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Addressing the Domestic and International Environmental Impacts of China's Economic Development

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Table of Contents

China and the World—Background, Economic and Political Issues

For all but approximately 300 of the past 2,500 years, China has been the largest economy on the planet. China has had a long history of strong central states and even empires. In the next decade, China is again poised to become the largest single economy on the planet. There is an increasing perception, however, that there is a gap between China's prominence and its leadership. The world is waiting for China's moral presence to catch up with its physical presence. Finally, the issue going forward will not be one just about the ascendency of China but rather the waning of many traditional, Western powers.

For all its ancient civilizations, the current iteration of China is a rather new country. Over the past 20-25 years, people have begun to ask, "What is it to be Chinese?" Can an African in China ever be an African Chinese? For that matter can a Tibetan or a Uighur? Such groups are citizens, but they don't have the same rights as others. The battle for the hearts and minds will be about identity (e.g. Chinese) rather than ethnicity (e.g. Han, Tibetan, Uighur, etc.). Ultimately a new Chinese identity will be formed if the different peoples feel that their state delivers for them as well. What "China" stands for is a unified country. But that tends to define it in terms of who is in and who is out. In a globalized world such a definition may be difficult to maintain.

However, in this evolution, size matters. China is enormous. The state is both omnipresent and an independent actor. The state mandate is powerful even if its application at times creates perverse consequences. Size also makes it take longer to accomplish things; it makes development uneven; it makes inequalities and it makes them last longer. Yet as long as there is a net policy gain, it is considered a success.

The biggest issue of all, however, may be transparency. In an economy with considerable uncertainty it is important to know what government policy is and where it is headed. The more governments can do to reduce uncertainty, the stronger economic recovery will be. But in the case of China, the stronger the country will be. While China has very clear long term plans and planning processes, it is also true that policy can and has turned on political whims that are not always based on sound economic rationale. It is troublesome that economic decisions and even investment strategies can still be trumped if not altogether decided for political rather than economic reasons. This decision making has implications for such issues as human rights, for example, when China is dependent on Iran or Angola for energy.

One way to introduce more transparency is through the internet. The growth of the internet in China gives citizens access to information and views from abroad that they have never had before. One impact of this information is the increasing nationalism of Chinese people. It can only be hoped that public opinion will emerge increasingly to help shape both public policy as well as responses to global situations. Most recently the issues arising with the censorship of

Google seems to have cut both ways—a rise in anti-Americanism as well as the desire for access to more and better information.

The issue going forward for China will be that with increasing power comes increasing responsibility. China has often asserted the right to be at the table because of the former but more reluctant about stepping up to its responsibilities as a global power (e.g. climate change and Iran's nuclear program). More fundamental, as the world's manufacturer, China, too, has a direct interest in a peaceful world order, strong economies and less encumbered global trade.

At the end of the day, the United States and China are not as much rivals for global dominance as they are mutually dependent economies with everything to gain from cooperation. Everyone (and not just in these two countries) loses if disagreements lead to conflicts. Yet there are likely to be some bumps along the way. In the post 2008 recession, there is growing support in China for the decisiveness of Chinese authoritarianism versus what is seen as indecisive and ineffectual Western democracies and the government policies that they spawn.

Regardless of one's perspective, China has addressed the 2008 financial crisis and emerged from it, if not stronger than ever, at least stable and moving forward. Something similar happened with the Asian financial crisis in the late 1990s. In China, people are asking why the country is not exerting itself more externally. To date, its insertions into international affairs are not always helpful (e.g. in Copenhagen where it played a central, but unhelpful role in climate change discussion, in the UN with regard to Iran's nuclear program, and in territorial disputes with India, Japan and Vietnam). However, China—and increasingly middle-class urban Chinese—wants its say, and wants it to be heeded by others. However, this will all have to be carefully monitored as popular nationalism can interpret any political strategy to get closer to and work with the West potentially as caving in to what China can be.

Moving forward, there are three issues that will need to be monitored carefully regarding the 2008 global recession and its aftermath as each has implications for ongoing economic strategies:

a. Is the economic recovery self-sustaining or only the result of government stimulus?
b. Will the Iceland's of the world be stand alone instances or do they erode investor confidence in other heavily indebted governments?
c. Can global central bankers and finance ministers effectively close out the stimuli that have been put in place to date?

At this time emerging economies are in the best shape globally. Domestic demand is high and there is little spare capacity. Many of these economies are able to take care of themselves. While the Chinese economy is arguably perhaps the most at risk from political manipulation, the developing country economies have moved on from late 2008. As bad as the situation is in

the US, it is worse in Europe and Japan. All of this has implications for China and its growth in the future. Critical issues for China will be whether it can wind down its economic stimulus packages, raise interest rates before inflation becomes a big issue, and let the currency float.

Some Cultural Issues that Have Implications for the Future

There are several historical legacies of previous Chinese policies that have yet to be fully felt within the country. The first is that many of the 100-150 million rural migrant workers employed in export factories live in company dormitories. They do not have resident permits that enable them to bring their families and take advantage of schooling and other social services. They are second class citizens. China still has two classes—urban and rural, and they live very different lives. During periods of economic declines such workers are expected to simply return home, but there is little for them there.

For decades, China has ignored the environment. Regardless of the programs in place today and even the amount of money being spent on the environment, it will be hard to catch up to redress past issues. One 2006 report suggests that the cumulative costs of all environmental damage and pollution related health care was effectively offsetting all of the country's widely envied 10% annual economic growth. What is the cost of when 1 in 4 Chinese drink contaminated water every day?

Another factor to be addressed is the one-child policy. This policy was extremely important in helping China gain control of its population growth and the concomitant demand that population increases would have meant for food and food security specifically and for the economy more generally. However, this system is not without its own long term implications.

The most obvious impact is that in the cities the Chinese population is not replacing itself. This means that the Chinese population is aging rapidly and not being replaced. In rural areas this was never a problem as people would have been cared for by their children and many elderly would have simply worked until they died. However, the biggest impacts of this aging population are not in the countryside but in the cities—where people increasingly retire rather than work until they die and where the number of children is actually smaller than the number of adults that need to be cared for. There are simply not enough young people to provide for and maintain their elders. This will likely put great additional pressure on the state. It may also, however, encourage the migration to urban areas from the countryside for another kind of work—domestic help.

There is another side affect that is perhaps even more significant of the one child policy. The policy has led to a disproportionate selection of/for male children which could have significant implications in the future. The Chinese Academy of Social Science, for example, has shown that within 10 years of selecting for boy babies (and the infanticide of girls), one in five men would

be unable to find a bride because of the dearth of young women. This is unprecedented in any country during peacetime.

By 2020, China will have some 30-40 million more males than females under the age of 19. This means that China will have more men without wives than exist in the same age group in all of France, Germany or Britain and about the same as in the entire United States. The dominance of males has been correlated with a doubling of the crime rate over the past 20 years, bride abduction, trafficking in women, prostitution and rape. One study concluded that about 14 percent of crime was linked to the increased ratio of boys.

Some researchers in China and elsewhere suggest that it will lead to more authoritarian policing and authoritarian regimes in efforts to crack down on crime, gangs, smuggling, etc. Also female suicide is the most common form of death among rural women in China from ages 15-34. One unexpected benefit of the policy is that due to extreme competition for brides, families tend to save more to ensure that their sons have a better chance of attracting a bride. This problem will get worse over the next generation.

The Chinese Economy Today

There has been ten-fold economic growth since 1978 or at a rate of about 10 percent per year. Much of the growth has been about shifting from an agricultural society (80% of population was rural in 1980) to one that is much more urban (about 50% today). By 2030, only 30% will be rural. Reducing population growth spurred economic growth. China is now the third largest economy globally and within the decade will be the largest. It ranks 2nd in industrial output, 3rd in manufacturing output, and 7th in services. And, PetroChina recently passed ExxonMobil as the world's largest company. However, because of the size of the population, China's per capita economic performance only ranks 133rd globally with per capita income just at $6,000.

With 1.34 billion people, China has the world's largest population, though India is expected to exceed that shortly. About 59.5 percent of China's population is in the workforce, making it rank 5th in the world. Today about 43 percent of China's population is urban but by 2030 some two-thirds of the population is expected to be urban.

Economic growth aside, there is still a lot of poverty in China. Some 21.5 million have income of less than $90/year ($0.25/day). Another 35.5 million have income of less than $125/year. In total some 100 million (8 percent) live below the poverty line. Even so, since 1978 China has lifted some 600 million people out of poverty.

China's Domestic Environmental Goals

China has made a large public commitment to the environment. It is stated very clearly in the current five year plan. It has increased spending on the environment—public investments have increased 18 percent/year during the period 2003-07 compared to economic growth of 10% per year during the same period. Unlike the US and EU, China has also increased environmental spending as part of its economic recovery program. The government has also identified some very specific environmental goals. Four goals of note include:

- 30% reduction in water use/unit industrial output
- 10% reduction in pollution emissions
- Target of 60% recycling rate of industrial waste
- Increase forest coverage to 40 M ha.

Of course for many, these targets are late in coming. Most of China's forests have been lost already and desertification is moving forward so quickly that it will be difficult to hold it back. This is not just a forest or even a soil issue—this is a major cause of air quality and health problems especially in the northern and western parts of the country. It is not clear that a 10 percent reduction in pollution emissions would even target such a problem. The impacts of climate change on, for example, pollution, forests and water are also unknown. Even so, these are measurable targets and many other countries could do well to emulate them. While one might argue about whether the performance level targets are rigorous enough or not, the indicators are certainly important ones.

1. Finance

In the past 10-15 years, China has become a financial giant. Chinese banks have assets equal to two-thirds of US 2008 GDP and five times the GDP of all of Africa. The largest bank globally is Chinese; and three of the top ten are as well. As important, in 2009 five of the top six banks globally, when comparing share price to book value, are Chinese. There is little doubt at this point in time that China's economy is poised to dominate the 21st century. To date, China has not made the level of investments some feared. While China ranks 6th in terms of incoming foreign direct investments, it is only 18th in terms of outgoing FDI with some $22.5 trillion in 2007. Even so Chinese investments in Africa are larger than the World Banks and in Latin America are larger than the Inter-American Development Bank's. [In fact, China is Brazil's largest trading partner.]

What is perhaps more striking is that since 2006 or 2007 China has been sitting on the largest global financial reserves of any country. Yet, countries like Poland, Turkey and even Taiwan are

larger international donors than China—both in absolute dollars as well as percentage of GDP. In fact, China is not in the top 30 donors. And, while the government lags behind others globally, it appears that wealthy individuals are even further behind.

With the advent of the global recession in late 2008, China's government began to rein in its lending, but it is not clear what role the country will play in the global economy over the next decade. Policies on currency values, inflation, and the holding of foreign currencies, particularly the dollar, will most likely have significant impacts globally, but exactly how those impacts might play out are not well understood. One issue to note in particular is the re-emergence of the pivotal role central banks are now playing with the meltdown of the private sector banks in many countries. However, as Greece and others show, even developed countries are not impervious to financial issues. And when it is not the country itself, it may be the governments that are vulnerable, e.g. the Netherlands. All these issues raise uncertainty and stimulate more short-term thinking at the expense of longer-term strategies.

Recent financial woes have also reduced the value of assets held domestically as well as those held abroad. Global stock markets have taken another plunge. Commodity prices have tumbled and volatility has increased. Global share prices have fallen in value by about 10% since January. The conventional wisdom is that this is not a V shaped recession but more likely to be a W one—with the second dip perhaps much deeper that the initial one. The issue for China in this scenario will be whether the country has grown to such a size that it can simply continue to grow its way out of financial difficulty. This would be a remarkable outcome for the "manufacturer to the world."

But, China's economic growth is not without risks and they are not all economic. There are real concerns about China's exchange rate policy as well as its foreign reserve holdings. More generally, there is concern that China's economy is coming into its own at a global scale precisely when it is becoming more clear that we live on a single planet, and have finite resources. As we move forward, China's credibility on the global scale will be under a magnifying glass.

Many are beginning to wonder if China is not sitting on a social time bomb. Growth has not come without costs. Growth has been uneven. This is true both when comparing wealthy and poor in cities, rural and urban populations and the many different nationalities within China. There are disconnects or fault lines between these groups—in each instance there are the haves and have nots.

This poses some serious challenges for the government moving forward. It will be very important to keep food affordable and continue to increase and intensify production. Balancing that with producer expectations regarding income will be difficult. Yet, if rural life is not

attractive, there will be more people moving to cities. Incidentally, the quality of rural life is not really defined just by income—it is also defined by health care, education, the creation of assets in rural areas, and ensuring that children and future generations have the capacity they need to make a living under any conditions that may come their way.

And, as difficult as it may be to get the equation right in rural areas, it may be even more difficult in cities. Feeding and employing everyone who moves to cities may be more difficult. Urban consumption patterns change more rapidly than those in rural areas. This includes food as well as a whole manner of other goods and services. Many of the demands will be triggered by what is known to exist globally (e.g. via television, movies, the internet, etc.). There will be huge demand for imports.

To prevent unrest, China could easily create or exacerbate global issues as it attempts to address its own internal domestic issues through international investments. Locking in rights to minerals but also to land and other resources could potentially trigger food insecurity, social unrest and other political reactions particularly if the global economy does not rebound as quickly as China's does. However, we live on a finite planet. This means that resource scarcity (e.g. water, land, food, energy) is real. Without care, it will not only jeopardize economic growth in China but other countries that have yet to achieve their economic potential.

WWF has come to the conclusion that the best way to influence Chinese investment flows whether domestically or internationally is to target the institutions (and their policies) that all other financial institutions must comply with—The Peoples Bank of China, The ExIm Bank, and the China Banking and Regulatory Commission (and Ministry of Environmental Protection – who are jointly developing the environmental conditions of investment and lending). WWF has already begun to work with these groups. The goal is to get China's financial sector to adopt leading industry practices in their financing and investment decisions (for example like the Equator Principles). While this is a long, arduous journey it is arguably far easier to change three institutions than a few thousand. Incidentally, the first Chinese bank (Industrial Bank of China – CIB) has actually signed on to the Equator Principles and WWF is working closely with CIB in the implementation of its sustainability programs.

China has already instituted a green lending policy and green securities and insurance policies are planned. The Peoples' Bank of China requires a review of previous environmental performance before making a loan. Similarly, the Peoples' Bank of China and the Minister of the Environment restrict credit for companies that have environmental violations.

Domestically there is wide recognition of the Green Credit policy (though very uneven implementation across the sector and even within individual institutions). However, many feel that the real impact of Chinese lending policies in the future will be more through their global

impact than their domestic ones. Most Chinese banks believe that Chinese companies, including banks, respect the law in the countries where they operate. That may or may not always be the case.

The issue, however, is that if problems result on the ground in many countries because they do not have comprehensive or even minimally appropriate laws, foreign institutions will need to go beyond compliance. If Chinese laws are more strict than the countries where investments are taking place, then perhaps it is important to insist that Chinese companies follow China's laws even when operating abroad.

US and EU companies have found that it is more efficient and profitable to have the same policies and standards regardless of where they operate. It is likely that Chinese banks (and companies operating on the ground) would have the same experience. The issue here is not just Chinese investments in projects or other companies, but also China's investments in foreign banks. China now owns 20 percent of Standard Bank, for example. While it is possible that China could begin to influence positively that bank's lending practices as well, the reverse seems to be happening. Standard Bank is influencing its Chinese investors. However, it is how China wants to be perceived as a leader. It is also about "Brand China" that is at risk. This includes not only market share and public opinion issues, but more importantly the social license to operate – and for China to be seen as a reliable and honorable investor at a national level.

2. Infrastructure

China has invested significantly in its infrastructure. After the US it has the second largest road system of any country in the world. After the US it also has the second largest number of air travelers per year. It has the third largest railway network (after the US and Russia) and moves the second largest amount of freight by rail after the US. China has the largest merchant fleet and has the third largest amount of maritime freight—by both volume and value. It ranks 6th in internet hosts globally.

In addition to its domestic investments in infrastructure, China is one of the largest investors in infrastructure globally. This appears to have come about for two primary reasons—Chinese loans are cheaper (e.g. sub-market rates) than those of the World Bank or other multi-lateral or bi-lateral donors in part because they do not include the standard social and environmental impact studies that are required by other international institutions . The second issue is that Chinese infrastructure investments are often part of Chinese bids for access to strategic minerals or other natural resources that are, in effect, subsidized by the Chinese government. Chinese infrastructure investments have tended to fall into the following categories but most are inter-related:

- Transportation—roads, bridges, railroads, ports
- Dams, hydro and irrigation
- Energy generation and transmission
- Mines and associated infrastructure and development
- Communications

Infrastructure investments have a number of other impacts as well. In fact it is some of these "conditions" that have been less attractive to some countries but help to explain why many of China's investments are in Africa. One of the ways that China's investments have lower costs is because Chinese workers are brought to undertake much of the work. Unlike locals, these workers are put on shifts that work day and night until the job is finished. Most countries' labor laws would not allow the type of work schedules endured by Chinese workers.

Leaving aside the stated infrastructure projects, there are a number of other predictable impacts. Most infrastructure projects, particularly those in remote areas, open up new areas and encourage migration. The operations themselves put considerable cash into local economies and this stimulates other economic activities as well—this can include anything from food production and sales to alcohol and prostitution and anything in between. A less well known impact of infrastructure projects is the creation of disease vectors/corridors which facilitate the spread of diseases (human and wildlife), and the indirect impacts relating to bushmeat harvesting and illegal wildlife and timber trade.

3. Agriculture

One of the consequences of China's lengthy civilization and its long history with agriculture and livestock production and use of forests for fuelwood, timber and paper is that it has depleted its resources over the centuries. Today, the average per capita availability of arable land and water available for production is about a quarter of the global average. Simply put, many technologies that exist today that allow for more sustainable food production were not available in the past.

And yet, in 2007, China has the largest agricultural output measured by value ($357 B compared to $195 B for India and $131 B for the US). By volume of production in 2007, China produced more cereals, meat, fruit, vegetables, rice, tea, and cotton than any other country. The EU combined production of wheat barely edged out China. In addition, China is the number 2 producer of rubber, wool, and coarse grains.

However, at this time, some regions of China are so degraded that it is far cheaper to import food and inputs from other parts of the world. Furthermore, China has intensified much of its

production on the remaining agricultural lands through the excessive use of agrochemicals which have left both soil and water quite toxic. This has had enormous impacts on terrestrial, freshwater and marine biodiversity. As important, it has also had significant impact on the human food chain through the uptake of heavy metals and other contaminants. At this time it is not clear that these soils can be cleaned up.

One very large issue that is related to the increased contamination and poisoning of soil and water in China is whether food produced in the country is safe. This is increasingly important to Chinese consumers as not only are certified organic foods more readily available but so too are various shades of green products. And, if this is an important issue for Chinese consumers it is probably even more important for global consumers when product from China is increasingly entering international markets via multi-national companies.

To date, China has focused its agricultural strategies on calories rather than nutrition. While that may have been acceptable given the chronic food shortages of the recent past, such strategies will not address malnutrition issues per se. And, plentiful calories are not a very good basis for reducing rural poverty either.

However, as China's economic development increases and as personal income in China increases there will be increased demand for food. While China was able to increase significantly the production of calories in the country, it is unlikely that Chinese food production systems will be able to intensify sufficiently to produce the diets and nutrition that Chinese will begin to demand. In particular, as demand increases "up the food chain" e.g. more animal protein, more fresh fruits and vegetables, etc. Chinese farmers will not be able to produce sufficient product or surpluses to meet it.

As income has increased in China, Chinese investments in agriculture superpowers (e.g. Brazil and Argentina) and regions with agriculture potential (e.g. Angola, Mozambique, Tanzania, and Sudan) have increased accordingly.

At some point on a finite planet, trade will begin to take into account the embedded impacts of producing food. Carbon and GHGs will likely be addressed first because global markets already exist for carbon. But, water will likely be addressed very soon as regional shortages are likely to exacerbated by climate change. Even natural habitat and biodiversity may not be far behind. As more natural habitat is lost, what remains will be more scarce and thus more valuable. In short, what is considered high conservation value habitat will change as natural habitat shrinks. At some point any natural habitat will have high conservation value.

As scarce as arable land and water are in China, the country is still the largest producer of food in the world and increasingly is an exporter as well. China's strategy tends to be to import raw materials and use them to produce higher value items for consumption in China. For example,

China has more pigs than the rest of the world. They do not produce sufficient feed for these pigs so they need to import soy and other animal feeds. Due to the increase in per capita income, the Chinese population is able to afford more pork—their preferred animal protein. As a result, increased demand in China for pork (and the soy for feed) represents an increase in global demand that is equal to the entire increase in soy production in South America over the past 15 years. Moreover, even as a result of the global economic crisis the demand for imported food inputs in China (particularly animal feed for pigs and chickens) has not lessened and in some cases is still growing. During the first quarter of 2009, for example, China imported 30 percent more soy than it did during the first quarter of the previous year when there was no global recession. In fact, this was the third quarter in the recession. This suggests that the Chinese economy may be sufficiently large to cushion itself if not fuel its own growth through this crisis at least for some years until the rest of the world gets back on its feet.

In addition to food consumption, China is playing a bigger role in global food exports than it ever has due to its low cost of production and use of exports to support/subsidize increases in domestic consumption. Not only is this a remarkable turnaround for a food deficit country, it is also a tribute to comparative advantage and, since the days of the Cultural Revolution at least, the positive role central states can play in supporting both food production and economic competitiveness.

While most of the food production impacts (e.g. soil, water, GHG, pesticides/toxins, habitat, etc.) are far upstream at the producer level, it is also clear that water and energy impacts are also downstream as are the impacts from the development of infrastructure (e.g. roads, ports, refrigeration, storage, transport, etc.) to reduce spoilage and post harvest losses.

Finally, there is little understanding in China (or elsewhere) of the relative embedded impacts of a global food system. For example, which is better, locally produced or globally sourced? Which is better, frozen, fresh, canned or dried food products? Which has bigger carbon or water impacts? Which have bigger impacts on post harvest losses or on retailer and consumer waste? How do we know which are more important? China has not created this problem. However, with China we have a unique opportunity relatively early on in its development process to understand the implications of policy choices including where and how food is produced and the implications of “making or buying” food—provided we can agree on the key variables/impacts and the methodologies and parameters for assessing them.

At this time there are five agricultural crops which either dominate Chinese domestic production and consumption and lend themselves to a more global approach where MacArthur might play a useful role—rice, cotton, palm oil, soy and horticulture (e.g. fruits and vegetables). Each is discussed separately.

- Rice

Rice is the single most important source of calories globally as well as in China. Rice is an important crop in China, especially in the southern half of the country. It requires huge amounts of water to produce (it represents 21 percent of all water used globally for agriculture and 14 percent of all water used by people for any purpose)—water that is becoming more scarce in China. In China, rice production also uses large quantities of agro-chemicals many of which end up as runoff downstream and lead to red tides and other harmful, marine algal blooms. China, incidentally, has more algal blooms each year than any other country. Finally, rice is the single largest producer of greenhouse gases (GHGs) of any agricultural crop.

There are new systems of planting rice that reduce water use by half and reduce GHGs by a similar portion. They also require less labor. As China's development continues, it will be important to identify strategic interventions where it could produce the most basic commodity of all in the country with less land, water, agrochemicals and labor. If China cannot succeed in doing this it will be forced to begin to import larger quantities of rice from other countries with levels of impacts that may not be acceptable.

- Cotton

Cotton is globally significant. It provides fiber to clothe half of the people on the planet. When all aspects of cotton are considered—production, processing, manufacturing, and sales—it touches 1 of every 16 people globally. China is the largest producer, consumer, buyer and manufacturer of cotton globally. In addition to its own production, China buys nearly half of US production in any given year as well as cotton from other traditional spinning and weaving countries such as India and Pakistan. China has some 80 percent of the world's installed cotton textile manufacturing capacity. Moreover since it has been built in the past decade, it is generally the most modern and efficient textile manufacturing capacity in the world.

Global area planted to cotton is about 30 million ha, but the actual land planted is constantly shifting in attempts to stay a step ahead of insects and other pests in order to reduce losses and avoid the use of expensive pesticides. In addition to habitat conversion, soil erosion and degradation, water use and pollution, cotton uses about a third of all pesticides used in agriculture.

The impacts of cotton production in China are numerous. The expansion of cotton production in the arid western Xingjiag Province has been linked to the advance of the Taklamakan Desert. Because China's arable land base is rather limited and it cannot shift its crop to other regions, the country uses 2-3 times more pesticides per hectare than either Brazil or the US and 6 times more than Africa.

Cotton textile production has other impacts as well. Only ten percent of the dye wastes are recycled. China exports cotton textiles to virtually every country on the planet, including most of those who also manufacture them. But the US dominates cotton purchases from China with more than $30 billion of T-shirts and other cotton imports each year. Combined, Wal-Mart and Kmart account for one-quarter of all the clothing exported from China. Put another way, Wal-Mart's own cotton brands represent 1 percent of all pesticides used on the planet each year.

- Palm Oil

The consumption and production of vegetable oils is the most rapidly expanding of any grouping of agricultural crops, with fruit a close second. Vegetable oils make the preparation of food quicker which is important, especially in cities whether cooking at home or buying food on the street. Frying and stir frying are faster than waiting for water to boil. In addition, adding oil to noodles makes them cook much more quickly making them "instant" meals. Both of these traits are important globally, but especially in Asia. In addition, palm oil is the most widely consumed vegetable oil in the world. While palm oil is more productive per unit of land than any other vegetable oil source there are still nearly 15 million hectares of oil palm being cultivated globally—the vast bulk came at the expense of moist tropical forests. The moist forests are home to globally unique assemblages of mega-fauna e.g. tigers, elephants, and rhinoceros in most places and with the addition of Orangutan in Borneo.

China is already the largest single importer of palm oil in the world. As the urban population increases and as income increases, the country will consume even more. However, since Chinese companies do not respond the same to consumer demands as companies in the EU or US a different strategy will need to be developed. The strategy should probably focus on traders—two companies (Wilmar and Cargill) account for more than half of all palm oil imported to China.

- Soy

Soy was first domesticated in China about 6,000 years ago. Today, however, China imports most of its soy from the United States, Brazil and Argentina. Bean curd is still consumed in China, but today most soy is crushed to make soy meal for animal feed (especially for pigs, chickens, and aquaculture fish) with vegetable oil as a by-product.

Globally, soy production has expanded most rapidly in Latin America—particularly Brazil, Argentina and Paraguay. Initially producers simply converted existing pastureland to grow soy or substitute it for other food crops. However, increased global demand for soy has caused the area of production to expand rapidly (more than 20 million hectares in Brazil alone) often resulting in deforestation directly or through the displacement of other activities such as

ranching. In short, over time soy has contributed to high deforestation rates in Latin America either directly or through displacement.

To date, China has continued to purchase soy and make it into feed and use it to produce most of its animal protein production domestically. Over time, it may shift its purchases to animal protein products that have been produced in Brazil, the US or Argentina where the sources of feed and water are abundant and there is a comparative advantage to produce both the grains and the protein in closer proximity and only transport meat which has higher value and lower volume. Of course this will not work for species that are consumed mostly in China (e.g. certain species of fish) or where fresh is more of an issue than price.

- Horticulture

In China, as populations become more urban and as incomes increase, diets are shifting to include more fruits and vegetables in general and at least seasonally fresh produce as well. This type of production is both more intensive and high value. A rather large amount of income can be produced on a small amount of land so it makes the production of these crops possible near cities and centers where food processing can take place. Most important, these kinds of crops are more labor intensive and generate considerable employment. Because of both the income and employment aspects they can be important for poverty reduction.

The production of horticultural crops is not only for the domestic market. International companies are now beginning to look to Chinese producers as suppliers of food. The food they are purchasing is both for their operations/sales in China, but increasingly for global markets as well. Wal-Mart, for example, is purchasing various food items from 232,000 individual producers in China at this time for sales in their Chinese stores as well as in their other operations as well. They plan to increase the number of suppliers they buy from to more than a million over the next two years. Currently, one person manages their work with producers. Given recent health and safety issues arising in the country, they now recognize this is a significant risk. Wal-Mart is not unique in this. Other multinational are facing the same issue. It might be most useful to see if environmental and health and safety issues can be approached together as pre-competitive issues.

4. Energy

China is the largest producer of energy (in oil equivalent units) and the second largest consumer of energy (after the US). It is the second largest consumer of oil and produces about 40 percent of the oil it consumes. It is not currently a self-sufficient energy producer. It is the largest global producer and consumer of coal and it currently produces slightly more coal than it consumes though it imports increasing quantities of coal.

Moving forward, China needs to decouple energy production from economic growth. And of course China will also need to look at the corollary—decoupling economic growth from the environmental impacts of cheap energy. Beginning in the 1970s, Amory Lovins of the Rocky Mountain Institute was one of the first to point out that in the future economic growth could and should proceed much more quickly than the growth of energy, particularly electricity. This would be accomplished through improved efficiency in energy use and fundamental changes in manufacturing processes. Most developed countries have been successful in delinking these two issues. To date, however, China has not. The apparent reason is that the environmental externalities of inefficient energy production have been acceptable relative to the economic growth that increased energy allows. Put another way, China's global competitiveness is in part related to low energy prices and high environmental impacts. As the markets for Chinese products become more sophisticated about embedded impacts (particularly carbon and water) the impacts of cheap energy in China will not go unchallenged at least in developed countries.

At Copenhagen, China pledged that by 2020 it would reduce energy intensity by 40-45 percent from 2005 levels and increase non-fossil fuels from 8 to 15 percent in the same time frame. The areas where China can achieve energy savings (e.g. the key energy using sectors) are: buildings, iron and steel production, electric power, building materials, chemical production, industrial electricity, and a range of other industries.

At Copenhagen, China pledged that by 2020 it would reduce energy intensity by 40-45 percent from 2005 levels and to increase non-fossil fuels from 8 to 15 in the same time frame. The scope one and two areas where China can achieve energy savings (e.g. the key energy using sectors) are: buildings, iron and steel production, electric power, building materials, chemical production, industrial electricity, and a range of other industries.

China's energy needs fall into two general categories—electricity and transport. Today, China is making sizeable investments in green energy but most electricity in the country is still produced from coal-fire powered plants with unacceptable GHG emissions. China has continued to invest in outdated coal-fired powered energy plants in order to maintain steady increases in electricity generation. In addition, coal plants are much cheaper to build and operate. As a result, at the peak of China's economic growth in 2007-08, a new coal powered plant was coming on line every 6 days on average. As a result, coal imports as a percentage of total coal used are increasing. Thus, coal not only has pollution impacts in China (23 of the 33 most polluted cities in the world in 2006 were in China—6 were in India) and GHG impacts globally, it has mining impacts domestically as well as in countries such as Australia and Indonesia which sell coal to China. While this issue is not yet acknowledged in China, it will probably become a bigger issue to the retailers and brands that buy products that are manufactured in China using such energy.

Oil is a more serious issue, however. While China has made some recent oil and gas discoveries in the South China Sea, China is much more dependent on foreign oil. In fact, China is now shifting the geopolitics of oil. In 2009, for example, Saudi Arabia exported more oil to China than it did to the US and most analysts believe this will never revert back—China is the growth market for petroleum. China's imports from Saudi Arabia doubled between 2008 and 2009 and now represent a quarter of all Saudi exports. Globally, increased Chinese consumption accounts for a third of the world's consumption growth. Meanwhile, like China Indian demand for oil has grown seven fold from 2000-08 and Saudi exports account for 25 percent of the Indian market.

There are a few issues at play with regard to energy in China. China has the ability to leapfrog some of the less acceptable ways of producing energy. It also has the advantage of having a political system that allows solutions to be identified with reasonable timeframes for investments and political support. China has the potential to create its own solutions to GHG issues through innovation and low carbon technologies. However, it is also clear that no country has a corner on innovation or low carbon technologies. China could benefit greatly from global searches and competitions for identifying and acquiring technologies from abroad.

While there will most likely be clear market signals to reduce GHGs and embedded carbon in products exported from China, there will also likely be increased rewards in at least some global markets for improving embedded CO2e in products. China needs to take advantage of this too. At the very least pollution is inefficient. It represents costs—some can be felt immediately, most are felt later. How energy affects quality of life, is both a local and a global issue. Carbon molecules do not have passports. However, increased efficiency provides the basis for longer-term growth and overall sustainability as well as reduced domestic health care issues and costs from air pollution that results largely from energy production. And, for China, a reason to step up the move to more sustainable energy is the ability to shift the global perception of the country from one of being an international pariah or at least a major part of the "problem" to one of helping solve global problems most of which began long before China's recent economic growth spurt.

5. Mining

Between domestic production and imports, China accounts for approximately half of all metals used globally. China is the largest consumer of copper, lead, zinc, tin, nickel, aluminum, gold and iron. It is this increase in demand in China that has led to increased mineral prices globally. From 2000-08, the price of the following metals increased at unheard of rates over such a long period in a non-war period: lead (359%), copper (282%), tin (240%), gold (212%), nickel (143%), zinc (66%), and aluminum (65%).

What is much less well known is that China is the leading producer globally of lead, zinc, tin, aluminum, gold and the 15 rare earth metals—strategic minerals used to make super alloys, electronics, etc. China is also the world's leading producer of coal and cement. Mining in China is not pretty. Mining and refining operations not conform to global norms for health and safety much less best practice. Both are often sources of toxic effluents.

Increased demand from China both to meet domestic consumption as well as to manufacture products for international markets has caused price of most minerals to increase globally to record highs. And even after the beginning of the global recession, prices have not fallen to previous levels. Increased hard commodity prices have not only made existing mines more profitable overnight, they have also caused previously closed mines to be economically viable once again around the globe.

Most important, perhaps, increased demand for hard metals has led to a "gold rush" of exploration and investments in new mines and refining capacity as well as all associated infrastructure that goes with it. As most deposits in relatively accessible areas have already been opened up, most of the new mines are in regions that are so inaccessible that they would not have been profitable to operate previously. In short, many of the large deposits being eyed today or even in the process of being opened up are in remote regions and their development most often involves large impacts both on natural habitat and biodiversity as well as overall ecosystem functions. And, this is just the environmental impacts—the social impacts of massive mining operations on remote people is equally or perhaps even more significant.

In short, the issues raised by increased demand from China for hard commodities are not limited to China. Rather, they tee up questions that are long overdue for serious research and discussion. WWF recently completed a global survey of 25 global metals, mineral energy sources and other minerals. WWF had previously undertaken such work on two other industries to identify the most appropriate strategies, e.g. with 21 food commodities and 14 aquaculture species to understand better global production and consumption trends, impacts, tradeoffs, leverage points and what its strategies should be to help reduce the most significant environmental impacts of each industry. In short, through a side by side comparison of key impacts including GHG and water impacts, WWF's work on minerals suggested a global focus on iron, gold, aluminum, coal, oil and gas and cement.

What has become clear from our hard commodities work is that we simply do not have good data for a number of key impacts. For example, WWF was unable to find out how much CO2e on average is used to produce a MT of each of the 25 top minerals WWF researched. There is not even a global range for most. Nor is it known how much water is used to mine and process a MT of any given mineral. Even less is known about the importance of the water (e.g. is it from a water stressed area, what are the downstream and/or hydrological implications, what are the

impacts on food, fecundity and fertility for a range of freshwater and marine organisms)? Finally, what are the direct and indirect impacts of production and processing facilities on habitat, infrastructure and related development, etc?

Cement is the most used mineral globally. China uses more cement than any other country, and more than most countries combined. Cement has arguably the largest impact of any mineral. It includes re/moving overburden and open pit mining of limestone (with potentially significant biodiversity impacts), GHGs to move and process, some of the highest energy use per unit of output of any other mineral (and the environmental impacts of producing that energy), sand and gravel removal which often has freshwater and marine impacts, and water—both to make the cement and pollution and runoff from all of the different processes.

Though there have been some recent discoveries of oil and gas in the South China Sea, China is absolutely dependent on oil imports and relatively dependent on coal imports. Imports of both are increasing—to date mostly from Saudi Arabia, Angola, Iran and Nigeria. And, the relative portion of energy as a cost of production in China has increased over the past decade.

Iron/steel and aluminum require both large amounts of energy and water to mine and process. In absolute terms iron and steel require more because more steel is used than aluminum. However, aluminum is more energy intensive than iron. Due to the intensity of inputs to make these commodities, they should be recycled as many times as possible. However, as with energy generation, Chinese refiners/smelters do not use the most efficient technology. Alcoa recently invested in a Chinese mill to ensure that they had access to the best aluminum technology (the company's assumption was that the global aluminum industry will be tarred with whatever brush China ends up using anyway. In the end the company pulled out of the investment because of the corners that were being cut in China.

One of the more interesting issues posed by China's increasing dependence on the import of hard commodities and energy minerals is its overall strategy for sourcing such commodities. Inevitably this involves foreign direct investments—either outright ownership or joint ventures. To this day the largest Chinese companies that invest in such ventures are largely if not entirely state owned. As such, they have relatively easy access to low cost capital compared to global companies based in other countries, and they have the Chinese government willing to intercede favorably in discussions and even guarantee investments if necessary. In fact while companies often invest in mines and the specific mineral deposits, the government will step in to invest in the energy and infrastructure necessary to ensure the success of exploiting the mineral in question. However, this also means that most Chinese investments involve politics as well. In fact for the past decade, China has increasingly used investments as an overt part of its political strategy. While this is not limited to Africa, nowhere is it clearer than in Africa.

6. Seafood—Fisheries and Aquaculture

China has been the largest global player in fisheries and aquaculture for the past 20 years. Seafood production (from both aquaculture and wild caught fisheries) has increased 108-fold over the past 60 years while global production has increased only 50 percent over the past 30 years. China's seafood industry currently represents about 1.5 million jobs, most are in aquaculture. Seafood represents a third of all animal protein in China with total carp production equal to total poultry production. While most seafood is consumed domestically, some three million MT of seafood are exported each year.

China began overseas fishing operations in 1985. By 2010, it had 1,500 vessels operating in 32 countries. Today, there are 130 overseas offices of Chinese seafood companies and joint ventures. At this time, China accounts for between 15 and 20 percent of all forage fish on the planet. Overfishing of forage fish puts pressure on marine food webs and has impacts on livelihoods and nutrition of coastal communities globally.

In addition to its catch, China is increasingly a global processor of the catch of other countries. Today, China processes more than 50 percent of all whitefish globally. In fact, reprocessed whitefish represents a million MT of seafood or about a third of all Chinese exports. Increasingly, there are concerns about IUU fish (most likely from Russia) being included in the reprocessed fish.

While China is an increasingly important global player when it comes to fisheries—particularly with regard to forage fish and reprocessing fish—it is the dominant player when it comes to aquaculture. China accounts for 70 percent of all aquaculture production globally. And, China produces 70 percent of all its seafood from aquaculture. In addition, 70 percent of its seafood exports are from aquaculture—mostly just five species including: shrimp, tilapia, eel, etc.

In fact, much of China's overseas fisheries production is forage fish which in turn are used for fishmeal and fish oil for aquaculture feed. China's significant increase in the reprocessing of whitefish globally is a significant source of fishmeal and oil for domestic aquaculture feed. Finally, with the world's largest aquaculture production, China is producing considerable by-product from the processing of aquaculture product which can in turn be used to make fishmeal and fish oil. Given the lack of control over some of the manufacturing processes in China in the recent past, however, it is imperative to ensure that there are sufficient firewalls in the system to ensure that waste from a species is never used in the manufacture of feed for that same species. Given the impact of BSE and an overarching need for precaution this is a hugely important issue not just for exports but for domestic production as well.

As with Wal-Mart and agricultural productions, many multinational companies are beginning to source increasing amounts of seafood from China. For instance, for price and year round

availability, a fast food restaurant chain as shifted its purchasing from Alaskan pollock to Russian pollock (for price reasons) and then to Chinese produced frozen, block tilapia from aquaculture (because of the IUU risk of Russian purchases). Now the health and safety issue of aquaculture product is becoming better understood so the desire is to help insure that Chinese tilapia is of acceptable quality. There are similar issues with shrimp, ell and oyster to name but three other common aquaculture export species. If China is to increase its exports and if it is to export its model of production to other regions, it is important to work with producers to ensure that they production meets world standards.

As natural resources (e.g. land, water, feed) become more scarce, as pollution becomes a more important issue in China relative to other parts of the world, and as China sits atop an ever increasing volume of foreign exchange earnings, China is likely to turn its attention to overseas investments in aquaculture as well. Chinese investments in aquaculture are likely to increase internationally in Africa where land and water are plentiful. However, labor in Africa is rarely as productive as in China. Thus, China may also supply most of the labor for such investment projects rather than rely on local labor. In Latin American countries like Brazil, Chile and Peru feed is abundant and infrastructure is already in place, but land and other resources are more important and these countries would be less interested in large contingent of workers from China.

Three Additional Areas of Note

In addition to the areas outlined in the consulting agreement, there are three key issues that warrant special attention as they are very likely types of crosscutting issues that MacArthur may want to use to organize its program since they each touch so most of the six areas that MacArthur has identified for special attention. In addition this type of organization might touch other programs at MacArthur. The three crosscutting issues include illegal trade, water and China's interaction with Africa. Each is discussed briefly below.

Illegal products

As resources become more scarce globally, legality will be a key issue for raw materials and the products that are made from them. Given that China's resource consumption is expanding more quickly than any other country, this issue is likely to be more important for China than for other countries. Initially the key issue will be around the legality of the products China exports. This includes three general categories of "illegal" products. These include products that:

1. are illegal under CITES regardless of the source,
2. are legal for trade but are from illegal sources, and
3. contain substances or levels of substances that are banned or not acceptable in international markets.

Each of these issues will be discussed separately because they each require a different response.

As the Chinese economy has grown, individual consumers have had more disposable income. In addition to increasing their consumption of food and other consumer goods, Chinese are increasing the consumption of traditional medicines. To date this has included unprecedented levels of trade in endangered species including tiger parts as well as those of other cats, and herbs and other species that are ingredients for traditional medicines that are listed under CITES. Continued economic growth in China will only increase demand for such products unless there is more effective enforcement at borders and in the outlets where such items are sold.

There are also a number of products that are traded legally globally, but a portion of those that find their way into China and into products manufactured in China for sale at home and abroad are in fact obtained illegally. These include other ingredients for traditional Chinese medicines (e.g. ginseng, devil's claw, etc.), minerals that are obtained illegally, IUU (Illegal, Unreported and Unregulated) fish that is mixed with legally caught fish, illegal timber (e.g. from the Russian Far East) and paper (e.g. from Riau, Sumatra), etc. Finally, certain Chinese products have shown high levels of substances that are illegal—shrimp, children's toys, baby food, pet food, food products, furniture and other wooden products, paper products, etc.

Many companies are affected by these illegal products. For example, both Wal-Mart and Costco are 2 of the top five sellers of furniture in the US. Many of their products come from China made with wood from Russia. The latest information from WWF's office in Russia as well as other local NGOs suggests that as much as 70 percent of the wood from the Russian Far East is harvested illegally, e.g. without the right permits, without paying the appropriate fees to the government, etc. These logs are simply trucked across the border to China. Similarly, many companies buy paper products from China made with pulp imported from the APP pulp and paper company in Riau, Sumatra. Bird's Eye/Igloo and Findus/Young's also buy whitefish that is processed and packaged in China. There is increasing concern that there is IUU Russian pollock within what they buy. By extension, it could be argued that any palm oil or soy that is produced on land that has been illegally cleared in Indonesia, Brazil, Paraguay or Argentina is also illegal. And, by extension, any beef, pork or poultry that is fed with illegally produced grains such as soy or on illegally cleared pasture would also be illegal.

NGOs and the private sector have come together to lobby governments for stiffer regulations around the issues of illegal products. For NGOs the issues are mostly environmental but also social. For the companies the issues are really focused around unfair competition—it has been shown in both timber products as well as seafood that illegal products can lower prices by as must as 10-20 percent. This basically undermines those companies that are trying to play by the rules. As a result, the US has begun to enforce illegal timber product issues (wood and pulp and

paper) and the EU has begun to enforce sanctions against companies that traffic in illegal timber and seafood products. This issue will become more important going forward as enforcement steps up and as legality, as an issue, is extended to other products, e.g. minerals, agricultural products from illegally cleared land, etc.

There is increasing concern, even skepticism, about China's role as "manufacturer to the world." Too many products from a wide range of industries have been showing up with unacceptable contaminants. This suggests that there simply are not the controls in place to produce products for those global markets with acceptable standards and the ability to evaluate and enforce risk criteria. At least for developed countries and multi-national companies, product safety is a precompetitive issue. Contaminants and other health and safety issues regarding products are simply unacceptable. China is clearly the low cost producer globally, but it will lose many of the higher end markets in developed countries if it does not take a proactive stand around these issues.

Water

Water is another issue that was targeted by MacArthur; yet water is one of if not the most significant crosscutting issue in China today, including all the other issues that are the focus of this white paper report. China has about a quarter of the water per capita as the global average. Even so, water is not distributed evenly in China. More than 40 percent of China's population live in the arid north which has about 8 percent of the country's water resources. The most sever water shortages are in the north and west of the country. In Beijing, for example, it is common now for water wells to be 1,000 feet deep. This is five times deeper than just 20 years ago. In the north, some 60 percent of the available water in the Yellow River is used for irrigation. Yet, the UNDP estimates that China uses 4-10 times more water for irrigation than counterparts in industrialized countries. The same is true with industrial users.

To encourage more frugal use, late last year Beijing raised water prices for commercial and industrial use by 11 to 50 percent and for residential use by 8 percent. However, water use per person in China is only one-ninth that of the US. It is not clear how much more efficient pricing will make overall water use.

And the issue isn't just with water use but also water effluents. With China using two to three times more fertilizers and pesticides in agriculture (and with much of that agriculture being irrigated) it has a higher load of agrochemicals in effluent and runoff. Similarly, China has built hundreds of sewage treatment plants to improve water quality. However, this year alone there have been 600 reports of violations by sewage treatment plants that do not meet the standards either because the sewage is simply not treated, treated improperly or where the sludge is not

disposed of properly. Projections for northern China suggest that by 2030, water used for industrial and municipal sectors will reach 35 percent of all water.

Some of the most ambitious and potentially troublesome solutions being proposed for water in northern China include the construction of a new large-scale water diversion project that will take water from rivers in the south and divert it though tunnels in two mountain chains to bring it to the north. Some of these systems involve gravity but others involve both pumping and gravity. More important, some of the schemes will go through five different active fault zones. At this time, three are planned with a total cost of $75 billion, the first scheduled for completion in 2013. None have been subjected to rigorous environmental or social impact assessments.

China and Africa—Some Key Issues

China has become the key economic partner across the board for Africa. China invested only $50 million in Africa in 2001, but by 2009 the investments totaled $1 billion. The Economist has reported (20 March 2010) that since 2009, China has invested more than $5 billion in Angola (oil), Liberia (mining), Tanzania (IT and infrastructure) and Zambia (development and the construction of a stadium). About 80 percent of these investments are FDI and about 20 percent are loans. Brazil, India and Russia aren't that far behind with a combined investment of more than $8 billion in the same period.

China's trade with Africa is also significant; in fact China has a trade deficit with the continent. China exported $51 billion of products to Africa in 2009 (up 37 percent in one year) while importing $56 B from Africa (up 41 percent in one year). And China's impacts are spread throughout the continent—China has at least $1 billion in trade with 20 different African countries. This trade is still increasing too, despite the global recession e.g. trade volume up between China and Tanzania was up 48 percent between 2007 and 2008. While the US and France have more trade with Africa than China, neither is investing as much in it at this time. Today, there are some 800 Chinese enterprises that are active in Africa.

In Africa, China is attractive because it is a "no strings attached" lender. Deals with China are often little more than resource swaps for infrastructure development. The following examples illustrate this trend.

- Democratic Republic of Congo, $8 B—roads and infrastructure for minerals
- Angola, $12 B—roads, 48 bridges, airport, telecom capacity, oil refinery for oil exports (13% of China's oil imports)
- Mozambique—dams, hydro, agriculture development for rice exports

- Zimbabwe—energy projects & mines for mineral exports

However, Africa is more than a source of raw materials for China. It is an opportunity, not just a cluster of quid pro quo trading partners. However, China's focus will need to include financial assistance as a donor with a focus on water, energy, value-added production (of timber, food, minerals, etc.), local capacity and the creation of assets.

It is clear that China's integration of the government and private sector give it a financial and political edge in Africa. The government generally is the largest investor in the "private" sector. In addition the bids for specific resources by the private sector, the government generally guarantees it will build major infrastructure. Tying foreign assistance to private investments makes China a very attractive investor. There are also persistent rumors that each African leader also ends up with considerable cash from China stashed in bank accounts in Europe.

The 2008 financial crisis stalled, initially at least, many of the proposed developments in Africa. When the financial crisis ends, it is likely that dozens of projects poised to take off, e.g. the Belinga mine (iron), will begin in earnest even though the recent crisis may be used to improve the terms of the deals for China. In addition, there will be major investments in East Africa in agriculture and export sectors.

Africa has little infrastructure, so in most instances Chinese investments are welcome. However, holding Chinese companies to international standards will be difficult practically and politically. China benefits from operating outside of existing multinational processes and conventions. It will most likely continue to do so into the future. Standards such as the Equator Principles, though weak, could erode Chinese competitiveness. More stringent safeguards would make some investments untenable.

WWF's Theories of Change

Five years ago, WWF began a major re-evaluation aimed at assessing the continued relevance of four key issues:

- our goals and objectives,
- our understanding of the key impediments to achieving them,
- the strategies that would be the most effective to deliver our goals, and
- conditions that would make those strategies more effective.

As a result of this analysis, WWF realized that it had to be more strategic. While the organization would like to work on everything it can't; it doesn't have the resources. So, of the several hundred most important places WWF identified, 35 were targeted initially where WWF can make a real difference. Once the places were identified, WWF assessed the key threats to

them. Through this research the production of 15 commodities were identified as key as well as CO2e/GHG emissions and the take and/or pollution of water. However, WWF does not buy or sell any commodities. It needs to work with the producers and companies who can influence how these products are produced. Further research suggested that 300-500 companies touch 70 percent or more of each of the 15 commodities identified as most important by WWF. However, side by side comparisons of value chains for each commodity suggest that 100 companies actually "touch"`25 percent of all 15 of our priority commodities. Our theory of change is that if by 2020 we can shift 25 percent of demand (e.g. the equivalent of CA to the US market or the EU to the global market) to more sustainable production, then this will shift 40-50 percent of production as producers address seasonality issues and compete to sell into better markets. WWF is currently on track to exceed those targets. NB: it should be noted that after 40 years, organic production is at 0.7 percent of global production.

In a few short years, WWF has gained some important insights. As this strategy has been implemented and WWF has signed non-disclosure agreements with 40 of the 100 priority companies (and are on track to sign 40 more over the next 12-18 months), it has found that just 25 companies represent 25 percent of trade in 9 WWF priority commodities. WWF now thinks that working with as few as 50 companies may allow us to shift entire markets.

Moreover, WWF has discovered key pinch points that were previously unknown. For example, two companies (Wilmar and Cargill) account for more than 50 percent of the palm oil that is sold to China. Do we need to convince hundreds of Chinese companies to put conditions on their purchases or just change two traders? Cargill, which accounts for 22 percent of global palm oil trade, has asked WWF to help develop a tool to assess all Cargill's suppliers against the RSPO criteria for sustainable palm oil. The advantage of making bulk commodities and entire supply chains sustainable is that costly traceability systems will no longer be necessary.

WWF has also made another significant discovery regarding CO2/GHG targets—100 companies, either directly or indirectly, account for 25 percent of global GHG emissions. Some 50 companies (thermal energy producers, oil and gas companies, and chemical companies) do this directly. Another 50 do this through the embedded GHGs in their value chain—e.g. food and clothing retailers and brands. This type of analysis is core to WWF's global Market Transformation Initiative and allows the organization to be more targeted and effective in delivering its conservation strategy.

Similarly, WWF has begun to look much more critically at where the global dynamism is both for consumption but also for primary production and manufacturing. This overall strategy also explains the genesis of WWF's China SHIFT Initiative. China now joins the US in dominating global consumption, but China is also coming to dominates global manufacturing as well. WWF's China SHIFT Initiative focuses primarily on China's financial investments and their

environmental impacts, the demand for and production of energy domestically, and the overall demand for natural resources. But, China is really an indication of what is already beginning to happen in India and to a lesser extent in Indonesia, Pakistan, Brazil, etc.

Through the development and initial implementation of its Markets and SHIFT Initiatives, WWF has identified a few overarching operating principles. Much of this thinking is relevant (and much probably obvious as well) to the MacArthur Foundation as it approaches it's ten year strategic plan. WWF has found it useful to articulate these "learnings" and keep them front and center when implementing its overall strategy.

1. ***Be strategic***. We cannot do everything we would like to, much less everything others want us to do. We need to focus on the places, the threats, and the companies. If we try to do too much we will certainly do too little. We need tourniquets not band-aids.
2. ***Find partners***. WWF does not buy or sell anything. We must convince others (particularly government and the private sector) to do the work that is necessary to deliver our overall conservation strategy.
3. ***Measure the results***. At the end of the day, we care about the results on the ground, not the strategies, processes, or practices. For us, they are all means to conservation ends, not ends themselves. Identifying acceptable performance levels encourages innovation. Adopting BMPs encourages compliance.
4. ***Move the middle***. NGOs tend to work with the best. Yet, most environmental impacts are caused by the worst producers. Thus, most gains will come from shifting the bottom half of the performance curve not the top. We need to find ways to engage the less willing.
5. ***Focus on the future***. Most published data is already out of date. What are the key trends that will affect our conservation objectives? How can we invest a little now to shift them more efficiently and effectively than later? Who can help?
6. ***Whatever it takes***. At the end of the day, we need to work on whatever or with whomever it takes to deliver conservation results.
7. ***Learn (and share)***. Those who do the heavy lifting have little time and even less inclination to document and share what they have done with others. NGOs could do this and use the information to create cases that others can learn from.
8. ***The Right Capacity***. Get the right person, tool, or partner to do the job. Recycling inappropriate staff and on-the-job training are ineffective—the "cost" is too high.
9. ***Listen***. Most solutions come from understanding not only a problem but why it hasn't been solved before. Effective partnerships require that partners listen to partners.
10. ***The Bottom Line is Nine***. By 2050 we will have 9 billion people with 2.9 times as much income, consuming twice as much per capita. If we are to meet this demand and still have a living planet, we will need to do more with less. In fact we will need to produce twice as much from the same amount. We must embrace intensification.

Crosscutting Opportunities for MacArthur Regarding China's Environmental Impacts

There are a number of themes that run through the discussions laid out about finance, infrastructure, agriculture, energy, mining, and seafood as well as the sections on illegal products, water and Africa. The proposal here is that it will be more effective for the MacArthur Foundation to look at the underlying issues and commonalities across key threats and issues rather than develop issue-specific strategies. Whatever MacArthur's budget, it programs will be small by comparison to the work that needs to be done to reduce China's environmental footprint at home or abroad. As such, MacArthur would be best served by identifying a few key institutions/partners to work with either domestically or internationally, but these partners will each need to have and be willing to tap into a much larger network of individuals and organizations to undertake the cutting-edge, meaningful work that needs to be done.

The activities supported by the MacArthur Foundation, to be the most meaningful, need to address a range of issues. For example, research, field testing of concepts and ongoing implementation are all important but will vary depending on existing understanding and capacity around any given issue. There needs to be a mix of programmatic support that supports domestic as well as international work. Similarly, it is important to find the right balance between documenting China's current environmental impacts that are unacceptable as well as what can and should be done, e.g. an approach that includes both carrots as well as sticks.

Most importantly, we do not yet understand the full range of the current impacts much less what they mean for the future, e.g. investments in extractive industries and infrastructure that is only just beginning, or what it would take to change existing trajectories going forward. The most effective strategy will be to "peal the onion" a layer at a time to support the analyses and data collection as well as the capacity in local organizations that, simply put, is insufficient to address the key issues.

Given the paucity of money that will be available relative to the scale of some of the issues involved and the sums that may need to be invested in order to understand many of these issues, it is important that MacArthur partner with other donors. It is also key that the MacArthur Foundation builds in to all grants line items for to assessing impacts of each grant and the identification of key lessons learned so that others can take advantage of these initial investments. Finally, it would probably be useful for the Foundation to invest over the course of this 10 year period in assessments of what is happening with regard to work on these issues whether they are being supported by MacArthur or not. A lot of good work is likely to be funded by other sources or to come from the efforts of individual researchers. It is important that the MacArthur Foundation continues to have an independent assessment of key issues and trends rather than relying on a few key, trusted institutions or individuals.

There are a few key issues that should be kept in mind as a backdrop to the discussion that follows. They tend to fall into the category of how to think rather than what to think about China. This is important because the "what" of China is likely to continue to evolve and today's analysis will not be as relevant for tomorrow. Whereas the "how" to think about China will most likely continue to be relevant for some time.

1. What is China big to, what is big to China? What China is big to is not necessarily or even usually big to China (e.g. China produces most of the minerals, coal and cement it uses; no single African country dominates any product trade category for China—forest products, minerals, oil, etc.). Any strategy will need to address this issue.
2. The government is the largest investor in most "private sector" Chinese companies doing business at home, but especially abroad. And, politics will likely trump economics every time if/when the two are in conflict.
3. Neither China nor most of the places where it is investing or doing business have strong civil society organizations. This makes transparency, grassroots activism, local monitoring and reporting very difficult. Yet this function is essential for identifying and monitoring, much less reducing, environmental impacts.
4. Existing NGOs in China and areas of Africa and elsewhere that are invested in by China and Chinese companies will rarely if ever have the capacity to monitor China's investments effectively much less develop and implement strategies to influence them. Furthermore, the salaries that would be needed to recruit competent people with the right skill sets are often not acceptable within existing staff compensation plans in local NGOs. MacArthur will need to find a way to address this issue.
5. Much of the most influential research done in China about these issues is undertaken by institutes affiliated with the government. Universities, independent research bodies and NGOs for the most part do not have sufficient capacity in this area to challenge the work done by government agencies. There are a few however which MacArthur could support.

The key areas/issues are indentified and clustered below.

Transparency

Transparency is a key issue that must be addressed in any strategy regarding China at this critical point in history. This issue needs to be addressed domestically as well as internationally. MacArthur could support activities that would increase transparency in a number of important ways. MacArthur could make important contributions to the transparency needed to improve environmental performance by supporting the following types of programs:

- A geowiki-like tool to track Chinese investments (but also other BRIC investors) in Africa

- A database to house investment agreements so the terms and conditions can be benchmarked with other investments, particularly for those entities (countries, companies, etc.) just beginning negotiations, e.g. Oxfam's initiative on mining contracts, WWF's analysis of the Belinga contract, etc.
- World Resources Institute's Forest Transparency Initiative
- WWF/Yale studies to document forest product trade flows to China from Africa, Indonesia, insular SE Asia, Latin America, Russia, etc.
- IT networks to allow Africans to share information about investments and critical trade flows. Ethan Zuckerman has worked on IT issues in Africa should be consulted about this. He has an affiliation with Harvard Law School.

Standards

The production of any product has thousands of impacts. Increasingly, the question that is being asked is which impacts are most important and which levels of impacts are acceptable? Globally, the definition of what are the key impacts and which levels of performance are acceptable are being developed by many different entities—governments, industry groups, NGOs and multi-stakeholder groups. Standards are both voluntary and regulated. At a global level, voluntary standards and verification programs have been developed by transparent multi-stakeholder groups for a number of commodities important for China. They include:

- Forest Stewardship Council—for forest products including wood, pulp and paper, and charcoal.
- Marine Stewardship Council—for wild caught seafood and industrial fish for feed;
- Aquaculture Stewardship Council—standards will be finalized for a dozen aquaculture species by the end of 2010;
- Agriculture standards—RSPO (palm oil), BSI (sugarcane), and BCI (cotton) standards have been completed and RTRS (soy) will be completed later this year.
- Equator Principles—basic social and environmental criteria/screens for international private sector finance for products above a certain amount.

MacArthur can support the implementation of credible voluntary standards for commodities that are deemed priorities due to their domestic or international impacts but not yet covered by others (e.g. rice). In addition, MacArthur can support work that will assist Chinese producers improve their performance so that they can meet global standards and gain market access in those markets that require such standards. For example, WWF has created the Global Forest and Trade Network to help nearly 400 companies find and buy certified product from producers on five continents. Increasingly as wood and paper products are made in China, it will be

important to work through them back to their wood suppliers. Similarly, WWF, SFP, SCA and NEAq are in the process of creating the Seafood Trade Network to help seafood purchasers locate and source from certified wild fisheries and aquaculture producers.

Without standards that focus on reducing a few priority impacts and allow Chinese producers to benchmark themselves against their global peers, performance will not improve. In China it will be important to establish baselines for whichever industries are targeted by the MacArthur Foundation (e.g. Agriculture, Energy, Finance, Infrastructure, Mining, or Seafood). Once baselines are known individual companies can be compared against the average, and China as a whole can be compared against the rest of the world. Given that this is a bit complicated and not always cheap, it will be important to choose the commodity and impacts focus carefully.

Another key issue will be monitoring—to ensure that what is required is enforced. Encouraging Chinese firms to adopt globally recognized standards would be a very important step to reducing impacts. Standards provide the ability to assess whether they have achieved the appropriate results or not. However, there are hundreds of better management practices (BMPs) some of which that would be appropriate for any scale producer in China that would allow them to meet international standards.

In addition to the issue of voluntary standards, any performance levels that are required of producers or firms in China should be required of Chinese actors operating outside of China. Some specific activities MacArthur could support along this line would include:

- The Natural Heritage Institute program of work on dams and ecological flows could be applied to Africa.
- WWF has begun to work with three Chinese financial institutions (the Peoples' Bank of China, the ExIm Bank and the Chinese Banking and Regulatory Commission) that could influence all Chinese domestic or international investments. The goal is to adapt the Equator Principles for Chinese financial institutions. With a key training partner (e.g. PWC, KPMG, etc.) this work could be rolled out more quickly.
- The Ministry of Commerce and Trade (responsible for reviewing and approving every investment outside of China) could be helped to develop an environmental screen to review all investments.
- The ICMM has developed standards for the production and processing of key global minerals. MacArthur could support their incorporation in Chinese mining operations, both domestic and international.
- Strengthen the capacity to encourage transparency and accountability in key countries (e.g. in government and civil society) where China is investing.
- Support journalists who investigate the environmental impacts of China's economic development domestically and internationally. The International Center for Journalists

based in Washington DC sponsors credible environmental journalism programs around the world.

Global Leadership from China

The world is waiting to see what kind of leadership China will exert on a global scale. Thus, there is a clear opportunity to help China position itself as a global leader on sustainable development. MacArthur could support global discussions on sustainable development. This would involve supporting the interactions between world class individuals and institutions in China and abroad around sustainable development. This support could be to universities, NGOs or research institutions to offer courses, programs, symposia, or conferences that are focused on MacArthur's overall strategic China focus [e.g. potentially finance, energy, infrastructure, agriculture, minerals, and seafood (fisheries and aquaculture)]. For example, MacArthur could support:

- Academic training programs (e.g. the Masters in Development Practice at Tsinghai University);
- Post-docs or other short term researchers to be in residence and working intensively on a key issue for a 1-2 year period;
- Conferences, workshops, or symposia on sustainability issues bringing together experts from around the globe to showcase China's expertise in key areas, share global insights and expertise around cutting edge issues, and identify and explore global trends; and
- Venues in China where it is not only safe but the norm to debate differences and the strengths and weaknesses of different approaches to resolving local and global environmental issues.

Education

China is one of the largest forces on the planet at this time; its dominance will only increase. Very few non-Chinese speak Chinese globally. At the very least it would be important to find ways to increase the number of courses and language training programs for Chinese in regions where Chinese is important. This would certainly be the case in Africa, but probably also in SE Asia and India. China, for example, has only two formal language training centers in India.

But, education issue does not stop with language. No Chinese University is considered a world class institution at this time. Yet, there is value placed on education throughout China. And, this year, the government has increased the science budget by 8 percent, up to a total of $24 billion. With a few well considered grants, MacArthur could help focus some of this science spending to help resolve key domestic and international environmental issues that relate to China's economic development model. There is precedence for this. The Ford Foundation's

successes in Brazil suggest that a targeted education strategy (in their case social sciences in this case environmental sciences) can payoff with significant impacts for decades. MacArthur should identify and support key programs within universities that would reinforce investments from its overall China strategy, e.g.:

- Programs that provide technical training in various disciplines that relate to key environmental issues (e.g. energy, pollution, efficiency, design, efficiency, etc.).
- Public policy programs, particularly those that have strong environmental components.
- Best in class programs such as Beijing University which is generally considered the best on foreign policy and international issues as well as trade and the economy. Faculty already work with the Global Environmental Institute to develop environmental guidelines for investments. The work to date has focused on key gaps, impacts and best practices. Future work should focus on sector strategies. The Blue Moon Fund (VA) has supported this work.
- Land use planning programs in universities as well as short training courses for public officials. Such programs could focus on:
    - Infrastructure
    - Development corridors
    - Water and watershed issues
    - Forests and wildlife corridor issues
    - Biodiversity
    - Modeling land use performance and risks under different economic and ecological scenarios
- The development of tools for planners both for domestic and international work.
- TNC to implement its Development by Design Tool—Avoid, Mitigate and Offset to help change the thinking on key issues in China
- WWF to work with Chinese companies to improve their supply chain management for key commodities as well as for embedded carbon and water

Freezing the Footprint of Resource Use

Unless consumption patterns change dramatically, by 2050, we will need to produce twice as much with the same resources (e.g. land, water, inputs, etc.) if we are to meet consumer demand and maintain a living planet for future generations. The current model from the West will not achieve this. China is in a unique position to offer an alternative, leap-froging, low-carbon way forward, but it will require leadership and innovation in China. The commodities or issues where current impacts are high and alternative strategies are needed include:

- Agriculture commodities globally (e.g. cotton, horticulture, palm oil, soy and rice);

- Sustainable fisheries (forage fish and whitefish) and aquaculture (shrimp and tilapia, near shore marine aquaculture);
- ICMM standards for Chinese mining operations (both domestic and international) to reduce the biodiversity impacts of mining and mining infrastructure as well as the amount of water and energy used to mine and process minerals with high environmental impacts (e.g. iron, gold, aluminum, coal, oil & gas and cement);
- Embedded carbon and water in China's imports, domestic production, or exports to help prioritize future work; and
- Bringing environmental externalities (e.g. carbon, water or biodiversity) back into the price of commodities.

Research

As the old adage goes, "Get informed, then get involved." There are a number of research projects that could help MacArthur identify future opportunities where small investments now can have tremendous impacts in changing the trajectories of change going forward. The development of MacArthur's 10-year China strategy should be like peeling and onion rather than having a finished strategy in year one. Ultimately the research that is helpful and its timing will be dependent on the key planks of MacArthur's overall strategy. However, there are several "types" of research that would be useful if not essential in MacArthur's initial strategy development phase. Some of these would be timely if they were undertaken over the next couple of years as MacArthur is laying out the overall structure for the strategy that it is proposing to take forward. Work that could be supported includes the following:

Overarching Issues

- Who benefits from China's economic growth and how is this likely to affect environmental performance in the future?
- Which are the most important levers for each of the targeted sectors (e.g. government agencies, companies, banks)?
- For the private sector companies, which are the most significant leverage points (e.g. suppliers, buyers, investors, regulators, consumers, etc.)?
- Each ministry has a research institute/think tank intended to undertake research and feed it into the overall policy framework. MacArthur needs to ensure that the universities and NGOs it supports can feed ideas and data into these "official" think tanks rather than operate on parallel but unrelated tracks.
- The recent privatization of 60% of China's forest lands will have impacts on forests and forest services (e.g. wood, biodiversity, water, desertification, etc.).

    - Mexico underwent a similar privatization about 20 years ago, what were the lessons learned that could inform or shape China's efforts?
    - How would conservation easements, conservation concessions or carbon payments affect privatization schemes? Can they be linked? Should they be?
- What would the impact be of bringing avoided carbon and carbon sequestration payments into China's domestic agriculture on the overall sustainability of the sector?
- Could China offset some of its domestic GHG emissions by bundling carbon into the price of commodities it sources internationally? What would be the environmental impact on the production of those commodities? Which are the most likely candidates?
    - Could China use agricultural carbon or REDD in Africa to further political goals while offsetting its coal GHG emissions at least as a transition strategy?
    - Or, could China prefinance livestock biogas projects in Africa or Asia that would reduce deforestation and methane emissions; increase security, life expectancy and literacy; and increase time for other economic activities?
- What are the environmental risks from projects aimed at transferring water from areas with more rainfall to the drier northern part of the country? What are the alternatives?
- What are the most significant environmental impacts of domestic mining operations? Which minerals have the most significant impacts?
- What are the environmental impacts of the Economic Stimulus Plan and infrastructure development more generally on Western China?
- Considering all possible areas of energy savings (buildings, iron and steel, electric power, building materials, chemical manufacturing, industrial electricity and other industries), where are China's biggest energy savings likely to come from?
- What strategy could increase official Chinese foreign aid? What focus would allow China both to do good and do good by doing good?
- What information and strategy would encourage the private sector and wealthy Chinese to get more involved in philanthropy domestically and internationally?
- What strategy would hasten China's shift from coal to alternatives (e.g. hydro, solar, wind, nuclear)? How should China compare the impact of alternatives to each other and to coal? Is there a role for international retailers and brands who buy products made in China to work together to stimulate further green energy development (e.g. IT)?
- What are the best available global technologies for power generation that could benefit communities that are off the grid in northern and western China? What can China learn from and share with others?

Benchmarking Performance

If you manage what you measure, what environmental performance issues are the most significant? Which should be measured to understand the impact of China's economic growth

on the environment both domestically as well as internationally? It is impossible to measure everything, so of all the key issues, which are the most important? Which of these impacts can be benchmarked globally or within China?

- Public and private environmental guidelines for domestic and overseas investments—what is the norm? Where does China stand?
- Private sector environmental performance against key issues, e.g. energy, water, waste but also scope three issues as well.
- International development assistance—where does China stand now and what strategy could be the most significant for moving Chinese and recipient country interests forward simultaneously?
- CSR reporting categories
- There are several areas where performance could be measured and compared—either variability within China, China compared to other countries or overseas Chinese companies compared to other multi-nationals. The specific areas could include:
    - GHG emissions from coal power plants
    - Energy efficiency in refining minerals
    - Water effluent quality standards for different industries
    - Water used per unit of production by priority commodity
    - Agrochemical use per unit of production by priority agricultural commodity
    - Fishmeal and oil use per MT of production of seafood
    - Habitat loss for commodity imports

Innovation

It is important that China lead innovation globally not lag behind it. As the economy grows and its impacts are felt increasingly globally, it is important that China take a leadership position in demonstrating that not only can countries that have long lagged behind others in terms of overall development can move forward, but they can do so in such a way that maintains the planet for future generations. To do this, China will need to leap-frog over technological dead ends or at least ends that do not afford the country and the world the kind of resource efficiencies we all will need going forward. Rather than being exhaustive, just a couple of examples will be included here.

- One of China's strengths is the strong central government. China can make things happen through government that few Western democracies can. China can bring resources to bear on any change it identifies as important and it can focus on problems for as long as it takes to solve them—not just the next election. China can create demand and pricing mechanisms (e.g. for water and carbon) at a scale that few other governments can. It can (and has to a large extent) addressed population growth,

poverty alleviation, food security, malnutrition (at least calories), and productivity at the national level. It can also address competitiveness issues, invest in science, and identify green technologies at a pace and scale that is difficult in democracies. Finally, the power of the state allows China to make substantive changes very quickly. The question, however, is how can MacArthur and others provide information, in acceptable form, that helps to shape such strategies? And, perhaps as important, is how can China's successes (and not everything will be successful) be identified quickly, adapted and made acceptable in fundamentally different political systems?

- The private sector is new to China at least this political system. China needs to find new ways to engage that are not just state to state. One place where this might begin is with IT. Nearly 200 global IT hardware and software companies have joined together to reduce the amount of energy it takes to use their hardware or software. Their goal is a 20 percent energy reduction in consumer energy use. The question these companies are being asked is, "Does a 20 percent savings of consumer energy use offset the GHG emissions from coal powered utilities if the products were manufactured in China?" Furthermore, if the aluminum in a laptop is from virgin sources then it represents as much energy as two full years of consumer use. If it is recycled, then it is only 5-10 percent as much. It would be interesting to see if an entire industry could work with China to find ways to reduce the carbon embedded (e.g. less carbon, green carbon, etc.) in and used by an entire industry. This is the type of innovation and partnering that will make China a more acceptable "manufacturer to the world."
- A pivotal organization regarding innovation in China is the Society of Entrepreneurism and Ecology (SEE). This NGO is supported by the top 100 entrepreneurs in China. Its focus has been on Inner Mongolia. Because of its support from the private sector, this group has good connections to Chinese leaders. The individuals behind this group could help develop a global strategy for the Chinese private sector regarding reporting and benchmarking that, if positioned correctly, could have influence on the Chinese regulatory system as well as its financial investments abroad.

Capacity Building

The capacity needed to undertake most of the strategies outlined above is not currently in place or at the very least needs to be increased. The best strategy will be to identify key individuals and institutions and build on their successes. If new capacity is needed it will at least have a better chance of success if it can be mentored in such institutions. There is little time capacity training. And, much of the work that needs to be done will only become more difficult over time.

It is hard to identify, hire and retain top notch individuals in China who can hit the ground running either in terms of identifying the key environmental impacts, engaging in policy work or working with the private sector. This issue is even more complicated in places the impacts of Chinese investments are even more profound, e.g. Africa or SE Asia. In short, most NGOs and research groups, whether in developing or developed countries who work on China find it hard to attract and retain staff with the necessary skill set. In developing countries, the number of people with knowledge of China is virtually nonexistent. Often the place to find such people is in universities or the private sector, but they often either do not have the right motivation or are beyond the acceptable salary range for NGOs. In developed countries, the skill set for the work outlined here is rare as well. Very few speak Chinese. MacArthur will have to work hard to address this issue and to insist that projects and work plans are appropriately staffed and budgeted. In most respects, everything is likely to turn on this issue.

- There is considerable political will to make improvements in China both domestically and internationally. However, the private sector is much newer in China and there is less understanding and less political will about how it can and should behave. There is tremendous potential however. The issue will be to find the opportunities to improve performance not just identify the problems.
    - Identify and work with one or two NGOs to engage constructively the private sector by sector about its performance.
    - Support the development of tools or help individual companies or entire industries to benchmark their performance against their international peers.
    - Use the overall focus on China's domestic and international impacts to guide the types of programs supported as well as the NGOs or universities supported directly to do the work.

Communications

There are some interesting opportunities MacArthur should keep in mind as potential delivery mechanisms as it decides on its larger China strategy. These could include:

- Despite the recent issues with Google, China has 14 million internet hosts. Many more Chinese use the internet for communications and information than those that actually own computers.
- In 2007, Chinese went to the cinema (1.5 trillion times or nearly once a month on average) more than any other country. While this is rather passive communications, it allows ideas to be conveyed to many people.
- China has more homes than any other country and some 40 percent of all homes have a color television set. Again, while passive, this is another way to get information on the environment and impacts out to a much wider audience.

Regardless of the ultimate focus of the MacArthur strategy, at least for domestic issues and to raise policy issues within the country, the foundation should support work that takes advantage of the apparent interest in communications in China as well as the country's vast communications infrastructure. Increasingly, China is also including IT as part of the infrastructure it develops internationally as well.

Recommendations for MacArthur by Sector or Region

1. Finance

Suggested Domestic Focus:

- *The development of environmental screens for financial institutions*
- *Work with key regulatory agencies to ensure that such screens are required*
- *The development of EIA tools*
- *The requirement to use EIAs for all loans of a specific size and for specific sectors.*

Suggested International Focus:

- *The development and implementation of environmental screens to be used by all international loans originating from Chinese financial institutions.*
- *The development of EIA tools and the requirement to use them for all loans of a specific size and for specific sectors.*
- *The development of monitoring systems to ensure that international loans from Chinese lenders meet all the same standards as those for domestic loans.*

Background Research to Shape the Strategy

- What environmental impacts (short, medium or long term) can be expected from China's existing policy on currency exchange? How will it affect those developing countries where China increasingly sources raw materials?
- Has China stepped in to help central banks of any major raw material supply countries? What have been, or more importantly will be, the environmental impacts of such actions? What is the best proposed strategy regarding China's policy toward the central banks of supplier countries?
- In which sectors is China large enough to simply grow itself out of the current global financial crisis and which will require a more global financial turnaround? What are the environmental implications for these different sectors?
- What are the most significant financial leverage points (either public or private) to influence domestic investments either in green businesses or reducing the impacts of the worst producers in any sector?

- Who are China's worst producers environmentally by sector and how many of them are significant players internationally, either in terms of raw materials production or through imports or exports?
- China has some good regulations in place. How effective are they? How many companies have been denied loans due to previous environmental performance or violations? Is there an appropriate role for science-based publicizing of overall performance or benchmarking companies against their peers?
- Do Chinese companies tend to follow Chinese regulations when investing overseas or local ones? How does this vary by sector?
- Who is investing in domestic food production in China? Is it private institutions or public ones? Which crops are being targeted and what are their impacts? Are any environmental screens used in agricultural lending today?
- Is China investing in rural industries as a way to stem the tide of urban migration? Are there any key lessons here for other countries that are urbanizing rapidly and who could provide alternative economic activities for those who otherwise will move to cities?
- What countries receive most Chinese investments? What is the focus of such investments? Without this information it will be difficult for MacArthur or others to know where to focus or what to focus on going forward.
- What have the costs been to China (e.g. failed investments, delays, loss of license to operate, etc.) of not addressing environmental issues up front?

Civil Society Support

- Support grassroots NGOs to gather information on the international impacts of China's investments on the ground. Such groups could also help identify apparent violations of local laws in key countries where China has made investments. The best strategy might be to make bundled grants to a single "hub" NGO which would make smaller grants to support other groups in a region (e.g. Central Africa, East Africa, SE Asia, Indonesia).

Longer-term Strategies

- Determine what minimal requirements are essential in developing countries to reduce the impacts of FDI (including but not limited to China) and support groups to help identify the appropriate mechanisms and strategies to put those regulations in place.
- Develop environmental screens that can be used as a template for all domestic and international investments.
- Develop EIA templates for financial institutions but only require them (initially at least) for higher risk and larger projects.

2. Infrastructure

Suggested domestic focus:

- *Hydroelectric dams*
- *Water transfer canals and related infrastructure*

Suggested international focus:

- *Hydroelectric projects (Africa and SE Asia)*
- *Infrastructure—roads and bridges, transmission lines (Africa and SE Asia)*
- *Mines (Africa)*
- *Large-scale development projects*
- *Combinations of the above*

Research

- What are the impacts of infrastructure development on the migration of people, their use of natural resources, and their environmental impacts?
- What are the impacts of infrastructure projects on invasive species and the extension of disease vectors?

Domestic Issues

- Hydro-electric dams in Western China are likely to be those infrastructure projects with the biggest impacts in the near future.
    - Support the use of technical assessments for siting, construction, biodiversity, downstream user concerns, and ancillary development issues
    - Support independent technical expertise to assess larger and more controversial projects
- The construction of massive projects to move water from one part of China to another are likely to have tremendous effects. Five fault lines will be crossed. Nothing of this scale has ever been done before and no EIA has been undertaken. Support credible work to better understand the potential impact of such projects and feed the findings into the public policy arena. Since India and other countries are considering similar projects it will be important to understand better the impacts of these three projects if they go forward.
- Evaluate of the degree to which infrastructure projects open areas to other economic activities that have unanticipated environmental impacts.
- Evaluate the potential trade-offs between China's use of hydropower for green energy and the need for water downstream for agricultural irrigation?

International Investments—See also section on Africa below

- Evaluate whether Chinese nationals working on internationally funded projects are working under conditions that are legal in recipient countries
- Evaluate the impact of Chinese workers overseas on local employment and development (e.g. local purchase of food for enclave development projects)
- Encourage local purchase requirements to stimulate local economies

NGO Support

- Support local NGOs to insure that local concerns are reflected in their government's negotiations regarding infrastructure projects
- Ensure that local NGOs and communities have a way to provide feedback on the impact of projects as they are implemented and running

3. Agriculture

Suggested domestic focus:

- *Rice*
- *Horticulture (for domestic and international markets)*

Suggested international focus:

- *Palm oil (Indonesia),*
- *Soy (Brazil and Paraguay),*
- *Cotton (Uzbekistan, Africa, India and Pakistan)*

Research

- China is the largest agricultural producer globally. From a simple comparative advantage perspective (e.g. water, arable land, residues, pollution, etc.) when does it make sense to import more food? Which foods should be targeted first?
- Which foods are already being imported and which are likely to be imported in increasing quantities in the future? Where are they likely to come from?
- China is the largest producer of meat in the world. What regulations and management systems are in place to manage the effluents? Are the impacts benchmarked against other global meat producing countries?
- China produces more cotton than any other country and nearly half of global production. Cotton uses more pesticides than any other crop. China uses more pesticides than any other country. What is the norm for usage in China? What are they

doing to reduce it? Has this been benchmarked against other global cotton producing regions?

- When and for which species will animal protein consumption peak sooner and later and what are the environmental implications? For China? For exporters to China?
- Where are China's investments in food being made internationally, e.g. amounts, countries, crops? What are the key environmental impacts? Where are the impacts most significant?
- If one accounted for embedded water and carbon, how would food produced domestically and shipped around the country compete with food from other parts of the world? What is China's food footprint for key impacts? How can this information be used to drive government policies?
- What is the net impact of China's reforestation and aforestation programs when deforestation in its supply chains for soy and palm oil are taken into account? NB: This was an issue for Japan 20-30 years ago.
- China is at a pivotal point in its overall development regarding food. Should it encourage local vs. global? Fresh, frozen or dried? Which have fewer impacts?
- What have the financial costs been to China and to international manufacturers, traders and brands from the various recalls of China products (e.g. toys, 5 aquaculture species, pet food, infant formula, fresh fruits and vegetables, etc.)? What is the cost of not getting it right?

Domestic Agriculture

- Support the testing of agrochemical residues in conventional and various certified systems in China. Use the results to drive public and private reforms.
- China is increasingly exporting food to the rest of the world. Is it safe? What are the key costs in terms of environmental impacts (water, soil, agrochemicals, pollution)?
- Support more sustainable supply chains through the development of out-grower programs that reduce key impacts through BMPs, improved management systems, and control of critical points in the production process. A key program of this type could be work WWF has been asked to support by Wal-Mart.
- SureHarvest (Jeff Dlott) and NRDC have been working on horticulture standards starting in CA and then elsewhere in the US that might be applicable in China as well. At least the metric-based approach would be a good starting point in China as it would allow producers to benchmark themselves against others.
- Producing food takes a lot of inputs. Wasting them is expensive for people and planet. China is a global leader in reducing post harvest losses. What are its waste rates and how does it keep them so low? What could other countries learn from China?

- Has China developed any programs for reducing waste at the consumer end? This may become more important as urban populations increase and become wealthier both in China and globally.
- What is China doing to increase domestic production and reduce input use for rice production? Water, fertilizer and pesticides are key as is methane.
- China has recently (11/09) embraced GMOs. China has been working on dozens of species and has focused on numerous traits (e.g. pesticide tolerance, disease resistance, drought tolerance). Has it also focused on productivity, health and nutrition issues, etc? What can the world learn from China's work which will roll out during the MacArthur strategy?

International Agriculture

- What case could be made to sell meat from Brazil to China rather than soy?
- What are the key Chinese companies involved in the global production, trade or purchase of cotton, palm oil, soy, or sugarcane?
- Would China ever consider purchasing REDD, agricultural carbon, or biogas from international producers as part of an offset program for the GHGs it generates domestically?
- Support strategies with Wilmar and Cargill to link consumption in China with more sustainable palm oil production.
- Support strategies with ADM, Bunge and Cargill that encourage more sustainable soy production in South America?
- Work with global retailers and brands to insist that the cotton textiles that are made in China that they buy that are made with "better cotton," i.e. produced with fewer impacts.

4. Energy

Suggested domestic focus:

- *Support strategies that decouple economic growth from energy consumption*
- *Identify ways to reduce the impact of coal fire powered plants*

Suggested international focus:

- *Identify the most significant environmental impacts of imported oil and coal production*
- *Support strategies to reduce the impacts of oil and coal production*
- *Evaluate the impact of China's GHG emissions on such things as glacier melting and water availability and hydro-power generation capacity*

- *Identify and support strategies for China's exports to be produced with green energy*

Research

- Evaluate the role cheap energy plays in China's global competitiveness
- China has invested in outmoded coal-fire powered energy generation. What is the savings from energy generation compared to the cost of reducing CO2e emissions? What will be the cost of clean coal (e.g. CO2 capture and sequestration) or alternatives?
- What are the health and worker productivity costs of air pollution in China today?
- Which energy production and use technologies afford China the ability to leapfrog the lessons learned in other parts of the world? Which areas are the most important for focus and what would it take to identify and "sell" these technologies into China and have China become a proponent of them globally?
- As the leading producer (and increasingly the leading consumer) of many technologies (e.g. batteries, etc.) which technologies should China focus on in order to make global consumption greener?

5. Mining

Suggested domestic focus:

- *Domestic environmental impacts of mining and processing operations*
- *Standards for domestic mining operations*
- *Cement production and consumption*
- *Recycling of non-renewable, hard commodities*

Suggested international focus:

- *Direct and indirect International environmental impacts of mining and processing operations*
- *Iron, aluminum, gold, coal and oil and gas*
- *Monitor use trends*
- *Standards for international mining operations*
- *Embedded CO2e and water issues*

Domestic Focus

- Reduce the key impacts of domestic priority mining and processing operations on biodiversity, freshwater (take and effluent), energy use, and GHG emissions
- Identify when cement consumption will peak in China and what the environmental implications are likely to be

- Work with ICMM to adapt their standards for Chinese domestic mining operations
- Extract lessons from China and extended to other countries (e.g. the US) regarding recycling of minerals, starting with those that have the largest impacts e.g. steel, aluminum and glass

International Focus

- Reduce the key impacts of priority international mining and processing operations on biodiversity, freshwater (take and effluent), energy use, and GHG emissions
- Given current use trends and global economic development paths, which minerals is China likely to import more of, from where and with what impacts?
- Work with ICMM to adapt their standards for international mining operations that export product to China
- Develop standards for embedded CO2e (CO2e /MT) and water (M3 of water/MT) for each MT of refined minerals (ICMM does not address this)
- Assess indirect environmental impacts of mines from ancillary infrastructure and food production systems
- Work with China and African countries to adapt Norway's strategy of using only part of the proceeds from its mineral wealth and investing the rest for a future when the supplies of the minerals are exhausted?

6. Seafood

Suggested domestic focus:

- *Whitefish processing*
- *Seafood contamination from pollution*
- *Improving the performance of China's aquaculture producers*
- *Seafood consumption*

Suggested international focus:

- *Fishmeal and fish oil fisheries*
- *Subsidies for China's global fishing fleet*
- *Chinese investments in aquaculture globally*

Research

- A wider range of seafood is consumed in China than any other country. Which species are endangered? What systems can be supported to ensure that economic growth does not pose further threats to those species? TRAFFIC would be the best partner for this.

- Support the development of accurate data on fishmeal and oil production and use in China as well as total aquaculture and wild capture production. Roz Naylor (Stanford) and Chinese counterparts have begun to do this work with support from the Packard Foundation.
- How will freshwater shortages affect aquaculture production in China? Is China working on programs to develop salt tolerant species (e.g. tilapia)?
- What is the cost to China from pollution affecting both freshwater and marine aquaculture in China? What are the health, reputational and market access issues posed by this problem?
- How much mixing of legal and illegal seafood is occurring during processing in China? Where is the illegal product from? Which are the consumer markets? What is the potential impact on China's reputation?
- Identify the key global fisheries that China depends on for fishmeal and fish oil and assess their overall sustainability as well as the implications of increased demand.
- What success is China having reducing anti-nutritionals and increase Omega 3 in soy and other grains so that it can be substituted for fishmeal and fish oil?

NGO Support

- Create capacity to work on seafood (aquaculture and wild caught) both in China as well as seafood trade that originates elsewhere. The approach should include production, consumption and trade as well as policy work.
- Support NGOs to monitor aquaculture investments in Africa and Latin America and inform local stakeholders about key potential environmental impacts as well as global norms for such investments.
- Support NGO efforts to identify and track illegal seafood products in/through China
- Support NGO's who are working with global retailers and brands to assess the impact and improve the performance of Chinese seafood producers (aquaculture and wild caught) in supply chains that originate in or pass through China.

Long-Term Trends

- Seafood demand in Asia is expected to triple by 2050. What are the environmental implications of such increased demand for China both domestically and internationally and from wild caught as well as aquaculture species?
- By 2050, tilapia is expected to be more common than chicken in most countries. Traditional tilapia will compete for water and other resources within the Chinese context. I will be important to monitor the growth of this (or a similar lower trophic level white fish).

7. Illegal Products

Suggested domestic focus:

- *Chinese medicines*
- *Seafood*
- *Minerals*
- *Timber and paper*

Suggested international focus:

- *Ingredients for Chinese medicines*
- *IUU Seafood*
- *Minerals*
- *Illegal deforestation for palm oil and soy production*
- *Timber and paper*

Increasingly, global trade is being scrutinized for a broad range of illegal products. The issue is not trivial. The EU has estimated that illegal timber and fish can have a negative impact on prices by as much as 15 percent, in effect undermining those companies that purchase only raw materials that are produced legally. As a result many products that contain raw materials sourced illegally are being excluded from an increasing number of markets. As China already has a reputation for purchasing the worst quality products and being the buyer of last resort, this could be an extremely important reputational issue for China and for Chinese exports.

China is also somewhat at risk simply due to the vast quantity of resources that are being imported into the country. There is a lack of border controls to screen for such products. And, China is seen increasingly as a trading hub for a wide range of illegal products. China is also seen as the place low cost (often illegal) products are sold. Yet, if China can get the right systems in place and develop the political will to address the issue of illegal trade, it has the potential to show global leadership on this issue. However, China will need to start by cleaning up its supply chains. This will include raw materials that are imported as well as produced domestically as well as the raw materials that go into items consumed domestically or exported. The raw materials that are most likely to be illegal or contain illegally sourced raw materials include: endangered species and ingredients for traditional medicines, timber, paper, fish, minerals, and certain food products.

Research

- Document illegal ingredients and products in the source country and identify companies (local and Chinese) that trade in these products.

    - TRAFFIC is the best global partner but local NGOs can be effective and develop capacity through such efforts.
    - WWF-Russia has been key in documenting that some 70 percent of timber from the Russian Far East is not from legal concessions. WWF has also documented the role of APP/Sinar Mas in illegal pulp and paper from Sumatra.
    - The Sustainable Fisheries Program (SFP) and WWF are both are involved in undertaking evaluations of seafood supply chains for major global brands in North America and Europe. Packard Foundation is also interested in this topic in China (Lisa Monzon is developing a 5-year global seafood strategy). WWF plans to put a full time person in China on seafood issues and on aquaculture when private sector interest justifies it.
- Document illegal contaminants or levels of contaminants in China's food and seafood exports
- Support the development of a tool to evaluate the effectiveness of purchase and traceability systems at eliminating illegal product.
    - Both ISO and ISEAL are potential partners for this kind of work.
- Support efforts to cultivate ingredients that replace illegal ones in Chinese medicine.
    - Prof. Peishengji is a good resource on Chinese medicine. He directs the Institute of Botany of the Chinese Academy of Science in Kunming. He is the founder of Ethnobotany in China and Xishuangbanna Botanic Garden, the first botanic garden in China. He has also worked in the International Alpine Institute in Nepal for 5 years. He has recently established Yunnan Biodiversity and Cultural Diversity Conservation Center, a new NGO intending to work with neighboring SE Asian countries on various conservation issues.
- Information campaigns in China as well as in other consumer countries about illegal products.
    - The opportunity and strategy would vary tremendously by country. Greenpeace has been increasingly effective around this issue and has experience on timber, pulp and paper, palm oil and wild caught seafood.
    - In China this might not be possible at this time, at least in a traditional way—it might be possible to use the internet with viral messages that could get into China.
    - In Africa, the appropriate strategy and group will vary tremendously. Illegal products represent considerable income to some, so funding work to expose it should be done with some caution and circumspection.

8. Water

Suggested domestic focus:

- *Water use efficiency*
- *Water pricing systems*
- *Water pollution and effluents*
- *Water infrastructure*

Suggested international focus:

- *Share China's water use efficiency lessons and technology globally*
- *Focus water use efficiency programs internationally on irrigation and aquaculture*

Work on water should be strategic, it should focus on the areas where water is most scarce and it should focus the most significant water impacts—take and effluents—and those with the most significant impacts on the above.

- Identify key areas where water take poses or will pose severe environmental threats.
    - Dr. Jiqiang Zhang is currently VP of Blue Moon Fund (he previously worked at Rockefeller and W. Alton Jones Foundation and in the Chinese Ministry of Environmental Protection). He is one of the few Chinese scholars who got his PhD overseas in the 1980s. He is well connected and has been supporting those in China interested in addressing China's global environmental impacts, including water. But, he is perhaps the most knowledgeable Chinese on the entire range of issues that have been identified in this draft strategy.
    - What are the political and security implications of diverting water and stream flow from one country to another (e.g. China from the Tsangpo-Brahmaputra River before it enters India)?
    - Half of the world's population depends on water at least during the summer months on snow melt in the Himalayas, yet China and India are emitting large quantities of GHG that are causing the glaciers to melt more quickly and thus threaten future water suppliers.
    - By 2020, China will import 46% of Asia's total roundwood production (India will import 19%). This demand will contribute to deforestation which will affect ecosystem services and water retention and runoff, GHG emissions, and biodiversity.
- Identify which types of water pollution, from what sources, in what regions are the most significant threats to biodiversity and human populations domestically.

    - Mr. Ma Jun is an active environmentalist in China and the author of *China's Water Crisis* and *China's Water Pollution Map*. He directs the Institute of Public and Environmental Affairs a Chinese NGO dedicated to the protection of water resources. He would be a key person to approach early regarding any water strategy and where MacArthur might be able to invest limited resources most effectively.
- Map the proposed hydroelectric dams in China and in Asia more generally that are proposed to provide energy directly or indirectly (e.g. through production and/or processing) to China.
    - How will glacier melt affect the viability of such dams?
    - Which sites are more prone to earthquakes? NB: China has plans for 750 projects in Tibet alone. India plans to increase its dams in the Himalaya-Kush from 74 to 355 over the next 15 years.
    - Which will have the greatest impact on downstream hydrology?
    - China has a lot of experience with micro-hydro which could be documented and extended to governments throughout Asia and beyond.
- In a 15-year period, China also increased forest cover from 157 M ha to 197 M ha. Lessons learned from this afforestation and reforestation regarding water should be captured and shared.

9. Africa

Suggested domestic focus:

- *Investment screens*
- *Policies and assistance programs for Africa*

Suggested international focus:

- *Monitor investments*
- *Improve negotiations and contracts*
- *Currency values and commodities*
- *Infrastructure, minerals, energy, agriculture and finance*

Research

- Do Chinese investments have larger direct or indirect environmental impacts than other investors? Is it helpful to benchmark its performance?
- To what extent do China's investments in Africa "lock up" scarce resources, and if they do, which resources are most affected by this strategy?

- What levels of financial assistance does China give to African countries?
- Is value added production a key component of Chinese investments in Africa?
- Is China working with African countries to ensure that the income generated by the sale of natural resources is being invested for the benefit of future generations?
- Identify ways China can help to turn around China's steadily declining soil health and fertility
- Identify ways China can help Africa improve its steadily deteriorating roads and infrastructure with the fewest environmental impacts but the greatest economic benefits
- Transfer Chinese systems to reduce post harvest losses and other food waste.

NGOs and Civil Society

- Build overall NGO capacity in Africa to address the issues raised by China, starting with organizations in key hubs and then extending through them to other, local NGOs
- Support NGOs to work with their governments to assure the best possible outcomes from Chinese investments in their countries
- Develop capacity to monitor the impact of Chinese investments
- Explore the allegations that deals are made with African leaders individually to ensure smooth sailing for Chinese interests and investments
- Use the global financial crisis and the slowdown in Chinese investments to identify and target those projects that would have the most serious environmental impacts.

Government

- While most investments in Africa come from Finance and Commerce, there is the new China/Africa Forum (housed in Foreign Affairs) that has been established to engage directly with African governments. NGOs are not welcomed in these circles unless they are able to influence their respective African governments. Local NGOs and large international NGOs are often in positions to influence those teams at least on specific issues.
- China is interested in mutual interest and benefit. It does not want to define what Africans want, nor listen to NGOs on the topic. Thus, it is important to work closely with Africans so that they can articulate clearly and negotiate carefully precisely what they want. Making some of the issues more public in Africa might help this happen.
- Before Copenhagen, the government pledged to invest in technology transfer to Africa some Chinese institutions are positioned to help make that happen—if supported or sometimes pushed a bit. The government has made large pledges to clean tech since Copenhagen, it would be important to link these two in Africa.

- The government has supposedly identified seven priority zones in sub-Saharan Africa. I have only heard an incomplete list. I believe 2 are in Nigeria, 1 in Ethiopia, 1 in Angola and 1 in Liberia. The list is incomplete. It would be important to screen China's targets with regard to overall biodiversity and habitat priorities.
- China is discussing the creation of a bi-lateral type of development agency. It would be good to work with respected Chinese individuals and institutions to try to influence the priorities of the work of such an agency in Africa.

Other Donors

- The US State Department/AID has more of a focus on Africa. Jennifer Adams (formerly rant the AID office in Brazil) is now in Beijing. It would be good to reach out to explore common interests.
- The Blue Moon Fund was a very early supporter of WWF's Forest Trade Network in China, other work on water. They are an early mover that could be a good partner for MacArthur.
- The Gates Foundation has a presence in China (Dr. Ray Yip, formerly of the CDC), but the real agenda appears to be to try to influence what China is doing in Africa.
- Several EU bi-laterals have a focus on China. DFID's China-Africa Program (Mark George) is perhaps the furthest along in its thinking. Most of the groups focus on the MDGs. DGIC, SIDA and NORAD are all working (separately) on different smaller pieces but it might be good to reach out and see if any of them are aligned with MacArthur priority issues.
- The African Progress Panel (with Tony Blair and Kofi Anan) is another potentially interesting partner when it comes to addressing/influencing China's work in Africa.