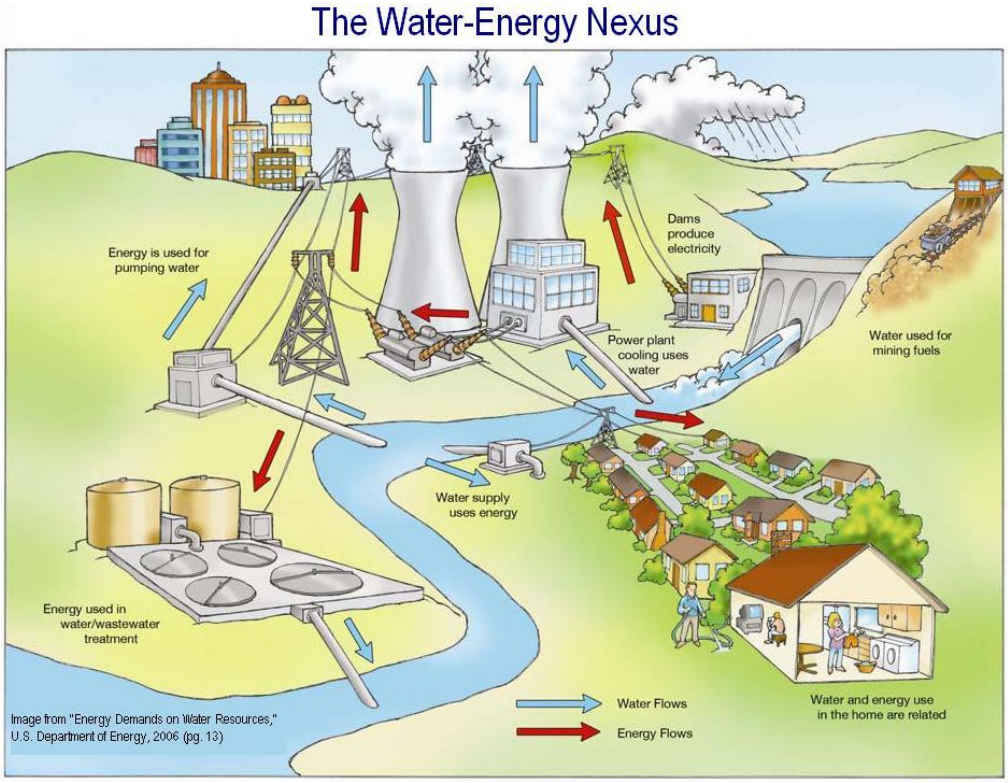
Watergy: China's Looming National Security Crisis

Link: http://greenleapforward.com/2008/11/22/watergy-chinas-looming-national-security-crisis/

Nov 22nd, 2008 by Julian

China is not going to solve its energy problem if it does not solve is water problem (see previous post on "China's Water Torture"). It is as simple as that.

The fact is, the exploitation of just about every energy resource (including renewables, but especially fossil fuel) requires water. Conversely, the purification of water for drinking requires energy, and some purification methods, such as desalination, require a lot of it.



Click to enlarge. Source: "Energy Demands on Water Resources" a December 2006 report by the Sandia National Labs to the U.S. Congress on the interdependency of water and energy that remains the definitive report on the topic.

In energy resource and water scarce China, the energy-water nexus, or watergy, is a twin threat. Power production in China has to compete with agriculture, industries, and environmental flows for an already scarce resource. China relies heavily on coal for

electricity, is pushing hydro power and nuclear as major alternative sources of energy. Coal-to-liquids (CTL or coal liquefaction) has also been cited as a way to reduce China's dependence on oil imports. According to the Pacific Institute, there have been 188 conflicts worldwide over water, 53 of which have been since 2000 alone. The crisis that is watergy represents, perhaps, the biggest threat to national security that China will face, yet it is alarming how little of it is being discussed. When I did a search on Google Reader through my subscriptions of some 60 or so blogs and news feeds, I found only two articles that discussed the water and energy nexus, and one of them was from this blog (the other was a Forbes article in the context of the U.S.)! Let's look at the water implications of coal, hydro, nuclear and CTL:

Coal: The production of coal-fire electricity consumes and pollutes water at various parts of the supply chain, as a recent report commissioned by Greenpeace China-"The True Cost of Coal"–recently explained. Coal extraction from the ground results in the drying up of groundwaer and the lowering of the water table. Coal also needs to be washed before combustions. Each ton of coal requires 4 to 5 cubic meters of water for washing, resulting in some 40 million cubic meters of water consumed for coal washing alone each year, leaving behind wastewater that is laden with toxic heavy metals, sulfates and saline.

Hydro: Hydropower has been described as "water-neutral" in that hydropower dams do not actually consume or alter the physical chemistry of the water. However, hydropower dams do shift in time the release of water relative to natural flows. It is also certainly the case that you can't make hydropower without the hydro. With little by way of effective water rights management along rivers, overuse of water is threatening to deplete riparian water levels as the major rivers start to run dry. The massive diversion of water from southern China to the northern regions and the increase frequency of droughts raises serious questions about the feasibility of the long term plan to more than double hydropower capacity to 300 GW by 2020 from 140 GW at the end of 2007. Climate change, ironically, could have a countervailing effect (see World Bank report on effect of climate change on hydropower in certain Asian countries). As the Himalayan snow frost melts with climate change induced by the combustion of all that carbon-rich fossil fuels, it may be that water flows in southwestern China actually get a boost, says Roman Cheung, a power industry professional based in Beijing told *The Green Leap Forward*. This complicated

relationship of hydropower to water use and climate change speaks to the complexity of the water cycle, suggests Mr. Cheung. Do we know enough?

***Nuclear*:** Uranium mining can result in serious contamination of groundwater, while the running of nuclear power plants requires a lot of water for the cooling of its systems. Despite of this and other problems of nuclear (e.g. waste management and earthquakes), nuclear remains largely in favor by the central government as an energy solution, and in the near-term, apparently, and economic booster.

Coal-to-liquids: CTL has been touted by its advocates as a partial solution to China's oil security problem (about half of China's oil demand is met by imports). But CTL is no solution to energy security at all. Not only does the conversion of coal to liquid fuel emit massive amounts of carbon dioxide, it also consumes massive amounts of water. As much as 7 gallons of water is needed for every gallon of diesel produced through the CTL process! This realization has contributed to the halting of most of the proposed CTL projects in China.

Conversely, the extraction, purification and transportation of water requires energy. There is almost a negative feedback loop between energy and water when talking about the supply of clean water. Where water is scarce such as in dry arid desert regions, industrial solutions for water supply become increasingly energy intensive. NEWater (the purification of sewerage to potable water) or desalination (seawater to potable water) are prime examples of highly energy intensive water purification processes which become the few remaining options where natural freshwater supply is limited. We could consider this the "decreasing marginal energy efficiency of water purification".

Food-The Third Dimension

At the heart of watergy issues is food security. Food, afterall, is essentially a store of (and require inputs of) water and energy for human and animal consumption. The implications of watergy (i.e. the every deepening scarcity of both energy and water resources) call for more efficient agricultural practices that reduce the need for energy and water inputs. Organic farming reduces the need for petrochemical-based fertilizers while drip-irrigation reduces unecessarily excessive use of water.

Meat-based diets are yet another aspect. The implications of cattle-rearing on food and water is clear when one considers that the production of one pound of beef requires 16 pounds of grain, the food of choice for cattle. Separately, the flatulence of cattle, made up of methane gas, is so significant that it has been identified by the UN Food and Agriculture Organization as a major source of greenhouse gases (18% of the total), prompting Dr R K Pachauri, head of the International Panel on Climate Change and Nobel-laureate to urge the rexamination of our eating choices.

Biofuels represents a unique aspect of the watergy problem. The food-for-energy debate has made a villain out of corn and other grain-based ethanol, and led to the outlawing of the use of grain-based feedstock for biofuel production. Grain-based biofuels not only take food of the table, but consumes large amount water in the grain cultivation process. The growing of crops for energy also competes with food crops for arable land.

Watergy Policy

At a discussion panel on watergy at the recent US-China Green Energy Council conference in Beijing, Tom Rooney (first from left in picture below), managing director of RCI Consulting and a global water expert, observes that he knows of no country that has coordinated water and energy policies to meet the watergy challenge. When asked by *The Green Leap Forward* what the main features of such a watergy policy would be, Mr. Rooney outlined the following questions that such policy would need to address:

- Where are the water reserves?
- Where is the water going and for what is it being used for?
- How is the water priced?
- What are the water inputs of our energy production?
- How will climate change affect water patterns?

The Water-Energy panel at the US-China Green Energy Conference in Beijing, November 16, 2008.

Another speaker on the panel, Larry Dale (second from left in picture above), environmental economist at Lawrence Berkeley Labs and UC Berkeley added two added two other features:

- Helping water utilities appreciate and realize the energy saving and environmental benefits of water conservation so that they in turn can promote water conservation.
- Related to the water pricing issue, allowing for the transfer of water rights, essentially creating a market for water, so that some sor t of "market price"for water can emerge.

A point of action for governments all over the world that would seem to be a no-brainer would be to fix all the leaky piping in water distribution systems. Water loss from pipe leakage can be up to 50% (or more), depending on country. The wasted water also represents wasted energy. An investment in water infrastructure with a focus on fixing the leaks and implementing leakage monitoring systems.

Both Mr. Rooney and Dr. Dale were making recommendations on the watergy policy. Introducing the food aspect to the equation, however, would surely add a few more parameters to integrated "agro-watergy" policy, such as agricultural policies favoring water-efficient farming techniques and water rights allocations to farmers.

The sooner policymakers awaken to the need for integrated watergy policies, the better. It seems that earlier this decade, there has been some World Bank activity focusing on energy efficiency improvements in some wastewater plants in Hebei province, but further web searches failed to reveal further developments on this particular front.

Watergyprenuership

Apart from the policy imperative, the looming watergy crisis also means business opportunities for innovation. Several watergy solutions are emerging:

Energy Recovery, described in our "Chinese Water Torture" post, brings down the energy costs of reverse osmosis desalination by allowing the recovery and reuse of energy.

Tahoe Water Systems, based in the Silicon Valley but with manufacturing facilities in Xiamen in Fujian province, uses solar photovoltaics of a novel and streamlined customized design so as to cost effectively use clean, renewable energy to power water purification systems. CEO and Co-founder Mark Vilimek, also a speaker at the Watergy panel in Beijing (third from right in picture above), said they are actively seeking markets in China to deploy their hybrid solar-water purification systems.

Direct Combustion Technologies, LLC, backed by the Cha Group, a Hong Kong-based family investor group, has devised a novel way to combine biomass and coal into electricity a process that consumes no water, creates capture-ready carbon dioxide, no NOx emissions and all at a high conversion efficiency. The set up consists of a fluidized bed DCFC, essentially a fuel cell-like structure within a ceramic encapsualtion. James Boettcher (first from right in picture above), a venture capitalist with Focus Ventures (whose first fund of which the Cha Group is a limited partner), introduced this company at the Watergy panel session.

These are just three examples on what has the potential to be a huge sector for watergy solutions. Imagine the possibilities in closed-loop water cooling systems, electronically controlled drip-irrigation systems (or better yet, solar-powered drip irrigation systems), water distribution control technologies and genetically modified drought-resistant crops, just to name a few.

We are also likely to see more deals like the the building of a reverese osmosis desalination plant next to a nuclear plant currently under construction in Liaoning. The nucelar-desalination hybrid system up involves the harnessing and channeling of waste heat as an energy input for the desalination plant.

The Green Leap Forward predicts that we'll start to see watergy policies and innovations emerge in the coming years…It might perhaps be a case of too little too late.
