

WORLD RIVERS REVIEW

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Here Comes the Sun

Taking Solar Power to Grid-Scale

by Lori Pottinger

What renewable energy source is highly reliable and predictable, especially productive during the hours of highest electricity use, can be scaled small enough to power one building or big enough to electrify a town, is a proven technology whose costs keep dropping, creates more jobs than gas or coal, and could, with a major rollout, displace 2-3 billion tons of carbon annually worldwide?

The answer is concentrating solar power, which uses mirrors and the power of the sun to run steam turbines. Unlike some other energy innovations being put forth today – “clean coal,” for example – there’s no “smoke

and mirrors” trickery about it. Just mirrors. Lots and lots of mirrors.

This exciting renewable energy technology has been working reliably in California since the 1980s, when oil was cheap and climate change was for wonks. Today, the political and economic conditions that prevented a major rollout of the technology are, pardon the pun, almost a mirror image of the situation in the 1980s. Today, every indication is that concentrating solar power (CSP) is on the cusp of a renaissance, thanks to increased investments in R&D, tariff support for CSP plants’ electricity in Spain, and a growing realization among governments and

financiers that the world needs to build renewable energy sources now.

A surge of development in Spain and the US West is well underway. Two plants producing 65 megawatts of electricity have recently been built in the US (adding to California’s 355 MW of CSP), while Spain has completed 10 MW, has 50 more projects in the pipeline, and intends to develop 500 MW by 2010. The goal of the US National Renewable Energy Lab (NREL) is to help develop up to 4,000 megawatts of CSP in the southwestern US by 2015. “This penetration level is aggressive, but possible if the 30% investment tax credit is extended per the primary recommendation of the task force,” says George Douglas, an NREL spokesman.

Elsewhere, plants are planned or being built in Egypt, South Africa, Australia, Libya, Algeria, India, Israel and Morocco. And if a Jordanian prince has his way, tens of thousands of megawatts would be generated in the Sahara for sale to Europe. *Renewable Energy World* forecasts 6,400 MW installed globally by 2015, leaping to 36,850 MW by 2025. By then, they project an annual installation rate of 4,600 MW/year.

“After more than a decade of inaction, CSP is finally taking off,” says Sven Teske

Continued on page 14



A line-concentrator solar power plant in the Mojave Desert, California. Oil in the receiver tubes collects the concentrated solar energy as heat. The hot oil is then pumped to a power block located at the power plant for generating electricity. Photo: Warren Gretz

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A NEW CLIMATE FOR WATER PLANNERS

The central assumption governing the design and operation of all major water projects has just been declared dead by a group of leading water and climate scientists. Designers and builders of dams need take note.

The scientists, led by Paul Milly of the US Geological Service, explained in a recent article in *Science* that our dams, floodwalls and sewers have been designed and operated under the assumption of “stationarity” – that natural systems fluctuate within a defined set of extremes that can be estimated from past experience. But climate change means “stationarity is dead” for water resources planning, the scientists say.

Two recent studies of the western US from scientists at the University of California’s Scripps Institute show just how quickly streamflow is changing. One study found declining snowpacks and earlier spring river run-off over the past 50 years, all consistent with climatologists’ models. The authors maintain that models for future warming mean “a coming crisis in water supply” over the next 20 years for an already water-stressed region.”

A second study’s findings were shocking even to longtime observers of US water resources. This study calculates that Lake Mead, the massive desert reservoir behind Hoover Dam, could run dry within 13 years if climate changes as predicted. There is only a 50% chance of there being enough water in the Colorado River within nine years to turn the turbines at Hoover. “We were stunned at the magnitude of the problem and how fast it was coming at us,” the lead author told journalists. Lake Mead supplies almost all the water for Las Vegas and much of that used in southern California and Arizona.

The inability of water planners to cope with the new paradigm imposed by global warming is strikingly shown by a study on allocating Colorado River water in dry years, released last year by the Bureau of Reclamation. Although the issue under consideration was how to deal with hydrological extremes, the Bureau’s study did not look at the impacts of climate change.

This head-in-the-sand approach unfortunately appears to be the rule in dam planning. While dam feasibility studies are now finally starting to mention the impacts of climate change, the norm seems to be that they do so only to dismiss them.

The recent economic study by Power Planning Associates Ltd. used to help justify the World Bank’s approval of Bujagali Dam in Uganda dismisses the possibility of climate change altering flows of the Nile out of Lake Victoria (the source for Bujagali). “[C]limate change is not found to be significant enough in the medium term [to 2030] to influence hydrological scenarios” for this dam, say the consultants. Even more mind-boggling is the complete denial of the impacts of global warming in last year’s environmental study for Ghana’s Bui Dam by consultancy ERM. This study claims that climate change will only affect dam safety and performance “over the very long term (i.e., thousands of years).”

To be fair to the consultants, there is as yet no agreed concept to replace stationarity. And it is never easy for professionals to discard the assumptions on which their training and careers have been based. Paul Milly and his colleagues suggest a framework for post-stationarity water resources planning, and it is clear that this must be based on broadening the range of potential flow scenarios and helping decision-makers understand the implications of increasing hydrological uncertainties.

But just pretending that climate is not changing, and encouraging governments to make major investments in climate-sensitive infrastructure on this basis is highly irresponsible. The government of the Caribbean nation of St. Vincent and the Grenadines noted in the UN General Assembly on February 13 that “[m]any of us are still paying for infrastructural investments that are no longer viable, or whose effective lifespan will be severely curtailed by climate change. Many of us have to borrow more to retrofit previous investments, which are often funded and designed and built by foreign lenders. It is illogical and immoral that we continue to pay developed creditor states for items whose very use is compromised by their actions.”

If such calls for accountability become more common, water resource consultants may finally have to face a harsher climate reality.

Patrick McCully

MAKING WAVES

The Heat is On

Bui Dam, now being built in Ghana with financial backing from China Exim Bank, is described in the project environmental assessment (by UK consultants ERM) as having “minor” greenhouse gas impacts. In reality, it could end up becoming a major emitter of greenhouse gases.

Patrick McCully, International Rivers’ Executive Director, writes, “The ERM conclusion that the dam’s greenhouse gas impact will be ‘minor’ appears to be a deliberate distortion of reality. As a tropical dam which floods a very large area relative to its power generation capacity, Bui’s greenhouse gas emissions are likely to be significant and of a magnitude similar to those of Brazilian dams that are known to be major emitters. It can be assumed that Bui’s emissions would also be multiple times those of a natural gas power plant.” Our comments are being circulated by a citizens’ committee that is evaluating national dam-building against the recommendations of the World Commission on Dams.

Tools for Change

An upcoming guide by International Rivers offers advocacy tips to groups trying to address the impacts of dams built by China. The new report summarizes the growing phenomenon of China’s role as the world’s biggest dam-builder, which is affecting rivers and communities in at least 80 countries around the globe. The guide features a “who’s who” in China’s dam industry;

summarizes policies guiding Chinese dam building overseas, suggests best ways to approach Chinese institutions now building dams, and gives contact information for Chinese dam companies and financiers. *The Citizen’s Guide to Chinese Dam Building* will be available in April at internationalrivers.org (visit the new “Tools for Activists” section).



International Rivers recently visited communities who would be affected by Mphanda Nkuwa Dam on the Zambezi in Mozambique, and shared “lessons learned” from other African dams. Afterward, the village chief urged community members to “tell everyone you know about these things. The new dam cannot be allowed to bring us suffering.” China and Brazil are involved in the project.

In the News

“What Laos needs is a development strategy to reduce poverty without destroying the rivers and resources upon which Lao people depend,” says Shannon Lawrence of International Rivers. ”

From “Laos plans a water-powered future,”
BBC World’s Asia Business Report, Nov. 21, 2007

“The jewel in the crown that companies from around the globe are eagerly eyeing is the Grand Inga, the world’s biggest dam project, proposed for the Democratic Republic of Congo. At an estimated cost of \$80bn, Grand Inga will be a magnet for corruption in one of Africa’s least stable regions. Its price tag does not include distribution networks needed to supply energy to the long-suffering people of that country. Mining, timber and other industries will be the main beneficiaries, while poor farmers and fishers who depend on the river’s flow of the water and nutrient-rich sediments will be the losers. ”

From “Dam Shame,” a Jan. 23 op-ed in the UK *Guardian*
by Lori Pottinger, International Rivers, and Korinna Horta, Environmental Defense

Amazon Auction Sparks Protests, Lawsuits

The Brazilian government’s auction of the Santo Antonio Dam project on the Madeira River in December was met by demonstrations in Brazil and international protests. Two dams and an industrial waterway are planned for the Madeira River, the Amazon’s principle tributary, but activists and independent experts have criticized the project’s potential impact on rainforest ecosystems and communities.

Friends of the Earth Amazonia filed a lawsuit to stop the project. And on Dec. 10, some 300 members of the Brazilian Movement of Dam-Affected Peoples and Via Campesina occupied the National Electrical Energy Agency in Brasília, delaying the start of the auction, before being forcibly removed by police. Meanwhile, in Porto Velho, near the dam site, hundreds of people rallied to call for the auction to be cancelled. International Rivers organized a phone and fax barrage to Brazilian embassies and consulates around the world to protest the auction.

As expected, a Brazilian consortium won the right to build the dam. But activists vowed to continue the fight over coming months, as the dam builders work to meet 33 conditions placed on the project by the Brazilian environmental agency IBAMA.

The Klamath: No Dam Deal Means No Damn Deal

by Elizabeth Brink

Water wars in the arid western US are nothing new, but the rules of engagement have changed. The Klamath River basin on the California-Oregon border has been the stage for a decades-long epic battle between farmers, fisherman, government agencies, utilities, and tribes with treaty rights to dwindling salmon populations. More than 26 diverse groups have worked together to negotiate solutions to the most pressing problems the river faces, and are now close to a breakthrough that may breathe new life into the struggling river and its people.

The stakeholders' group unveiled its Klamath Basin Restoration Agreement on January 15. The agreement is designed to provide irrigation for upriver farmers, ensure adequate flows for the health of the river and restoration of fish populations, and guarantee tribal fishing rights.

At the heart of the matter, and the primary reason the stakeholder negotiations have been so protracted, are four century-old dams on the Klamath that many contend must come down to restore the river and its fisheries. The dams are responsible not just for blocking and killing fish, but also for outbreaks of toxic algae at levels thousands of times greater than what is considered safe for human health.

Dangerous to touch and poisonous when ingested, the algae are known liver toxins implicated in tumor growth and organ failure. The off-gassing from this algae releases methane, which adds to global warming.

The Federal Energy Regulatory Commission has stated that dam removal will save \$210 million for ratepayers using the dams' electricity. "Replacing the dams' power with real green energy was factored into economic studies. Add this to the millions of taxpayer dollars in disaster relief for commercial fisherman who lost their livelihoods to the 2006 salmon closure, and those dams are looking expensive," says Regina Chichizola of the Klamath Riverkeeper.

Where's Warren?

Proponents of the new restoration agreement argue that it represents a concrete step toward realizing the most ambitious dam-removal project so far in the United States, with a potential price tag of up to \$1 billion over 10 years.

Unfortunately, the hard-earned deal is missing a key component. It discusses no money for dam removal and has no commitments from PacifiCorp, the dams' owner, who left the negotiating table years ago. PacifiCorp Power is a subsidiary of Berkshire Hathaway, billionaire Warren Buffett's company. Buffett is the world's richest person.

Downstream tribes long afflicted by the impacts of low flows on water quality and fisheries have declined to support the agreement until these issues are addressed.

Craig Tucker, Klamath Campaign Coordinator for the Karuk Tribe of California, and a strong supporter of the agreement,

acknowledges that dam removal is fundamental to any real agreement: "If there's no dam deal, there's no damn deal. This sentiment is uniformly shared by the tribes, conservation groups, and fishermen at the table."

The Hoopa Valley Tribe, with its reservation located downstream on the Trinity River, was one of the parties to the long negotiation process, and was unable to accept the draft agreement because "it does nothing to remove dams from the Klamath River. And it uses the dam-removal dialogue and politicized science to support more water for Oregon irrigators at the expense of the fish."

More than half of the projected \$1 billion price tag for restoration

could come from money already being spent to mitigate the impact of the dams, which provide electricity for about 70,000 households. Arguments remain over who should bear the \$120 million cost of taking the dams down.

According to the California Energy Commission, with the money PacifiCorp would spend to modernize the Klamath River dams, the company could replace the entire project with a 170-megawatt wind plant, a 100-megawatt solar plant, or make efficiency upgrades to its distribution system.

"In short, removing the Klamath dams can be done without increasing greenhouse gas emissions

or raising electric rates a single penny," says Rebecca Wodder of American Rivers.

PacifiCorp Power disputes these estimates. Paul Vogel, a spokesman for the company, said, "Fulfilling everyone else's interests doesn't protect our customers. What we would not allow is for the cost of removal and the cost of replacement power to be totally borne by our customers."

Those who want the dams taken down have a few more aces to play. Klamath Riverkeeper, the Karuk Tribe and Friends of the River are now taking the issue directly to ratepayers through direct mailers and open houses to explain how dam removal and replacement power is cheaper than relicensing. This ratepayers campaign could put pressure on the Public Utility Commission to deny the rate hike as part of the dams' relicensing process. According to Tucker, "It is the PUC's job as regulator to ensure that the power company chooses the least cost option in a dam relicensing or else shareholders should bear the cost themselves." In this case, the biggest shareholder is Warren Buffett.

The state of California is also not likely to give PacifiCorp the Clean Water certification needed to operate the dams. "We also have several liability lawsuits on the toxic algae and fisheries issues on the Klamath that, if successful, will show that PacifiCorp is liable for the pollution that they are creating, and its impacts to fish," says Chichizola.

Meanwhile, the tribes, farmers, fishermen and conservationists in the Klamath Basin will continue to negotiate with PacifiCorp and hope for a swift resolution that clears the path for restoration of this beleaguered and battle-worn river basin. ●



Toxic algae blooms regularly poison PacifiCorp's Klamath reservoirs. A lawsuit filed against PacifiCorp last year states that the company has been aware of the problem for at least six years but has failed to correct it. Photo: Klamath Riverkeeper

Fish Ladders in the Tropics: A Trip to Nowhere

by Glenn Switkes

New studies confirm that fish ladders at dams in the tropics fail to meet their objective of guaranteeing the survival of migratory fish, and in fact could hasten the extinction of some species. Brazilian scientists found that ladders act as an “ecological trap,” attracting schools of fish to poorer environments, and making it even more difficult for them to reproduce.

Researchers studying a major dam built on the Tocantins River found that 16 migratory species were attracted by the turbulence of the water at the Lajeado Dam’s 874-meter-long fish ladder, built to simulate the rapids that were destroyed when the dam was built. At the base of the ladder, the scientists found greater than natural numbers of predators provided a serious challenge to the fishes’ ability to reach the ladder. Other predators stake out the ladder itself, attacking the fish as they maneuver through the barriers.

When the migrators finally reach the reservoir, they encounter clear, still waters that favor predators, including tucunaré and piranha. In the case of Lajeado, 282 times more fish climbed the ladder than those that descended. Larva and fry that return downstream encounter similar difficulties – lacking a strong current, their descent is slow, and predators await them in the reservoir.

In a study that analyzed fisheries impacts at a dam on the Paraná River and at a complex of dams on the Paranapanema River, scientists at the University of Maringá concluded that the fish ladders’ impacts were so great that “they should be de-activated immediately.” At Canoas I and II Dams, operated by Duke Energy, the ladders caused a collapse in fish populations downstream. Huge quantities of fish swam upstream the initial year of the ladder’s operation, but the following year the migration collapsed

– a sign that the fish that had climbed the ladder failed to descend.

Ladders can function relatively well in the northern hemisphere, but very few studies have assessed the effectiveness of these mechanisms in the tropics. The journal *Neotropical Ichthyology* (www.ufrgs.br/ni/) published a special edition with studies about fish passage in June 2007. Researchers found the efficiency of the fish elevators at Yacretá Dam (Paraguay/Argentina) in transporting migratory species to be only 2%, with nearly all the fish successfully transported from only three non-migratory species.

In Brazil, technical studies have often advised against construction of fish ladders, but environmental regulations required them as a symbolic mitigation measure. Studies are inconclusive about the effectiveness of the fish passage which was built at Itaipú Dam in 2002, 19 years after the dam began operation, but it is already being put forth as a model for the fish passage proposed for the Santo Antônio and Jirau dams on the Madeira River in the Amazon, which has one of the world’s highest diversity of fish species. The passage simulates diverse environments, and includes fish ladders, a natural fish passage channel, two artificial ponds and a lake for reproduction.

Although Amazon fisheries are a billion-dollar resource that sustains tens of thousands of families, Brazilian President Lula has made statements trivializing the issue, complaining that opponents of the Madeira dams “were trying to dump catfish in his lap.”

In the fight to save the Amazon, activists are calling attention to the risks of relying on ineffective passage systems to protect such rich fisheries. “The construction of the Madeira dams would

affect thousands of families here in Porto Velho, who earn a living fishing and selling fish,” says Iremar Ferreira of the Living Madeira Institute. “The poorer families are especially dependent on fish for their dietary and nutritional security. The proposed mitigation measures are a huge technological experiment, and the impacts of the dams would be grave and permanent.” ●



The elaborate fish passage at Itaipu Dam is being used as a model for new dams in the Amazon, but its effectiveness has not been proved. Photo: Caio Coronel/Itaipu Binacional

India's Ugliest Dam Builder

by Heffa Schücking

India's ugliest dam builder is undoubtedly the state-owned National Hydroelectric Power Corporation (NHPC). While the company is currently angling to acquire new capital, its operations at home and abroad have left a trail of ruined livelihoods and misery in its wake.

The best case in point is Burma. Where others see a human rights disaster, NHPC sees a prime business opportunity. In 2004, NHPC negotiated a contract with the country's military junta to build the Tamanthi Dam on the Chindwin River in Northwestern Burma. The dam is being built on the lands of the Kuki indigenous tribe, and will displace over 30,000 Kukis. Construction began in 2007, and according to reports from the area, the military has begun destroying villages and applying the slave labour system common to Burmese construction projects. Electricity from the dam will be exported to India and its proceeds will fill the military's coffers. As one Kuki leader says: "Tamanthi is yet another weapon in the hands of the junta."

Even in its home country (which after all prides itself on being the world's largest democracy), NHPC shows complete disregard for democratic norms or environmental and human rights considerations. In the Indira Sagar project in the Narmada Valley, NHPC enforced a regime of terror, forcing people to leave their villages through intimidation and the use of special armed forces. During the 2004 impoundment of the dam, NHPC began flooding villages without prior notice, so that many villagers had to run for their lives. In the Omkareshwar Dam area, just 50 km downstream of Indira Sagar, NHPC's approach has been similarly brutal. Here, the inhabitants of the village of Panthiaji were given only 24 hours to leave their homes, and were told that they would not receive any compensation unless they destroyed their own houses.

Ramphere Yadav of Panthiaji tells the story of what happened that day: "First we refused to go, but then the people from NHPC said that they would break our houses with their bulldozers and smash our belongings. So there was no choice. It was the monsoon and raining heavily, but we were forced to leave our homes, and all our belongings were lying in the rain. So we worked all night. We took out our belongings, took down our roofs and broke our homes because the pressure was so much. People were crying, and we were in extreme distress. Having to break our village was like breaking our own heart."

Amazingly, in spite of Supreme Court judgments, resettlement plans, project agreements, the conditions set out by India's Environment Ministry and state policies – all specifying that the affected villagers must receive land-for-land compensation and must be resettled at least six months before impoundment begins – NHPC has never provided a single family with new land. Recent-

ly, oustees in the Narmada Valley have managed to win a number of court cases against NHPC, so that the High Court of the State, for example, put a stay on the filling of the Omkareshwar reservoir. However, NHPC has completely ignored court decisions ordering it to compensate those who were already displaced for the Indira Sagar project. The result is that some 200,000 people, most of whom were formerly self-sufficient farmers, have been turned into refugees and paupers.



Women from Gunjari village in the Narmada Valley spent nine days standing in the rising waters to protest NHPC's lack of resettlement measures. Photo: NBA

Currently, NHPC's dam building is focused on India's Northeast, a region with a fragile ecology and home to over 100 indigenous groups. Here, too, the company is ignoring local laws and the rights of affected people. The best example is the Dzongu region in the state of Sikkim. Dzongu is home to the Lepcha people and the only remaining refuge for their culture. Over 100 years ago, when Sikkim was still an independent Buddhist Kingdom, Dzongu was proclaimed a Lepcha reserve in recognition of the tribe's unique culture and deep bond to nature. This law was affirmed when Sikkim became a member of the Indian Union

in 1975. In the meantime, the area adjacent to Dzongu has been declared a Biosphere Reserve to protect the region's spectacular biodiversity. NHPC has nonetheless begun planning and building a series of dams that will have severe impacts on both Dzongu and the Biosphere Reserve. The Lepcha are waging a desperate battle against these projects and last year, two of their leaders went on a 63-day hunger strike. As Dawa Lepcha, one of the hunger strikers, says: "The only law that the government is currently upholding is the Land Acquisition Act, which allows it to displace people. All other laws are thrown to the winds."

As a state-owned corporation, NHPC has been allowed to virtually ignore India's environmental laws and regulations, the conditions set out in project clearances, court judgments and in project agreements to guarantee the rights of people affected by its projects.

In recent years, the corporation has received support from European private banks such as Banca Monte del Paschi di Siena, Barclays, Deutsche Bank, HSBC, ING, Natixis, Société Générale and Standard Chartered as well as by the Asian Development Bank and export credit agencies such as Coface, Export Development Canada and JBIC.

NHPC has set a whole new standard for corporate social irresponsibility and sheer callousness. Any financial institution with a semblance of ethics needs to blacklist this corporation. ●

The author is with the German environment and human rights organization Urgewald. This article is based on her new report, "NHPC: People Don't Matter," which can be downloaded from internationalrivers.org.

Marching to Stop Dams on Mother Ganga

by Susanne Wong

For 15 days in January, hundreds of men, women and children marched across river valleys of India's Uttarakhand state to raise awareness about government plans to build dams. The government intends to build 220 large, medium and small dams in the upper reaches of the Ganges River basin, the country's holiest of rivers. Organizers say the scheme will transform the sacred Ganges into a plumbing system with all of the life engineered out of it.

"Our lakes and rivers, even the sacred Ganga, are in a rapidly deteriorating state. Our lives, work and cultures are threatened. If things go on unchecked, the continued existence of many villages is in question," said Dr. Ravi Chopra of the Uttarakhand Nadi Bachao Abhiyan. Most of the upper reaches of the Ganga will dry out with the extensive damming, critics argue.

Collectively, marchers visited 150 villages in 14 river valleys, including the Alaknanda valley where they met with villagers protesting the Kotli-Bhel hydropower project. Four people in Malettha village launched a fast-unto-death on January 15 to stop construction of the dam. On the eighth day of the fast, a state government minister met with protesters and promised that construction would be halted so the government could review the project with the participation of local people.

In Uttarkashi, activists held a rally urging the state government to stop the construction of dams on the Bhagirathi River. They argued that the government should first ensure that communities affected by an existing dam are adequately compensated.

Villagers in Chayeen village are already facing impacts due to dam-related construction. "Our village has been devastated by subsidence due to the tunnel for the Vishnuprayag hydroelectric project," said Geeta Bagasi. "The administration turned a deaf ear to warnings by the villagers that construction of a tunnel in this mountain was a hazard." Land subsidence destroyed the homes of 30 families in her village, and another 100 families are at risk.

The statewide actions are part of a larger effort to gather information, mobilize communities and put pressure on the government. Activists complain that environmental impact assessments for the projects were hastily prepared and incomplete.

"We are not campaigning against hydropower generation in Uttarakhand," said Chopra.

"We believe, however, that there are better ways to generate hydropower that pose less of a threat to people's lives and livelihoods."

The protests culminated in a statewide meeting to share findings and discuss future strategies. Campaigners presented the state's Chief Minister with a petition calling for a moratorium on dam construction until a comprehensive hydropower policy is developed in cooperation with dam-affected people. The Chief Minister told the press that the government would review the state hydropower policy. ●

"We are ready to die but we will not let them build dams on our sacred Ganga."

Pareshwari Devi



Marchers for the Ganga visited 150 villages in 14 river valleys. Here, Alaknanda river valley walkers approach Srinagar.

Patagonia's Best-Kept Secret

Activist Expedition Unearths the Mysteries of the Pascua

by Aaron Sanger

The Pascua River, in Chilean Patagonia, has many qualities that have so far kept it pristine – and virtually unknown. It is very difficult to get to. Located between the two largest ice fields on Earth outside Antarctica and Greenland, the river churns a treacherous path between two jagged mountain ranges. The only road that approaches anywhere near the Pascua leads you only to a point near the river's end. Once you finally reach its banks, you realize how truly daunting this river is. It's one of the fastest rivers in the world, with countless waterfalls and rapids more intense than Class 6, the most dangerous whitewater still considered survivable by boat. The Pascua is truly a river roller-coaster, embedded in a maze of canyons draining snow-capped peaks and glaciers.



Patagonia's mountains give rise to impressive rivers – and a lust for hydropower. Photo: Gary Hughes

Despite the obstacles, an expedition organized by International Rivers was determined to reach and explore the Pascua on foot. A Chilean conglomerate, the Matte Group, is pushing to dam the Pascua through a joint venture with Endesa called HidroAysen and controlled by the Italian monopoly Enel. International Rivers is part of a global campaign to protect the Pascua, and we felt the expedition could help the campaign by bringing the world first-hand knowledge about this river and the life that depends upon it.

I was one of eight who participated in the expedition. The other seven were expedition leader Gary Hughes, local guide Rene Millacura, Chilean documentary filmmaker Italo Retamal, Aysen resident Carlos Garrido, German ecology students Anna Rudlof and Maren Kloske, and British journalist Colin Barraclough.

Most river expeditions involve boating, but the Pascua is too wild for that. So we walked a rugged and uncharted path with fully loaded backpacks, sometimes more than 10 hours a day. Walking gave us an excellent visual and visceral experience of the terrain that forms (and is formed by) this great river. We walked up and down hillsides, around and over ravines, through dense brush, moss and mud – and finally to the tops of three unnamed peaks, each of which is higher than 1,000 meters.

All this trekking can make for a powerful thirst, and fortunately the Pascua made sure we had plenty of absolutely pure water to drink. That first mouthful of Pascua water broke a taboo that, sadly, many of the world's citizens must have against unboiled water from rivers. How liberating – and delicious – it was to break that taboo!

Our path went through a very strange, marshy area called *maillin* where we found islands of the most bizarre forest we had ever seen. Very old but diminutive, bonsai-like trees grew on huge humps of

peat moss, surrounded by water. We were able to cross the *maillin* only by walking around these floating old-growth forest islands.

After the *maillin*, we had to climb all the way to the snow pack to get around one particularly deep Pascua canyon. When we arrived at the swiftly running stream that drains the snow pack, a family of ashy-headed geese slowly waddled away, but our almost daily companions, a family of Andean condors, continued to circle overhead.

The next day our path began to ascend toward three unnamed peaks. During this stretch of the expedition we saw more *huemul* tracks than we had seen all the other days of the trip combined. The elusive *huemul* is a large, very beautiful deer native to Patagonia. Chileans are so proud of this creature that it is on their national coat of arms. But Chilean society has been so destructive of the *huemul*'s habitat that less than 3,000 survive today. Its scarce numbers and extreme shyness make it a very rare sight for humans.

And, despite seeing hundreds of tracks, prodigious amounts of scat and two skeletons – the Pascua's drainage is one of Chile's last refuges for huemul – I saw only one huemul during our expedition. He was running away quickly when I spotted him. For this critically endangered species, running away from humans is probably a good idea! If the dams move forward on the Pascua, however, there will be fewer

places for these timid creatures to hide.

The night before our pick-up date we camped above the tree line in a rocky bowl with snow patches melting into crystal clear ponds. While we prepared our dinner, a little dark-bellied *cinclodes* landed near our bags of food. It was either ignorant or unafraid of humans. As we went about our normal business, this intrepid bird hopped about our campsite as if it were taking inventory. Or maybe he was just lonely, as we were, since, other than a little moss, we were the only visible life forms at this particular spot on Earth. But on the horizon all around us were some of the world's most beautiful sights, the snow-covered Andes and the sun setting behind the Patagonian coastal range.

The next day, on the way to the highest of the three peaks, we had the exhilarating experience of two sightings of the rarest bird we saw during the trip, the white-bellied seed-snipe. Once we reached the highest of the peaks, we had the most breathtaking view of the expedition. In the full circle of our view we saw the Pascua roaring through one of its biggest bends, the Andes peeking above the horizon, icebergs floating in a lake – and the very inhospitable looking territory we had just trekked through.

We spent the last eight hours of our trip bushwhacking to our pick-up point through thicker and thicker undergrowth until it became clear that we were lost. Gary went ahead to scout a path forward, and I waited



If plans to dam the Pascua move forward, the very first dam would erase these exquisitely beautiful first falls at the Pascua's source, as well as a number of other falls further downstream. Photo: Gary Hughes

for the rest of the group to catch up. For 15 minutes or so, while totally alone in a dense stand of trees, I was visited by an extremely curious and bold *chucua tapaculo*, a bird that is commonly heard but rarely seen in southern Chilean forests. On this occasion, neither the bird nor I made a sound as we each enjoyed the closest and longest view that we had ever had of each other's species in the wild.

The next day, we boated from our pick-up point on the Pascua to our sponsor's small hostel on Lago Quetrué. At the confluence between the lake and the river, the Pascua's bright aquamarine water flows next to the deep blue of the lake. Crossing that vivid line, I felt something that I would only be able to understand later, after making the incredibly long return trip, from 49 degrees south where I began to know the Pascua to 49 degrees north in Bellingham, Washington where I live and work. By that

time I had crossed many other borders, many of them just imaginary lines on a map, but when the aquamarine turned into blue on the line between the Pascua and Lago Quetrué, I experienced a very real boundary between me and the river. And that's when I understood most clearly that, for a week, I had been inside the world of this ferociously wild river.

To experience the world of the Pascua is to understand things like the almost-lost treasure of pure water, the precious magic of wildlife that does not yet fear humans, and the sanctity of natural places that humans have not yet changed. And though it will take more than a week-long expedition with the Pascua to defend its rarity from the all-too-common effort to exploit it for profit, our expedition was part of a process to let more people throughout the world know what is there and why it's worth defending. ●

The elusive huemul. Photo: Cristián Saucedo



The Silver Lining in South Africa's Power Crisis

by Sarah Ward

South Africa is in the grip of a severe energy crisis, complete with rolling blackouts, industries stopping operations, much blaming and frustration – and plenty of opportunities.

The crisis now squeezing Africa's most industrialized (and electrified) nation has been brewing for some time. Eskom is one of the largest single electricity utilities in the world – it produces 96% of South Africa's electricity and 85% of Sub-Saharan Africa's electricity. Its electricity is the cheapest and among the dirtiest in the world. South Africa has been ranked as the least-efficient user of electricity out of 13 comparable upper middle-income countries (Brazil is more than twice as efficient, Hungary three times and Mexico four times).

Now, despite clear predictions in recent years of a looming shortfall, there is not enough power – either for South African citizens, industries and businesses, or for its neighbors who have long relied on its exported electricity. Billions are now being hastily allocated to Eskom to “quickly” build new coal-fired and nuclear plants. There is very little mention and no serious funding for renewable power plants or energy efficiency programs.

Fundamental to the problem in South Africa is the centralization of power (in all senses of the word). Eskom is the proverbial tail that wags the dog. We are a country force fed, and by now heavily addicted to, big power from one utility and one source of energy (electricity from coal power). When we should have been investing in efficiency and renewables, Eskom and the government were pursuing a pebblebed pipedream (small nuclear reactors which we would sell to China – but China has now built its own pebblebeds). Promising renewables like wind, wave and concentrating solar power plants are relegated to endless studies and even bogus pilot projects. Skilled staff have been laid off and maintenance schedules ignored. As with Jack's giant or David's Goliath, the colossus is falling. We stand at a moment in history which will determine South Africa's energy future: do we shore up the giant, or do we make a break for it – and change South Africa's energy picture forever, and for the better?

There is nothing like a crisis for opening the doors for much needed change. Suddenly energy has become everyone's issue – and it is this ‘democratization’ of energy which can spur the change. But how? Cities have the potential to be key movers and shakers here. Energy is the life blood of cities and they stand out as highly energy intensive nodes. South Africa's largest 10 cities use almost half of the country's energy, they account for three quarters of the GDP and are home to 50% of the population. Cities have different regional functions, needs, climates and resources: it is time for cities to step out of the ‘one-size-fits-all’ national shoe and take charge of their own energy security, carbon emissions and equity of access, and actively engage in developing an energy picture to suit their needs.

Imagine a city where:

- substantial energy supplies are provided by locally available sources (ocean, wind, sun, waste...) by several utilities;
- energy efficiency is heavily incentivized (it is much cheaper to save electricity than to make it) and the “polluter pays” principle is applied;

- safe and affordable energy sources are available to poor citizens and industry is encouraged to produce and purchase clean power;
- local government buildings are retrofitted for energy saving and staff are incentivized to reduce their energy consumption;
- municipal waste is turned into useful energy;
- all residential areas glitter with solar water heaters.

Sustainable Energy Africa has worked in partnership with cities to develop progressive sustainable city energy capacity and strategies. A number of cities now have excellent approved strategies with impressive targets – the real struggle now is with implementation. Cities are stuck in a quagmire of risk aversion, legislative and policy constraints and a history of being removed from their own energy production and supply. What is needed to help cities take charge?

Firstly, from within local government, we need political champions to take a proactive stand on their city's involvement in energy management, and this must be supported by appropriate institutional changes. As energy affects every aspect of local government, we also need energy capacity built across all departments.

Secondly, many cities around the world that are successfully implementing sustainable energy strategies have established energy agencies based on public-private partnerships to drive and coordinate sustainable energy project implementation. These agencies coordinate stakeholders around an Action Plan, raise and manage project financing and carbon trading funds, support the development of local energy businesses, support

the development of much-needed skills training programs, carry out monitoring and evaluation, and provide input to strategy revisions. Most importantly, they have the ability to bring key players together and to make things happen.

The key projects which Southern African cities should be implementing are:

- Information and education of residents and business (experience shows that energy efficiency gains are derived 20% from technology changes and 80% from the education of users);
- Mass solar water heater roll-out projects (in South Africa this would save 20-30% of household energy use which translates into a 5% saving of South Africa's electricity use), supported by training programs for solar water manufacture and installation;
- Energy efficiency projects in commercial buildings, housing and industry;
- Power purchase agreements for renewable electricity generation supported by active engagement with national governments around tariff subsidies to support renewable power;
- Waste to energy projects;
- Energy efficiency in municipal operations – cities must lead by example.

The benefits of greater energy security, reduced carbon emissions (and the associated economic competitive advantage), and local job creation which these will bring don't need to be spelled out. The challenge now is for cities to see the opportunities in this crisis and step forward to take their place at the power table. ●

Sarah Ward is an urban planner specializing in energy and cities. She is the author of The New Energy Book (2008), published by Sustainable Energy Africa.

Cities have the potential to help resolve South Africa's energy crisis and promote a more sustainable energy supply.

In Print

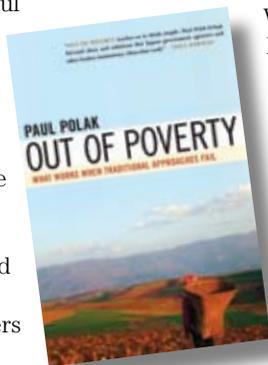
Out of Poverty: What Works when Traditional Approaches Fail by Paul Polak. Berrett-Koehler Publishers, Inc. 2008. US\$28.

Since founding International Development Enterprises (IDE) in 1981, Paul

Polak has worked to develop accessible and appropriate technologies that have helped millions of rural farmers around the world.

Out of Poverty draws on Polak's experiences with IDE to dismantle what he identifies as the "Three Poverty Eradication Myths" – charity, growth in GDP, and big business. However, after billions of dollars spent on aid and corporate-led economic expansion in the global South, there has been little progress toward alleviating poverty.

So, what works? At the heart of Polak's approach to poverty eradication are the world's poor themselves. Through a series of case studies of IDE partnerships with subsistence farmers and slum dwellers, he demonstrates that by enabling the entrepreneurial spirit of the poor it is possible for the poor to lift themselves out of poverty. For example, families of small-plot farmers around the world have been able to grow high-value crops thanks to treadle pumps and low-cost drip irrigation systems. And by fomenting the development of local markets that serve the poor, small-scale farmers are then able to take their produce to local markets for profit, improving their own standard of living and that of all of the other participants in the supply chain.



Out of Poverty is an engaging read, and offers a practical, measurable, and culturally sensitive approach to helping the world's poorest people.

(Paul Polak was a co-author of Spreading the Water Wealth: Making Water Infrastructure Work for the Poor, available at www.internationalrivers.org)

Reviewed by Karolo Aparicio

Cambodia's Hydropower Development and China's Involvement by Carl Middleton, International Rivers, and the Rivers Coalition of Cambodia, January 2008. PDF available at www.internationalrivers.org and www.ngoforum.org.kh

Strong support for large hydropower dam development by senior Cambodian decision-makers – backed mainly by Chinese project developers and financiers – is threatening some of the country's most precious ecosystems and the livelihoods of thousands of people, according to this new report. To date, hydropower development in Cambodia has proceeded in the absence of meaningful public consultation and with a lack of accountability in the decision-making process. The authors identify an urgent need for better energy planning practices and enforcement of existing laws before new dams are developed.

China's growing interest in Cambodia's hydropower development over the past couple of years is a complex interplay of entrepreneurial initiative on the part of Chinese State Owned Enterprises, backing by Chinese financiers, and high-level political support. In April 2006, China announced a US\$600 million aid package to Cambodia, almost half of which financed the Kamchay Dam,

Cambodia's first large domestic hydropower project. The project, now under construction by China's largest hydropower developer, Sinohydro, is located in Bokor National Park and will flood 2,000 hectares of protected forest. A second major hydropower project was approved in 2007 and six more large dams are undergoing feasibility studies, mostly by Chinese companies. Four of these projects would impact areas of the Cardamom Mountain's protected forest. In addition, Chinese investors are pursuing the Sambor Dam on the Mekong mainstream that, if built, would block major fish migrations and threaten habitat for the endangered Irrawaddy Dolphin, around which a thriving local tourism industry has grown.

Securing access to reliable, cheap electricity to supply Cambodia's expanding economy is a key challenge faced by the Cambodian government. The report calls on the government to establish a public process to examine the recommendations of the World Commission on Dams (WCD) report to explore how they could be adopted in Cambodian law. As described by the WCD, the report recommends that a participatory options assessment be conducted that would evaluate Cambodia's current and future energy and water needs and the best options for meeting these needs, including the potential role of decentralized renewable energy resources. When there is consensus among stakeholders that a hydropower project is the best option, planning to mitigate environmental and social impacts should be a priority and legally binding measures for benefit sharing put in

place. This approach, the authors argue, would ensure that Cambodia's electricity system is affordable, sustainable and accessible to all.

Global Perspectives on Large Dams: Evaluating the State of Large Dam Construction and Decommissioning across the World edited by Kara DiFrancesco and Kathryn Woodruff. Yale School of Forestry and Environmental Studies, 2008. PDF available free from: www.yale.edu

This report gathers more than 50 summaries of presentations from a conference held at Yale University in late 2006, plus a dozen full essays on a diversity of topics. The summaries of presentations – by river activists and experts, dam-lending bankers, government officials, lawyers and International Rivers' own Peter Bosshard – are less interesting than reading a complete essay, but do allow the book to cover a lot of ground efficiently. Panels on fisheries issues, legal aspects of dams, climate change and using dam removals to restore critical habitat for endangered species are just a few of the key areas covered. The report would be especially valuable to a reader interested in a short course on the issue of dam removal in North America, which makes up about half of the presentations. The second section, on dam construction around the world, takes a scattershot approach to a hugely complex topic: it includes much good information, but is perhaps a bit too "all over the map" for its own good. ●



News Briefs



Site of Apertadinho Dam after it ruptured. Photo: Rondoniagora

Brazil's failing dams

On the morning of January 30, the 32 MW Espora Dam on the Corrente River in Brazil ruptured during heavy rains, flooding seven cattle ranches, tearing down bridges, and destroying homes downstream. There were no reported deaths. The 45-meter-high dam had been inaugurated just 18 months before it failed.

Jobal Velosa Filho, who owns a ranch 20 km downstream, said that his property was totally destroyed. "The main ranch house, the orchard, the livestock all washed away. There's nothing left. The workers would have died, but luckily a fisherman saw the waters rising and shouted 'Run, the water's coming.' The dam simply exploded."

And in Brazil's Amazonian state of Rondônia, the Apertadinho Dam ruptured during heavy rains on January 9, releasing 31.7 million cubic meters of water which uprooted trees and forced the evacuation of 200 families. Much of the water was absorbed by floodplain forests, and some was retained by a larger dam under construction downstream. Although no injuries were reported, Rondônia's governor, who flew over the area shortly after the accident, said it looked like it had been hit by a tsunami.

The Brazilian environmental protection agency Ibama fined CEBEL, the dam's developer, US\$28.4 million for the damage. A preliminary investigation laid the blame on the project's designers and on inadequate understanding of the geology of the dam site. The dam was designed with a capacity of 30 MW, and was scheduled to begin generating energy in February.

Apertadinho's developers applied for carbon credits from the Kyoto Protocol's Clean Development Mechanism in late 2006, arguing that the dam was only being built because of the extra income the carbon credits would bring. Since then their application has remained stalled in the CDM bureaucracy, and the project was all but completed, proving that it did not need carbon credits. The developers could now claim that they need CDM income to rebuild the \$120 million dam.

Dams lead to yellow fever surge

Dams built in the central Brazilian savannas have contributed to the rise in yellow fever cases affecting monkeys, say environmental specialists.

The Corumbá IV and Serra da Mesa dams caused ecological changes that may be related to the surge of yellow fever in the state. As monkeys and other animals became infected, they moved closer to urban centers, said infectious disease expert Marcelo Daher. The Serra da Mesa Dam was built in 1998 and was related to a yellow fever outbreak two years later. At least 24 people died in Alto Paraíso do Goiás, a city close to the dam.

Wind industry weathers growing pains

Wind power continues to thrive despite growing pains in the industry, and is now contributing more than 1% of global power supply (94 gigawatts). Wind-generated energy grew almost 30% in 2007 from the year before. Shortages of materials and limited production capacity have hampered the industry's

ability to keep up with demand for wind turbines. The need for steel, copper, concrete and other materials has driven up project costs, restricted turbine supplies and created a difficult market for smaller wind developers, reports RenewableEnergyAccess.com.

Despite rises in project costs, wind power is still economically attractive as fossil fuel costs continue to rise. According to the Global Wind Energy Council, the global wind industry will grow at an average rate of 19% over the next three years. The Associated Press reported that over 3,000 wind turbines were installed in the US last year, enough to power 1.5 million homes for a year. By 2010, the US could overtake Germany in cumulative installed wind capacity. China and India will continue to be a major force in wind development in Asia, leading an expected average annual growth rate of 28% on the continent.

In the next three years, the wind industry is projected to reach almost 150 gigawatts of installed capacity, more than double the amount of cumulative installed capacity in 2006. Jobs in the industry continue to grow as well: some 350,000 people were employed in the wind industry in 2007.

"I got information about a windmill, and I try and I made it."

Self-taught windmill maker William Kamkwamba, who made three windmills out of bicycle parts and tree limbs to bring power to his parents' home in Malawi. The project has made him a local hero, and landed him a cover story in the *Wall Street Journal* in December. "Our lives are much happier now," says his mother.

"It's important that the technology provides an income for people and also that it takes root and flourishes in the area."

Cornelia Ehlers, co-founder of Green Step, a German NGO helping villagers in Cameroon build simple wind- and micro-hydropower systems. The group is teaching people in M' muock to make wind turbines using wood, poles and scrap metal from cars.

Wind power is not the only renewable on the rise. Growing public and private momentum is fueling a huge boom in worldwide clean-energy investment that could surpass US\$7 trillion by 2030, according to the CERA report "Crossing the Divide: The Future of Clean Energy."

Ghana Cements its Hydro-dependency

Faced with crippling power shortages caused by low water levels in the nation's major dam, the Ghanaian government is pressing forward with plans to build five new hydropower plants. In its 2008 budget, the government announced that it will invest \$460 million on the Hemang and Awisam dams on the Pra River; a dam on the Ankobra River; the Tanoso Dam on the Tano River; and the Juale Dam on the River Oti.

The project in the most advanced stage of construction is the Bui Dam. In December, Chinese contractors and local workers started clearing land to prepare for construction of the 400 MW dam. Many hope the project will alleviate the country's energy crisis, which has crippled mining operations and local businesses.

However, critics say the power will come at a high price. The project would flood nearly a quarter of the Bui National Park, destroy habitat for rare hippos, forcibly resettle 2,600 people and affect thousands more.

Chinese company Synohydro is building the \$600 million project and expects to complete it within five years. *Business Day* (Nigeria) reports that the Chinese government is providing 90% of the funding for the dam.

The Ghanaian government's renewed interest in hydropower comes at a time when nearly 70% of the country's energy supply comes from hydropower, and climate change brings new hydrological risks. Akosombo Dam has been at record lows

since August, with serious ripple effects on the economy.

Battle over salmon rages on

Top US fisheries officials have endorsed a plan to spend \$1 billion over the next 10 years to protect salmon and steelhead populations. The plan is the latest development in a raging battle over how far federal agencies should go to protect endangered species.

While the monetary amount is staggering, the plan rules out decommissioning four dams on the Columbia and Snake river systems. Environmentalists and fishermen view the dams as the main obstacle to restoring the 13 stocks of salmon and steelhead the government is required to protect under the Endangered Species Act.

The federal government is "dancing around the elephant on the table" by refusing to address dam breaching, said Glen Spain of the Pacific Coast Federation of Fishermen's Associations. "As a region, do we want to keep throwing money down a rat hole or move in a more positive direction?"

According to *The Oregonian*, the latest plan would focus on providing new equipment to detour fish around turbines, manage water releases to better match when fish are present, improve hatchery programs, restore salmon habitat and control predators.



US salmon face an uphill struggle.

Uganda gives green light to hydro

Now that the once-stalled Bujagali Dam is under construction, the Ugandan government is fast-tracking several new hydro-power projects.

Construction of the 200 MW Karuma Dam, located downstream of Bujagali, will start next year, according to Junior Energy Minister Simon D'ujanga. He stated that engineering designs have been completed and that project funding is currently being mobilized. The \$450 million project is a public-private venture between the Ugandan government and Norwegian company Norpak.

The Japanese government has also agreed to send hydro-power experts to Uganda to help develop the proposed 500MW Ayago hydropower plant, according to the *New Vision*. The Ayago site is in Murchison Falls national park, a World Heritage Site, and would have "unacceptably high" environmental impacts, according to Acres International, a dam engineering firm hired by the Uganda government to rank its hydropower sites.

The 100 MW Isimba hydropower project is also being developed by Uganda.

Overall, wild salmon populations in the Northwest have plummeted to 5% of their historic numbers, and many argue that time is running out.

China's Dam Regrets

A recent article in the *Financial Times* revealed a huge well of regret over the Sanmenxia Dam, built in the 1950s on China's Yellow River – and for poorly conceived large dams in general.

An Qingyuan, a former Communist party boss in the province most directly affected by the project, was most outspoken: "The Sanmenxia Dam has brought severe disasters to the people living near the river and those disasters far outweigh any benefits that might have come from the dam at one time ... This dam was really a stupid mistake."

The *FT* notes that An's long campaign to have the dam removed is supported "in the highest corridors of power, even by staunch supporters of the Three Gorges project."

The huge Sanmenxia was a catastrophic failure, and even senior Communist party

officials blame it for many of the region's environmental and social problems. The dam silted up quickly upon construction and had to be rebuilt. Hundreds of thousands of farmers were relocated from its reservoir area.

Critics of the Three Gorges project have warned that many of the Sanmenxia Dam's worst environmental consequences, including sedimentation, chronic pollution and worsening floods, are likely to afflict Three Gorges as well.

Although dam critics are discouraged from become too outspoken in China, this flawed project seems to be channeling a broader discontent with the large dam model that China is pursuing both domestically and internationally. Wu Xinmu, a professor at Wuhan University and a leading expert on water management in China, told the *FT*: "The world has entered a post-dam period and the Sanmenxia dam was clearly a mistake. We should learn from the lesson of Sanmenxia and consider the long-term influence of dams rather than the short-term benefits."

with Greenpeace's Energy [R]evolution Campaign. "For 2040, CSP has a chance to contribute to the global electricity supply in a double digit range. The main reason for this is good policy. In the USA there are Renewable Portfolio Standards in place, in Spain there are guaranteed tariffs."

How it works

CSP uses sun-tracking mirrors to concentrate solar heat onto liquid-filled tubes or central towers. The liquid is vaporized into steam, which is used to drive turbines to generate electricity. CSP plants act much more like conventional power plants than solar PV or wind farms, which make them more attractive to utilities. There are a variety of types of plants being tested and built, with different advantages to each. Because they are fairly simple to design and build, the plants go up quickly. A new CSP plant near Las Vegas, Nevada took about one year to build. (Permitting and land-use acquisitions add to the process, however.)

CSP still has obstacles to overcome. Most importantly to utilities is its still-high cost. While concentrated solar power is now less expensive than solar PV panels, it is still generally around 15-20 cents/kwh, well above fossil fuels and wind (though windpower is more "intermittent" than a well-sited CSP plant, and generally wind's peak production time does not match peak loads as well).

Prices for CSP are coming down, however, and the projected increase in new plants will help drive down prices further. Most companies are shooting for a target contract price of 15 cents/kwh in the US, whereas "the price for electricity from new baseload natural gas plants is about 9 cents per kilowatt hour, and rises to 12 to 48 cents/kwh for peak power, depending on what report you read," says Tom Hunt, with the Community Environmental Council. Unlike fossil fuel

plants, which are expected to see rising prices over time, CSP plants have no fuel costs, and therefore no future price surprises once a contract is signed.

At least one company says they have already solved the cost issue. The US-Australian company Ausra has a new proprietary design that it says can produce electricity for 10 cents/kWh. Not only is Ausra's design cheaper; the company will also save money by manufacturing units as close to where they'll be installed as possible, to reduce shipping costs. Ausra is now building the "world's largest" CSP factory in Nevada that will be able to churn out 700MW/year in new systems, to supply the hot US Southwest market. Other companies are also trimming the costs of their units by incorporating lighter materials, fewer moving parts, and other innovations.

One factor that would allow CSP to compete on an equal playing field with fossil fuels sooner is a price on carbon. "Everyone thinks an increase in the cost of carbon is coming," said David Crane, CEO of NRG Energy Inc., in a recent article in *EnergyBiz* magazine. That would make the cost of electricity from coal jump significantly.

The other primary challenge for CSP is the ability to produce energy "24-7," the way fossil fuel plants can. Plants would need 16 hours of storage to generate electricity around the clock. Ausra says it can store

energy at its prototype plants for 20 hours – a breakthrough that, if it proves workable outside the pilot-plant stage, will place the company at the head of the pack. Ausra's solar collectors employ a proprietary storage system, but the basic idea is to focus light onto tubes filled with water, thus directly producing steam. Storing heat is more efficient than storing electricity: just 2-7% of the energy is lost in heat storage systems, compared with losses of at least 15% when energy is stored in a battery, according to the MIT Technology Review. Ausra will start construction on a 175 MW commercial plant in California later this year.

We shall overcome

Transmission issues can be more complex than with fossil fuel plants, as large CSP plants cannot always be built close to where power is needed. An article in *Scientific American* recently laid out a "grand plan" to massively increase solar power (both CSP and PV) in the US. It called for replacing the existing system of alternating-current (AC) power lines, which lose too much energy over long hauls, with a high-voltage, direct-current (HVDC) power transmission system, which lose far less energy than AC lines over equivalent spans. "The AC system is simply out of capacity, leading to noted shortages in California and other regions; DC lines are cheaper to

build and require less land area than equivalent AC lines," the magazine notes.

Water use is another potential drawback. Some CSP designs require water to cool the plant, which is impractical in the desert. Experts say R&D is needed to find air-cooling innovations. Some types, such as dish units, do not require water for cooling. Plants can also be built near the sea, where they could power desalination plants to produce their own cooling water.

A related environmental issue is the siting of large industrial solar fields in fragile deserts. Clearly, care must be taken to minimize impacts, to prevent CSP from being viewed as an unwelcome visitor in the way that large wind farms have become in some settings.

Another siting issue relates to the relatively large tracts of land needed for these projects compared to fossil fuel plants. Not all CSP plants are equally land-guzzling. "We are more than two times more efficient when it comes to land," said Rob Morgan, Ausra's chief development officer. Morgan states that using Ausra's technology, it would take a square of land 92 miles on a side to "provide all US electric power – the entire US grid – day and night" (US consumption is currently about 25% of electricity use worldwide). "This amount of land is less than 1% of America's deserts, less land than currently in use in the US for coal mines, and a tiny fraction of the land currently in agricultural use," according to the Ausra website. The company notes that CSP also has a much smaller land footprint than large hydro.

These aren't insurmountable issues, but they will have to be addressed for a mass rollout to succeed. Industry experts say that incentives are still important for the near term to help the industry address these challenges. The European Union has spent some 25 million euros in the past decade to help develop this technology. In the

More on CSP

Concentrating Solar Thermal Power Now! is a "blueprint for action" that aims to accelerate market introduction of CSP. The 2005 report (now being updated for a late-2008 re-release), written by Greenpeace and the European Solar Thermal Industry Association, "demonstrates that there are no technical, economic or resource barriers to supplying 5% of the world's electricity needs from solar thermal power by 2040 – even against the challenging backdrop of a projected doubling in global electricity demand." Download the report at <http://tinyurl.com/ynutaq>

Links to more reports on CSP: www.trec-uk.org.uk/reports.htm



Dish Stirling solar power systems concentrate the sun's heat to run a Stirling engine, which drives an electric generator. This highly efficient solar energy production system also can use alternative fuels instead of the sun's heat so power can be made day or night.

US, an investment tax credit (ITC) provides R&D incentive, but has to be renewed every two years, creating uncertainty for those trying to develop projects.

Another type of incentive is feed-in tariffs, as is being tried in Spain. These more direct forms of subsidy are not as good at encouraging innovations that lead to price reductions, say some experts. "At those prices, it's all project driven, you just want to get projects built," says Arnold Leitner, president of Skyfuel.

Under African skies

What will it take (besides sunshine) for this technology to reach poorer and middle-income countries? The potential is certainly there for the nations with hot, dry climates. Two of the fastest-growing energy users, China and India, are well endowed with desert solar resources to power their economies. Mexico also has huge solar reserves close to major cities in both Mexico and the US. And of course, the granddaddy of all deserts, the Sahara, has many CSP experts feverish in anticipation.

Last year European engineers unveiled a plan to build thousands of megawatts of CSP plants to connect via high voltage undersea cables to northern Europe – enough to meet up to a sixth of Europe's electricity needs. Engineers with the German Aerospace Center who carried out the feasibility studies see the project "as a win-win scenario creating energy, water and income for the Middle East and North Africa," according to the BBC.

An article in the UK *Guardian* states: "The Desertec project envisages a ring of a thousand of these stations being built along the coast of northern Africa and round into the Mediterranean coast of the Middle East. In this way up to 100 billion watts of power could be generated: two thirds of it would be kept for local needs, the rest – around 30 billion watts – would be exported to Europe." The plants' super-heated steam would be used to desalinate water (normally an energy-intensive operation).

The deserts of Africa would be a natural for CSP for domestic purposes too, but thus far there has been little progress. The South African

utility Eskom has been studying plans for a 100 MW CSP plant for many years, but the decision to build keeps getting put off. The site chosen for the plant is one of the best in the world for solar. The company hopes to use local producers for project components as much as possible.

A recent major power shortfall has Eskom in crisis mode, however, and it's not clear if the new CSP plant will benefit from or be sunk by the turbulence. What is clear, however, is that Eskom will need to find cleaner ways to produce energy. Currently, coal-fired plants produce about 90% of South Africa's power. According to Eskom's CEO, if Eskom were a country, it would rank 25th among the world's largest emitters of carbon dioxide. The huge utility, which supplies power to neighbors as well, is also looking to build a string of nuclear plants, and the world's biggest dam on the Congo River.

Other Southern Africa nations are farther behind. Morteza Abekenari, the CEO of Solar Power, a Botswana-based company that manufactures solar panels, says he has for years been trying to convince local

energy authorities to buy into the idea of concentrating solar power, without any luck. "When we started, we said that the sun was Botswana's diamond that would last forever, but the idea of solar energy was like science fiction here," he told the *Francistown Voice*.

Go micro

It's not surprising that a small nation with low energy needs like Botswana might balk at the big outlays of cash required for large-scale CSP plants and the grid extensions they might require. But there is another option that could prove workable for areas where grid expansion is impractical. Micro CSP is a smaller scale version of its big brother that is easier to install and can be cost-effectively shipped long distances.

At least one company, the Hawaii-based Sopogy, has developed a rooftop unit that can power a single building or industrial complex. Unlike standard CSP components, the Sopogy unit was developed with more humid climates in mind, and the company is now beginning to market worldwide for large industrial users and residential/hotel complexes. Their systems range from 500KW-10MW.

"I believe there is great potential for micro-CSP to make a difference in developing countries," says Sopogy's Al Yuen. "This is especially true for the application of process heat for industrial purposes, which can be generated at 60-70% efficiency and would be the lowest cost solar solution."

Clearly, CSP is a very exciting alternative with huge potential – but like other new renewables, it is only part of the solution. "No one thing will be the answer to renewable energy to power the grid," says NREL's George Douglas. "CSP will contribute more and more. Wind's role will grow. And ocean power has tremendous potential. A little further out it might be organic solar cells and solar cells that use nanomaterials. You'll see a combination based on geography and cost." ●

Fighting for South Korea's Rivers

Korea Federation for Environmental Movements (KFEM) has launched a letter-writing campaign to protest the proposed "Great Korea Canal Project," a huge river engineering scheme that would devastate wetlands in South Korea.

According to KFEM, "This set of proposed canals would pave over every wetland, mountain, and riverbed in its path. Korea and the world have already lost too many precious wetlands and rivers."

Newly elected President Lee Myung-bak is pushing for construction of the \$16.8 billion canal project as a way to boost economic growth. Lee previously ran Hyundai Engineering & Construction. The company is among those that are involved in planning the project, according to Bloomberg news agency. Lee's administration has already been tainted by corruption scandals in other areas.

Although final plans have not been drafted and there is not yet a project Environmental Impact Assessment as required by law, President Lee has pledged to complete the Canal during his 5-year term.

The proposed project would connect the four largest rivers in South Korea

with three canals. The largest canal would cut the length of South Korea, connecting Seoul to Busan – covering a distance of about 540 km. The canal would be one of the largest infrastructure projects in Korea's history, and would connect the Han and Nakdong River systems. The project would require constant dredging for maintenance of the canals, and would widen the rivers to as much as 300 meters to accommodate large cargo ships.

One complication is a major mountain range that runs down the peninsula, separating the two river systems. The project calls for building an underground tunnel to link the rivers under the mountains. Linking two major river ecosystems separated by mountain ranges would cause irreparable damage to these ecosystems and the biodiversity they support. The Ministry of Environment reports that these rivers support 58 wildlife species specifically protected by Korea's environmental legislation. The Han River estuary, the Nakdong River estuary and Upo Wetland, a protected Ramsar Site, would be especially affected. Rare species that would lose habitat to the

scheme include the black-faced spoonbill, white-naped crane, swan goose, Saunders' gulls, Eurasian spoonbills and white-tailed sea eagles.

Korean environmental groups are banding together to fight this enormously destructive project. "We learned from the successful campaign to stop the Dong River Dam that if we work together to expose the unnecessary destructiveness of a large infrastructure project we can win," says KFEM's Ma Yong-Un. "But we have also witnessed the destruction of the largest tidal wetland in the world – the Saemangeum Tidal Flat Reclamation Project has already destroyed some of the world's vital biodiversity because we did not mobilize until after the bulldozers had started destroying globally important wetlands. We are fighting for the Han and Nakdong River estuaries before construction companies meet with President Lee to get rich at the expense of Korean citizens and the world's wildlife." ●

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