studies observed that India had not yet demonstrated the political com-



While India's national solar plans gain steam, many communities are taking the lead by building village-scale projects. The village of Legga in Rajasthan was solar-electrified by women trained as Barefoot Solar Engineers. Photo: Knut-Erik Helle, justworldphoto.org

mitment needed to jumpstart the industry. (Currently, India gets around 70% of its energy from coal, and coal use is expected to grow in coming years.)

Among other elements, the Solar Mission will rely on a portfolio of policy measures to support the growth of local industry and innovation around solar technology – from raw materials to components – through the establishment of dedicated solar and technology parks. The goal is to achieve cost parity of solar energy with grid power by 2020, making solar "very cost competitive with respect to other fossil fuel based power," according to an early draft of the plan.

V. Subramanian, former secretary of the Ministry of New and Renewable Energy and CEO of the Indian Wind Energy Association, has suggested that the success of the plan will depend not on massive government or international funding, but on changes to national and state energy laws and "the appropriate institutional structures to facilitate implementation at the state level." Such changes would allow the solar industry in India to thrive as it

has in Germany and Japan – countries with meager solar resources in comparison, he said.

Looking to the future, Nicholas Parker believes the solar plan could be just the beginning. "If current calculations are right, solar will be cost competitive with fossil fuels in the next 5-10 years," he said. "Hopefully by then, we will look back and say that this plan was not audacious, but a tentative first step." ●

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The Next Wave *continued*

and sediment flow patterns, blocking passage for fish and marine mammals, and flooding coastal mudflats which have major wildlife value, especially for shore birds.

The British government is currently studying options for a major barrage in the Severn estuary between England and Wales. One of the options under serious consideration is an 8,600 megawatt power plant that could supply more than 4% of total UK electricity generation. Most of the large UK environmental groups oppose this megaproject.

Wave of the future

Britain and Ireland have one of the world's biggest concentrations of wave power potential. The resource is sufficient to supply 16% of the UK's electricity. The UK Carbon Trust estimates that up to 2,500 megawatts of wave power plants could be installed across Europe over the next decade. EPRI estimates that by 2025 the US will have installed 900 megawatts.

The world's first offshore wave farm to enter commercial

operation is the Pelamis "sea snake." The initial Pelamis scheme, installed off the coast of Portugal in 2008, had three floating cylinders made of hinged segments, each with a capacity to generate 750 kW. The scheme, however, had a tragically short life. Its cylinders sprang leaks and had to be towed off for repairs only two months after its deployment.

The company behind Pelamis is now working on a second generation machine. In December 2009 they announced a joint venture with Swedish utility Vattenfall to build a wave project off the Shetland Islands in the North Sea, up to 20 megawatts in size.

Brazilians have a joke that theirs is the country of the future ... and always will be. For years, wave and tidal power similarly seemed to be on the verge of a breakthrough into the big league of power sources, but for technical and cost reasons failed to meet the promise. Today, concerns over climate change and a sharply rising tide of political support for renewables, coupled with steady technological progress and investor interest, mean that the future has finally arrived for the new hydropower. ●

News Briefs

by Suzanne Wong and Jill Eisenberg



Guri Dam

Venezuelan economy crippled by drought

Venezuela is in the midst of a severe drought-induced energy crisis, which threatens to paralyze the government, economy, and daily life. The government mandated stringent limitations on electrical use in January, ranging from trimming state employee work time to cutting hours of operation at shopping centers.

Venezuela depends on hydropower for 90% of its electricity needs. The Guri Dam, one of the world's largest hydroelectric dams, supplies 73% of the country's domestic energy, while reserves of oil and natural gas are primarily exported. The current energy deficit is the result of Venezuela's worst drought in 40 years. The Guri Dam's water level risks falling too low for the electricity-generating turbines to operate.

President Hugo Chavez's government is scrambling to prevent an all-out energy collapse of the electricity system due to the decreased productivity of the Guri Dam. President Chavez has ordered a 20% reduction in electricity from various sectors including metals companies, billboards, casinos, and malls. He reportedly has even enlisted the aid of Cuban pilots to combat the drought with cloud seeding. The dam operator asked its workers to invoke the help of God to overcome the energy crisis.

Heavy dependence on hydropower has left Venezuela vulnerable to unpredictable rainfalls year after year. In 2009, Venezuela reported four nationwide blackouts and daily stoppages were commonplace in several cities.

Critics of the government argue that the present energy emergency was inevitable because of the reliance on an outdated system. Former Venezuelan Congressman and petroleum geologist Gustavo Coronel says, "For the last ten years the infrastructure generating both hydroelectric and thermal electricity in the country has been badly neglected."

Can't see the forest for the fish

Ghana's fishing community and environmentalists are torn over a foreign-investment project to harvest submerged tropical trees from Lake Volta, Africa's largest reservoir. The developer, Clark Sustainable Resource Developments Ltd., claims the project will create jobs, have minimal environmental impact and relieve deforestation pressures in Ghana.

The company, headed up by former Canadian Prime Minister Joe Clark, plans to harvest millions of underwater trees from Lake Volta. Investors foresee the potential to bring in up to US\$3 billion in ebony, teak, mahogany and other tropical hardwoods.

The company says the project will reduce the level of global deforestation by bringing old-growth timber to market without devastating living forests. Clark asserts new technology will minimize disturbances to the lake's unique environment.

Community members are concerned about the potential loss of livelihoods among the fishing community, and impacts on the lake's fragile ecosystem. Environmentalists question what will happen to the tilapia and other fish that reside among the root systems of the submerged trees.

Impacts to fisheries would have ripple effects on the livelihoods of community members. Fishing has been the main livelihood for much of the Lake Volta community since the completion of the Akosombo Dam in 1965.

The Ganges gets second chance

The Ganges, one of the world's most polluted rivers, is slated

for a makeover. The World Bank has pledged to loan India \$1 billion over the course of the next five years to restore the integrity and health of the Ganges.

The Ganges is a major artery in India and supports more than 400 million people. The majority of India's Hindus believes rivers are sacred and routinely bathe in the unsanitary Ganges as part of religious custom. Years of lax regulation and neglect have allowed industrial chemicals, agricultural pesticides, urban waste and sewage to pollute the 1,500-mile-long river.

The loan will provide financial support for new sewage treatment plants, drain renovation and measures to improve long-term water quality. Although previous attempts to improve the Ganges have failed, the World Bank and Indian government are intent on cleaning up the Ganges by 2020.

\$5.5 billion boost for concentrating solar

The Clean Technology Fund approved \$750 million in financing to support the global implementation of concentrating solar power. This financing will be used to mobilize an additional \$4.85 billion from other sources. The funds will be used to support concentrating solar power programs in Algeria, Egypt, Jordan, Morocco and Tunisia. The fund is supported by the World Bank and other multilateral banks to facilitate the development and implementation of low-carbon technologies.

Another threat to Colorado River

A new plan to divert water from the Colorado River has environmentalists and government officials up in arms. Entrepreneur



The Colorado River. Photo: NASA

Aaron Million proposes building a 400-mile-long pipeline from the Green River, a Colorado River tributary, which would divert up to 250,000 acre-feet of water each year to outlying Colorado suburbs.

One of the largest US pipeline projects ever conceived, the project could generate \$250 million a year for Million Conservation Resource group, but at considerable costs to the environment. Many Utah and Wyoming officials, environmentalists, and community members say the proposal would impact the Seedskadee National Wildlife Refuge, degrade municipal supplies and further threaten the already overburdened river. Officials highlight the yearly struggle to meet current needs of the already many groups dependent on the river.

Seedskadee Refuge manager Carl Millegan says that rerouting the river will hinder the Kokanee salmon migration from Flaming Gorge, which much wildlife depends on for sustenance.

Million says funneling the water to Colorado will not endanger the wildlife refuge or communities in Wyoming and downstream Utah. Million defends Colorado's right to the water under the Colorado River Compact, and cites the rising water needs of Colorado's growing population, which is expected to double to 10 million by 2050.

China to build Cambodia's largest dam

China Huadian Corporation announced plans in January to build a \$558 billion hydropower plant in Cambodia. The project, located 112 miles west of Phnom Penh, would be the largest in the country. The announcement follows the signing of a financing agreement between the Export-Import Bank of China and Huadian.

Brazil gives green light to Belo Monte

Environmentalists, indigenous people, and social movements in Brazil condemned the preliminary environmental license issued in February by the Brazilian environmental agency IBAMA for the Belo Monte Hydroelectric Dam. Belo Monte, which would be the world's third largest hydroelectric project, would divert the flow of the Xingu River and destroy an extensive area of the Brazilian rainforest.

Belo Monte is the largest project of the Lula government's Plan to Accelerate Growth. The government says it plans to offer the project to private investors at an auction in April, and that construction would begin in late 2010. The project is one of more than 100 large dams being planned in the Amazon, many of which would threaten indigenous lands and protected areas.

IBAMA had stalled on issuing the environmental license for almost three months due to concerns about the project's huge impact zone and the number of migrants that would move to Altamira in search of work. Two senior IBAMA officials resigned last November after complaining that they had been subjected to political pressure to approve the license.

Indigenous people have been fighting the project for more than 20 years. Megaron Tuxucumarrãe, a Kayapó

chief, said, "We want to make sure that Belo Monte does not destroy the ecosystems and the biodiversity that we have taken care of for millennia. We are opposed to dams on the Xingu, and will fight to protect our river."

Independent investigations have found that project studies underestimate the extent of Belo Monte's potential impacts. Federal attorneys have filed suit to force the government to hold additional public hearings to discuss the project's impacts. Further legal challenges to the project are likely.

Climate scamming

A burgeoning partnership between two banks may mean more dams in China and more coal in Botswana, even as bank directors claim that it will help lower the carbon emissions that contribute to climate change.

In 2007, the Industrial and Commercial Bank of China (ICBC) acquired a 20% stake in South Africa's Standard Bank, at the time one of the biggest single foreign acquisitions by a Chinese company. Standard Bank operates one of the largest teams in China among foreign banks dealing in carbon financing.

In May 2009, both banks agreed to finance Botswana's Morupule B coal plant project for nearly US\$1 billion, in addition to a pre-existing loan of \$136 million from the International Bank for Reconstruction and Development. The project involves a 600 MW coal-fired power station, adjacent to the existing Morupule A Power Station in eastern Botswana. Besides local air pollution, the environmental impacts that project developers expect include water pollution, habitat destruction and the loss of topsoil.

As if in exchange for ICBC's support of Morupule (not to mention having a 20% say in its operations), Standard Bank agreed to buy CO₂ emissions reductions from three new

hydropower plants in China last December, once they were registered under the Clean Development Mechanism (CDM). These plants will be operated by GD Power Development Co., one of the five largest power producers in China.

Despite having a large hydropower portfolio, GD will be able to receive CDM financing for projects it would have built anyway (a recurring problem for the CDM).

If registered, these projects could mean up to four million tonnes of fake CO₂ emission reductions during a 21-year period for the polluters that purchased these carbon credits. Standard Bank already has four registered hydropower projects in China, with carbon credits purchased by the Netherlands and the UK. It also has one withdrawn project which, according to a CDM board review, could be the result of a lack of proof that CDM financing was essential for the project.

In the face of more coal in Botswana and more dammed rivers in China, the real winners in this growing partnership will be the European polluters purchasing these credits.

Mekong drought

The Mekong region is experiencing its worst drought in a century. The impacts of the catastrophe are affecting fishing, navigation, water supply, and the region's farmers in the Delta, usually one of the world's most productive "rice bowls." Upstream dams are partly to blame. China has built or is planning to build eight dams along the Mekong (which begins in Tibet). Vietnam has built hydropower dams as well, and while it released some water to help with spring planting, it now says dam reservoir levels are at critical lows, and the state-owned electricity company says it can't let go of much more water.

Interview

The Fine Art of Watershed Protection



Alison Jones at Victoria Falls, Zambia.
Photo: © Bonnie Muench

Alison Jones has been photographing African and US landscapes for 25 years. Her “No Water, No Life” project combines the powers of photography, science and stakeholder information to document threats to watersheds, including dams, deforestation, climate change, and loss of wetlands and floodplains. We talked to Alison about her work for the world’s watersheds.

What was the inspiration for No Water No Life?

Jones: It sprang from a life-long enjoyment of photographing and being a part of nature. I grew up next to a gurgling stream that lulled me to sleep and filled my imagination. Years later I spent 800 hours as a Cessna copilot photographing waterways of nine African countries. I saw that life in Africa exists only along the green ribbons of rivers and lakeshores. I realized my images could help protect our environment, biodiversity and natural resources.

How do you incorporate science into your work?

Jones: Science is integral to “No Water, No Life” (NWNL). Many scientists wish they could hang their years of research on a wall next to images of endangered species and threatened ecosystems. NWNL believes that conservation photographers and scientists can and should serve each other. Scientists inform and validate our reports and publications. In return, our visuals and video interviews help publicize and disseminate scientists’ work to a much broader audience than that of scientific journals.

Of the various hotspots you’re focusing on, which one is closest to your heart, and why?

Jones: The watershed closest to my heart is usually the one I am currently documenting. In the Omo River Valley I was absorbed into homesteads of indigenous tribes and became a part of their daily rituals. Goats would wander into my tent as I watched elders paint spotted designs on their bodies with river clay and then onto black gesso-ed canvases I’d brought. I’ve swung to river-themed Blues in juke joints along the Mississippi Delta. I’ve grilled salmon under ancient cedars on the Salmo River, a Canadian tributary of the Columbia. From my childhood to today, I’ve lived in a cottage in the Raritan River Basin watching dragonflies and young skaters skitter over ponds. And in Kenya’s Mara River Basin, I stand tall and feel more in harmony with nature than anywhere else, as elephants splash in mud holes and wandering wildebeest decide whether to cross the river. Each river has its own winding course and its own character. Every river I’ve known has captured me with its movement, music, geology, riverine habitats and communities, changing moods and its essential, although vulnerable, gift of water.

What are the most exciting things you have on your plate for 2010?

Jones: Three expeditions are planned for 2010 to further document our case-study watersheds. I will co-lead a safari in Uganda’s White Nile River Basin in order to document Murchison Falls and the biodiversity, forests and habitats now protected by Uganda’s National Parks. Then our team will document the start-up of a Lake Victoria Basin Integrated Health Initiative. Sponsored by Direct Relief International, this initiative will address water-related health issues on the lake’s Kenyan, Tanzanian and Ugandan shores. This fall we’re planning an expedition to the Texas Panhandle in the Mississippi River Basin. This region struggled through the Dust Bowl droughts of the 1930s. A severe lack of rain and water availability the last few years has again devastated local ranches, farms and ecosystems.



White pelicans on the Mississippi. Photo: © Alison M. Jones

What lessons have you learned from the project?

Jones: Managing this project has meant taking crash courses in fundraising, video, interview techniques, hydrology and organizational workflow. But most importantly, I have learned that science is accessible, intriguing and essential to understanding and effectively addressing the sustainability of our freshwater systems. In school I dodged every science class I was supposed to take.

Continued opposite

JUST KICK IT

Four Harvard students think solving the energy problems of poor nations should be child's play. The team has come up with a soccer ball that converts the energy used to kick it around into electricity. For each 15 minutes of play, the ball can store enough energy to illuminate a small LED light for three hours. The goal (!) is to reduce poor families' reliance on polluting kerosene, now widely used for indoor lighting, and to tap into a huge energy source – kids at play.

Their sOcket ball generates and stores electricity during normal game play. "Soccer is something you will find in every African country," one founder, Jessica Lin, told the *New York Times'* Green Inc. blog. The team was inspired by dance floors that capture energy from the dancers' movements, and motivated by the huge need for clean, simple off-grid energy.

The idea is to sell the ball in Western markets and use the profits to subsidize the balls for sale at an affordable price in poor countries through organizations like Whizz Kids United, a South African NGO working to teach children about HIV/AIDS.

TREE POWER

London-based start-up firm Solar Botanic is trying to create the world's first useful fake tree. The firm's solar tree combines three different energy-generation technologies – gathering electricity from visible sunlight, heat, and from movement caused by wind and rain – on a "nanoleaf." Each tree gets thousands of nanoleaves.

Each branch will be added independently, and individual leaves or entire branches can be replaced as needed. The inverters needed

to turn the tree's electricity into usable alternating current will likely be located in the trunk.

The trunk will be made of recycled tires and plastic bottles mixed with liquefied waste wood. This wood biomass can be molded to look, feel, and even smell like an actual tree.

Solar Botanic says that each tree could produce between 2,000 and 12,000 kilowatt hours (kWh) of electricity a year. With the average US person using about 12,000 kWh a year, you'll need at least one large tree per person.

Each solar tree will probably cost between \$12,000 and \$20,000. At about 120,000 kWh over a 20-year life span, each kilowatt-hour would cost about 13.5 cents, not much more than the 2009 US average of 12 cents per kWh.

The typical US family of four would need four trees at about \$64,000. But said family already pays the electricity company more than \$100,000 for 25 years of electricity (at current rates), then it's not too bad of an investment for non-toxic (and aesthetically pleasing) power.

It's going to be awhile before our urban forests become power plants, though: a prototype probably won't be ready until 2012. ●



A Solar Botanic nano-leaf

Interview *continued*

Now I tell students how much I regret that. Science holds the key to new technologies needed to purify, recycle, store and distribute our water. It's the sci-fi nature of cutting-edge solutions, such as nano-sponges and toilet-to-tap recycling, that will help the planet's rapidly growing global population deal with its growing thirst.

It wasn't until NWNL's first source-to-sea expedition that we understood the significance of stakeholders as citizen scientists. Expedition meetings with local stakeholders were originally conceived as a chance to learn about places and people to document. Instead scientists, farmers, fishermen, Native Americans, River-Keepers, poets, politicians and stewards are anxious to share with us their struggles, their on-the-ground knowledge, and their need for solutions so that we can help their causes.

Most importantly, NWNL has learned that solutions to sustainable freshwater management must be both top-down and bottom-up, with a focus on reducing human consumption, waste generation and extraction of natural resources.

It can be discouraging to focus on troubled areas where you have little clout to change things. What gives you hope?

Jones: Our hope for the future comes from listening to the many stewards and community partners working tirelessly and creatively to effect sustainable change. Even small grassroots acts reveal the power of the human mind to devise solutions and change behavioral and consumptive patterns.

Perhaps most significantly, I am encouraged by 8th and 9th graders we are working with, who are often more aware of critical water issues than adults. I applaud teachers who are adjusting their curriculum to incorporate our recommendation to plan

their river-study curriculum with schools upstream and downstream so students can better explore and visually record their regional watersheds. Students following the NWNL model and sharing their findings with their communities represent one more step in raising awareness when they submit photographs, essays and letters to their local newspapers and other media.

More and more, adults and students are understanding that our water supply is finite and that humans must change their patterns of consumption and waste in order to protect our natural resources – the most vital of which is our finite supply of fresh water. ●



A Karo boy collects water from Omo River floodplain in Ethiopia. Photo: © Alison M. Jones

More information: nowater-nolife.org

On Twitter: <http://twitter.com/NoWaterNoLife>



Save the date:
Wild River Dance!
Celebrating 25 Years of
International Rivers

On Friday evening June 4, 2010, join International Rivers at the David Brower Center in Berkeley, California as we look back on 25 years of

successes, and celebrate a future of free-flowing rivers.

Join old friends and make new ones. Enjoy delicious organic food and drinks and dance the night away with us!

For sponsorship information, reservations, in-kind donations to the silent auction, and ad placement for the event's souvenir program, please contact:

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In Hot Water: Solar Thermal Takes Off

by Lori Pottinger

Solar thermal collectors – used for heating water and buildings (and even for cooling, through solar chillers) – are now the world's top renewable energy source, producing more energy than wind power, and more than geothermal, solar photovoltaic (PV) and ocean energy combined, a new report states.

In 2009, there were 147,000 megawatts (MW) of wind power, and 174,000 MW of solar thermal collectors. By comparison, there were only about 1,000 MW of concentrating solar plants (another type of solar thermal) and about 17,000 MW of solar PV capacity around the globe.

Solar thermal collectors use much simpler technology and convert far more of the sun's energy into useful heat than PV. They also are priced much lower than PV panels, and have a quick short-term payback period compared to other renewables.

The global market for solar thermal is booming. An estimated 60 million households worldwide heat water with the help of the sun. In 2008, the use of solar thermal jumped by around 40%, in part due to rising oil prices. It's expected to grow by around 15-20% annually in coming years.

Depending on the region, solar thermal plants can offset up to 60-70% of the energy required for warm water and heating.

According to the Swiss bank Sarasin, two-thirds of the world's solar thermal units are installed in China, where the government

has encouraged their manufacture and installation.

Mexico is trying to bring the technology to some of its poorer communities, using cheap loans to finance the installation of solar thermal, and sharing information and technical assistance. One case study is the working-class settlement Heroes de Tecamac in Mexico City, where 1,000 households have installed solar thermal systems.

Solar thermal energy has now found mention in the EU's renewable energy directive for the first time. EU member states have to present their plans for the national implementation of the directive by June.

New solar thermal markets are likely to develop in Indonesia, Mexico, South Africa and Brazil. Promising signs are also visible in southern Europe, the US, Australia, and India.

Two US senators recently introduced national legislation calling for the installation of 10 million solar PV systems and 200,000 solar water-heating systems by providing financial assistance to businesses, homeowners and government bodies. California recently approved \$350 million in rebates for homes and businesses that switch to solar water heating.

Even the grey UK is betting on solar water heating. New feed-in tariffs in Britain will encourage homeowners to install systems, and help bring the nation closer to meeting its carbon-reduction targets. ●