

Master of Arts in International Development Studies  
Chulalongkorn University

# International Cooperation and China's Energy Security Concerns

Kiratiya Pitisant  
October 2007

China is one of the countries that have received the most academic attention in the decades that followed the opening of the country. As the country that contains a sixth of the world's population, any changes in China would have global implications. Data collected by the United States (US) Energy Information Administration (EIA) clearly states that China has an above average growth in energy consumption as it reveals an average annual growth rate of 7.5% when compared with the world average of 2.5% within the period of 1994 to 2004. Both the United States and China, the world's highest and second highest energy consumers, regard continued access to energy as paramount to their security. Especially in China, future energy plans concentrate on increasing the amount of energy for consumption. Energy usage in China will heighten the stress on the remaining supply of non-renewable resources. The nature of non-renewable resources, being non-renewable, means that at some. China, realizing that their energy consumption has greatly increased and will continue to increase, has taken steps to ensure their access to energy.

China's lack of self-reliance in energy and increase in energy imports has caused it to take a proactive approach in rectifying the situation. According to Kenneth Lieberthal, self-reliance (*zili gengsheng*) refers to the ability to "keep the initiative in one's own hands" (Downs, 2006, p.11). This sense of insecurity is enhanced by contrast with the previous self-reliance during the Mao period. That China used to be an exporter of oil merely emphasizes its current dependence on imports. China only began importing oil in 1993; by 2006, China was importing 162.87 million tons (Zhong, 2007). Almost half of China's oil demands are met by imports and that number is predicted to increase as consumption increases faster than China's oil production. However, oil remains a small share of China's energy

composition. According to the EIA, in 1996, oil made up 20% of the total energy used by China, that figure rose to 24.5% by 2002, and is expected to rise to 25.9% in 2020. Coal is and will remain the main source of energy for China, as China is the biggest global producer of coal, producing an estimated 2 billion tons of coal in 2005; however, inefficient mining, irrational distribution and transportation delays have caused power shortages to occur throughout the country (Ebel, 2005, p. 61-66). By the third quarter of 2005, China had imported 18.76 million tons of coal (People's Daily, 2005, *China's Coal Imports*). The increased dependence on energy imports has raised China's vulnerability to energy shortages and fluctuating global oil and coal prices. Energy security is therefore high on the Chinese agenda.

One obvious solution to energy security is to use less energy. Lower demand means there is less need to acquire additional energy. Energy efficiency is therefore very important for energy security. Though the Chinese government has long recognized the importance of energy efficiency, energy efficiency activities are underfunded as, in 2003, only RMB 23 billion was spent on energy conservation while RMB 424 billion was spent on increasing supply (Sinton et al., 2005, p. 10). Though there have been many measures put into place to increase energy efficiency, such as 22 administrative measures, seven standards and 14 policies including an Energy Conservation Law, energy efficiency has not received the boost it needs to make a significant change (*ibid*). Low investment in energy efficiency combined with the little incentives for change due lax enforcement of energy efficiency measures and low government subsidized energy prices has stunted the growth of energy efficiency. Sinton et al. (2005) recommends that China should invest 10 % of its energy

investment budget in energy efficiency, enforce created measures rigorously, and target the industries as they consume 70 % of the energy consumption.

On the supply side, there are basically two main strategies in China's search for energy security: source diversification and fuel diversification. Source diversification is the more visible and contentious of the two. This is essentially China's "going out" strategy. Literally, in 2002, China began the official "Go Out!" campaign which encouraged Chinese firms to "go out" and buy foreign assets, specifically in the field of natural resources (Friedberg, 2006, p. 22). Though China has acquired many stakes in foreign fields, the use of non-renewable resource will cause the supply to dwindle, prices to rise and perhaps even conflict as competition for resources escalates.

A fuel diversification strategy is also currently being pursued with aims of increasing the share of other fuels in the energy composition, in this case, nuclear, natural gas, and renewable energy. The idea is to diversify primary energy sources to an extent in which disruption in one would not damage the economy. Nuclear energy has potential but is dangerous as the safe disposal toxic waste is still an issue. Furthermore, safety of the plants is a key concern, considering the deadliness of the Chernobyl incident. Natural gas can contribute to fuel diversification but does not provide a secure energy source as it is also a non-renewable resource which, considering the amount that China consumes, will have to be imported in increasing amounts over the years.

The only hope for truly securing energy security lies in renewable energy as it is available domestically. China aims to boost the renewable energy sector to 15% by 2020 (Biopact, *China unveils*). According to the EIA, in 2002, renewables consisted of 7.2 % of total consumption. A renewable energy law, passed in 2006, encourages the renewable sector through financial incentives, subsidies, price fixing, and even requiring power grid operators to purchase power from renewable sources. Though 15% is a small share of the total energy consumption, energy from renewable sources does not suffer the vulnerabilities that fossil fuel sources suffer. However, renewable energy is not the panacea to all problems as some seem to consider they are. There are, as always, advantages and disadvantages. Though there are no price fluctuations on wind, water or solar sources, ethanol and biodiesel components<sup>1</sup> could suffer from price increases as demand for the product increases and farmland decreases. Nonetheless, they have the ability to make China less dependant on energy imports and feel more secure about being able to control a portion of its energy supply. However, the high setup and operation costs along with research to develop these sources are expensive. Cooperation, in this case, could prove much more beneficial and lead to greater energy security for all those involved.

The idea of international cooperation is nothing new yet modern technology has made it possible for international cooperative initiatives to flourish. International cooperation is important for China to increase the share of renewable energy and reduce the amount of imported energy. Through international cooperation, developed countries and developing countries, in this case, China, are able to use their strengths and maximize mutual gains. For example, production and installation costs

---

<sup>1</sup> Sugarcane, corn, barley, wheat, sugar beets, sorghum; basically high starch crops.

in China are low. China also has abundant renewable energy resources. Its energy infrastructure is in the process of developing, which accounts for the annually high growth rates in energy demand. Developed countries, on the other hand, are usually the ones with the highest growth rates in renewable energy (REN21, 2006). However the potential for growth within the renewable energy sector is not as high as with a developing country as the energy sector is already quite developed. If developed countries share their technology and financial and human resources, they would benefit from the lower production costs and buy themselves time to transition their energy sector to a more sustainable one. China would benefit from gaining possession of renewable technology without research, gain markets for renewable technology components and increase energy security.

International cooperation over renewable energy comes in many forms in China. The partnerships involve governments with governments, non-profit organizations and governments, and cooperation between non-governmental organizations (NGO). Due to the restrictions stated in chapter one, this paper will look at notable cooperation efforts within these categories. The US-China Energy Policy Dialogue (EPD) with its Green Olympic Protocol and the Asia-Pacific Partnership on Clean Development and Climate (APPCDC) are great examples of governments working with governments. Renewable Energy Policy Network for the 21st Century (REN21) and the China Renewable Energy Scale-up Program (CRESP) demonstrate how public-private partnerships operate while the Energy Foundation and the China Rural Energy Enterprise Development (CREED), the result of cooperation between various NGOs, reveal the strengths and weaknesses of non-governmental involvement.

There are many governmental cooperation efforts over energy in China as many countries are concerned over China's energy growth. The US is particularly concerned as they see China as direct competitors for energy resources. To effectively deal with energy concerns, the US established the EPD in 2004 after Chinese Vice Premier Zeng Peiyan expressed to US Secretary of Energy Spencer Abraham on his visit to Beijing the desire for closer cooperation on energy with the US (Xinhua, Vice Premier, 2004). The EPD consists of policy level exchanges on energy security, economic issues and energy technology options between the US Department of Energy (DOE) and China's Reform Commission. In order to further facilitate these exchanges, the DOE opened an office in Beijing. There is hope from the Chinese that the office will provide the DOE with a better understanding of developments in China's energy sector. By having a dialogue that is about energy, mutual energy security concerns can be dealt with and tensions reduced. However, as a contributor to renewable energy, the EPD is not as successful. There have been two meetings, in which were mostly discussions over the definition of energy security, the differences in each country's definition; the value of a strategic petroleum reserve, something that the US already has and China is embarking on, the effect on the global energy market when China fills that reserve; and explicit details of the energy plans of both countries (Harbert, 2006). While renewable energy programs are discussed, such as the deployment of renewable energy including biofuels, they are not given as much consideration overall. (US Department of Energy, 2006, DOE Assistant Secretaries).

Currently, the EPD has not contributed to any renewable energy changes. This is not very surprising as the EPD is, after all, a dialogue, a place where the two countries meet to discuss issues of mutual concern and is not equipped to initiate

projects. However, according to the Chinese Embassy in the US (2006), China and the US agreed at the 2006 meeting that efficient energy and renewable energy will be key targets of their future energy cooperation and this could result in an increase in commitment and cooperation from both sides on the issue.

Nonetheless, as renewable energy becomes more viable, the EPD could become a great tool for integrated cooperation between the two countries. As EPD is a very high level dialogue, it could result in policy formation, increase in expertise-sharing with regard to technology and training. Nevertheless, the EPD is able to facilitate agreements, for instance, the Green Olympics Protocol. Due to the high level of decision-making power in the dialogue, once the Chinese representative expressed a desire to improve the environmental image of Beijing, and in the process China, the Green Olympics Protocol was quickly drafted and signed, ensuring the help of the US in “greening” the 2008 Olympics. The protocol, in addition to clean technology and energy efficiency projects, has a very interesting renewable energy project that, if well implemented, could serve as pilot and be replicated in other cities in China (Environment News Service, 2005, Beijing Enlists). One of the goals of the Green Olympics is to make the Olympic Village a model of sustainable development. China has asked the US to facilitate bids from US companies for the construction of the village which will be powered by renewable energy sources with solar photovoltaics converting sunlight into energy to light the street lamps, and heat bathwater and the pool. This will consist of 6,000 square meters of solar panels on the roofs of 18 buildings and reduce the amount of energy needed to heat water (BOCOG, 2007). The numbers of street lamps are not listed and their energy savings can therefore not be determined. The village will be converted into a residential area

and sold as high-end condos after the Para Olympics. If it is able to maintain its renewable energy sources, and is competitively priced, renewable energy buildings in urban areas could become more widespread, and not remain a Green Olympic gimmick.

A more diverse intergovernmental effort can be found in the APPCDC, a partnership that brings together six major countries of the Asia-Pacific – Australia, China, India, Japan, South Korea and the US. The APPCDC is a purely voluntary gathering of governments interested in pursuing renewable energy and other clean energy technology. China is deeply involved in APPCDC's projects as it funds or is a participant in many of the projects (APPCDC, 2005, APPCDC). The APPCDC has many advantages to the EPD and leaves little wonder as to why it performs better. Though the APPCDC was created later, in 2005, it is built on the foundations of existing bilateral and multilateral initiatives of the partner countries and is clearly organized – eight taskforces were assigned to the eight key sectors that they had identified. One of the taskforces that the Partnership created is on renewable energy and distributed generation. This taskforce operates on the premise that renewable energy will be critical to the energy mix of all six countries in the future, partly because of energy security, energy access, poverty alleviation, and environmental considerations. One of its tasks is to identify barriers against mass deployment of renewable energy technology and complement work undertaken by the member countries and the international community to address the issues. Projects undertaken are done with the goal of enabling renewable energy to become a viable alternative to conventional fuels (ibid).

APPCDC taskforces are managed by the APPCDC policy and implementation committee, which is currently chaired by the US. The organization is administered from the Administrative Support Group, also located in the US. In contrast with its heavy involvement and potential benefit from the APPCDC projects, China seems to be taking somewhat of a back seat in the administration of the Partnership. According to the Partnerships website, it holds only two co-chair positions out of a total of sixteen offices in the organization. These co-chair positions are in the Power Generation and Transmission, and Cleaner Fossil Energy Task Forces (ibid).

The projects undertaken within the renewable energy taskforce are diverse as each member's contribution and needs differ. Since its inception, according to its project roster, the taskforce has been involved in 27 projects, 10 of which concern renewable energy and China. Two of the projects are working on deploying renewable energy on a large scale, five on market enabling projects and three on research and development.

China's involvement in governmental partnerships is very high. In the instance of the EPD, though it was formally established by the US, it was only at the request of the Chinese government for closer cooperation on energy. As for the APPCDC, though China is not actively involved in the administration of the partnership, it is deeply involved with the administration, funding and implementation of the projects within China. Government partnerships offer the benefit of close relationships with decision-makers which can result in the facilitation agreements, as in the case of the creation of EPD. They are also well funded as the known budget allocated to APPCDC renewable energy total is approximately \$11.9 million (APPCDC, 2005,

*APPCDC*). A possible pitfall of the governmental partnership could be the espousal of too many projects, resulting in a stretch in financial and human resources which may lead to poor project execution as high level decision makers take on too many projects without studying the feasibility of simultaneous project executions. Though this has not happened yet, there is a real danger as the decision-makers involved in the acceptance of a project are not the ones that are involved in the execution.

Governmental partnership initiatives always receive the most media attention whether they are effective or not. However, projects initiated by public-private partnerships are not less valuable even though they may receive less media attention. Renewable Energy Policy Network for the 21st Century (REN21) is a global policy network which, though not an actor itself, assists in international cooperation by connecting governments, international institutions and organizations, partnerships and initiatives, stakeholders on the political level, and those “on the ground.” Born on a shared vision of renewable energy and energy efficiency as important components of the future and concern for the environment, it provides a forum on renewable energy with the goal of encouraging policy development and decision making on sub-national, national and international levels to expand the renewable energy sector globally. According to its mission statement, REN21 plans to expand the renewable energy sector globally through encouraging action in policy, advocacy and exchange. In the area of policy, REN21 will engage key leaders and stakeholders and encourage the inclusion and deliberation of renewable energy matters in relevant national and international processes. In advocacy, REN21 will host high profile international events and produce authoritative and influential issue papers to increase understanding of the subject and highlight the benefits of increasing renewable energy.

In the area of exchange, REN21 provides links to knowledge bases and encourages ongoing dialogues, joint work and transparency so as to fill knowledge gaps and build capacity.

According to the REN21 website and global reports, REN21's physical base is at its Secretariat in Paris. China is keenly active in REN21 as a Chinese representative, who represents the interests of the National Development and Reform Commission (NDRC), the Energy Research Institute, and the Chinese Renewable Energy Industries Association, is the vice chair of the Steering Committee. From this committee, the elected Chair and Vice-Chairs along with the head of the Secretariat comprise a Bureau which exercises executive authority over REN21. This is an active level of involvement at the highest level on China's part as the Bureau's executive authority involves decision-making in between meetings of the Steering Committee which initiates and executes all REN21 work plans. Members of the Steering Committee include representatives from fourteen different governments and government agencies, five intergovernmental organizations, five NGOs, four industries, one finance, one regional, one local and four members-at large.

REN21 originated from a planning and consultation process initiated at the International Conference for Renewable Energies 2004 that was held in Berlin. China has been represented on the Steering Committee since the first interim committee was established by the German Government in 2005 at the request of the stakeholders (REN21, 2005, REN21). Since its inception, REN21 has built a website in which interested parties could exchange ideas. It also publishes a yearly renewables global status report which gives an overview of current market and industry trends along

with the policy landscape in different countries. This allows different actors to access and assess how other countries are approaching the renewable energy. By compiling the different programs and how each is faring, these actors may seek to adopt or adapt a specific approach to their own situation. It allows governments to review the progress of other countries, compare their own progress, and business and NGOs to survey opportunities for further investment and development. REN21 has facilitated access to and increased the amount of information on renewable energy, making it easier to use for policymakers, researchers, businesses, and other stakeholders. China's progress is included in the reports and China is lauded for its increases in solar, wind and hydro projects. For instance, in REN21 2005 Global Status Report (2005, p. 5, 17), it details how five of the largest electronics and aerospace companies have entered the wind power business and over 500 enterprises produce hydrogenerators. China has also begun manufacturing solar photovoltaic equipment, producing 100 MW in 2004, and 70 MW in cell production (ibid, p. 17). Similar projects in other countries are listed together, allowing those involved in similar projects to seek each other out and discuss the various obstacles and their solutions. Access to the right information is, at times, more valuable than action as developing the same expertise independently in each country or organization would waste more and would be much more costly in terms of time and money than participation in REN21.

Having information without action is also useless. China Renewable Energy Scale-up Program (CRESP) is an organization that exemplifies how well researched information can be put to action. The program is the result of cooperation between the government of China, the World Bank, and the Global Environmental Facility (GEF). Previous World Bank and GEF cooperations have resulted in one-off projects (Meier,

2006). China is fully involved in CRESPP as it is one of the main partners, partly funds the project and is solely responsible for the administration of the project. CRESPP, was created in 2005, to deal with the problems encountered in earlier projects with the goal of scaling up renewable energy deployment. It aims to create an environment conducive to large-scale, renewable-based electricity generation through legal, regulatory, and institutional measures and demonstrate early success in large-scale, renewable energy development to encourage growth within the sector (World Bank, 2005, CRESPP). CRESPP plans to increase the share of renewables by introducing mandatory market shares (MMS) policy aimed at creating buyers for the energy produced, a problem encountered in earlier projects. In earlier projects, once the renewable energy plant was built, the power was considered expensive and had no buyers. By introducing supporting policies that reduce the initial set up costs and financial incentives, along with MMS, the program will have effectively dealt with those barriers.

The Chinese government's involvement in public-private partnerships is also very high. For instance, a Chinese government representative is the vice chair of the steering committee, the executive authority of REN21, and part of the Bureau, the body that takes care of decision-making during the intervals between the meetings. China's influence on REN21's activities is therefore very high. Though China did not actively seek this set but was offered it at the request of stakeholders, it is nonetheless active because the position of vice chair does not allow it to be passive. China is even more deeply involved with CSEP as it is one of the main partners, and funds and executes the programs, with the World Bank and GEF offering additional funding and acting in a more advisory capacity.

The funding for public-private partnerships exceeds many governmental partnerships as private funding is available in addition to the public fund. The projects are more sustainable as mostly projects estimated to bring financial returns are selected for execution. The total of known budget allocation for the CRESPP project is approximately \$7-10 billion, however, it is for a period of 10-12 years (Vidaeus, 2001, p. 5-6). Nevertheless, the current financial commitment of \$209.46 million for CRESPP exceeds the total budgeting for all of APPCDC's projects. Within this type of partnership, a possible flaw may lie in the very component that makes the projects more sustainable; as private companies are likely to be interested in investing in projects that make financial returns, projects that could leverage change but will not make substantial financial returns, if any, may be dropped.

Without the support of local governments, it is impossible to initiate any project. In China, the Energy Foundation, a philanthropic grant-making organization, has managed to collaborate effectively with government and non-government agencies, even without having any government or governmental agency as one of its partners. The Energy Foundation is a partnership of major foundations that concentrate on energy problems in the US and China, and, according to their 2006 Annual Report, has an annual budget of \$50 million. The Energy Foundation partners are all private foundations, which include The William and Flora Hewlett Foundation, The John D. and Catherine T. MacArthur Foundation, The McKnight Foundation, The Mertz Gilmore Foundation, The David and Lucile Packard Foundation, The Pew Charitable Trusts, The TOSA Foundation, The Simons Foundation, Randi and Robert Fisher, Nat Simons and Laura Baxter-Simons, and the Schmidt Family Foundation,

and being privately financed, are in control of their funds. Their projects cover a wide range as they grant funds to various energy projects that they think would be effective at leveraging change (The Energy Foundation, 1990).

In 1999, the Energy Foundation and the Packard and Hewlett Foundations launched the China Sustainable Energy Program (CSEP). The CSEP is comprised of Chinese energy policy experts who serve as a bridge to China's policy makers and international experts as the CSEP is in direct contact with ministers and directors general of China's energy related ministries. The CSEP aims to assist Chinese policymakers, experts, agencies and entrepreneurs in solving energy problems by themselves and provides international expertise when requested. However, the Energy Foundation does not fund research and development of technology, demonstration projects, community energy projects, or local projects that do not have broad national and regional implications because their main objective, at the moment, is to assist China in the development of new aggressive renewable energy policies and their implementation through such measures as MMS, public benefits wires charges, wind concession programs, and renewable energy pricing regulations (Heitz and Wooley, 2006, p. 26).

Most of the projects funded are, subsequently, policy-building in nature and makes them difficult to quantify. So even the non-governmental agencies that CSEP has direct contact with are working on changing policy and must contact relevant government agencies. The Chinese government is, therefore, closely involved with CSEPs projects. Though the Chinese Government does not have a representative on the Board of Directors, who are ultimately responsible for CSEPs activities, eleven

out of the seventeen members of the CSEP Senior Policy Advisory Council are officers or former officers of the Government of China. Chinese research institutes are engaged in developing policy proposals, and proposed policies are finally assessed by Chinese officials as to their worthiness for pilot schemes (CSEP, 1999). Policy plays a very important role in China's energy change. Without the right policies, strategies and planning, energy security would be unachievable because of the magnitude of the demand of an economy on the scale of China's.

CSEP's crowning achievement to date is the passage of the 2006 Renewable Energy Law. For the law to become reality, grantees worked on and introduced, from 2001, best policy practices at several forums involving China's top ministers. The analyses done by the grantees were then assessed by the Environmental Protection and Resources Conservation Committee of the National People's Congress (NPC) and the National Development and Reform Commission (NDRC) which finally resulted in the law in 2005 and became effective in 2006 (The Energy Foundation, 2007). They have not rested on their laurels but continue to work on making changes in China.

On a smaller scale, CREED, has managed to make itself viable not only in China but elsewhere. Part of the REED series, similar projects can be found in Africa (Africa Rural Energy Enterprises Development – AREED) and Brazil (Brazil Rural Energy Enterprises Development – BREED), with the African project being the most advanced (UNEP, 2003). According to the REED Report, CREED was established after the success of the other two sites. The Yunnan province, the site of CREED, was chosen because of concerns over biodiversity loss in the area rather than energy security, adding to the existing TNC efforts to conserve the biodiversity in the region.

CREED, along with its other counterparts, is the result of the partnership of the UNEP, TNC, and E+Co. Though the Chinese government is not an official partner, CREED engages with them as they aim to promote cooperative efforts between the public and private sectors to provide rural clean energy sources. CREED is working with the government to develop understanding and ability to plan and execute programs similar to CREED's. The local government in Yunnan is also cooperating with CREED and several other organizations to give effect on the various components of the plan (CREED, 2004).

As suggested by the name, CREED only focuses on rural areas and is currently only involved in the Yunnan province. However, considering that the majority of urbanization and industrialization is concentrated in the eastern coastal areas of China, CREED's model could be applied elsewhere in the Western provinces, which are rural, poor and especially rich in renewable energy resources. Another strength of CREED is its design as it was built to be sustainable. Funding is given to small and medium sized energy entrepreneurs rather than to the construction of the energy facility or the villagers themselves. The villagers must then get loans from their rural credit cooperatives, which, in turn, get the loan capital from CREED, buy the equipment for renewable energy from the entrepreneurs and from the freed labor, such as fewer hours spent collecting firewood, generate more income and pay back the loan. This creates business for the entrepreneurs who are then able to develop their business and, in the process, make renewable energy more affordable and accessible. The Chinese government involvement in non-governmental partnerships is much less than in the two previous partnerships as they are not official partners. This does not, however, mean that they are not involved. With CSEP, Chinese

government agencies receive grants while others lobby the government for change. As stated earlier, eleven out of the seventeen members of the CSEP Senior Policy Advisory Council are officers or former officers of the Chinese government, indicating a close working relationship with the government on the execution of projects. CSEP projects are policy in nature and would not become actual policies without the approval of the government. In CREED, the Chinese government is not very active as CREED has to initiate any interaction. The local government is, however, much more involved with the process. This is probably the result of the localized nature of the project.

The funding for non-governmental partnerships is entirely dependent on private sources and can result in less funding. The budget of CSEP projects and CREED total approximately \$1.3 million, less than some APPCDC project or CRESPI on its own. This is not a negative aspect as it encourages more creative thinking and can result in more sustainable projects as with the CREED program, where the funding is not sunk into buying and building the technology but as seed capital which will aid in the growth of the sector, allowing a more sustainable growth. However, non-governmental partnerships often result in smaller, more localized projects rather than national, most likely due to the smaller budget. Projects that do have national change leverage are generally over policy, which can be an effective approach even with a comparatively small budget.

International cooperation is key in increasing China's energy security and China is invested in creating opportunities and taking advantage of those that arises. Much of the effort has, however, been concentrated on securing access to

conventional fuel sources which, as argued earlier, does not provide a stable solution to energy security. While international cooperation over renewable resources has been relatively few, when compared to the efforts over fossil fuels, China is certainly one of the more active players in the developing world. China, for energy security and environmental reasons, has a large stake in ensuring that renewable energy gains a bigger share of the country's energy composition.

The Chinese government has had various levels of involvement in the organizations mentioned. Government partnerships and public-private partnerships are fully engaged in by the Chinese governments while a more hands-off approach is taken with the non-governmental partnerships. This bodes well for future cooperation as it indicates that no matter the type of partnership, China is committed to growth in the renewable energy sector.

In conclusion, international cooperation initiatives will only increase in the future. Not only are developed countries and their organizations motivated by energy security and the financial incentive of rising commodity prices to help China transition to renewable energy, they are also motivated by environmental concerns as China is fast becoming one of the biggest polluters, sending the byproducts of its energy consumption into the atmosphere resulting in pollutant clouds that traverse the Pacific all the way to the US and also contribute CO<sub>2</sub> to the global warming/climate change situation. For instance, energy security and rising oil prices are two of the main motivations in the creation of the EPD, the APPCDC, as stated in their mission statements, and is mentioned by REN21 and the Energy Foundation as a global concern. The environmental aspect crops up in the objectives of numerous projects

initiated by these organizations. China engages in securing international cooperation that will aid the quantity and effectiveness of international cooperation initiatives.

Though the renewable energy sector looks set to grow in China, there are still many problems. From an organizational perspective, the sheer number of projects conducted by different agencies without a practical database system and means of coordination poses problems. This generally results in overlapping projects, inefficient funding as more than one agency executes similar projects, and ineffective use of time and human resource.

Another problem is the lack of tangible results. Current renewable energy policies need more time to be evaluated and thoroughly assessed, though preliminary assessments yield positive results. Cooperative research and development initiatives are mostly still in their developmental stages and will not be commercially viable for many years. Completed projects or ones near completion are mostly small and/or localized projects, which have not been replicated on a national level, thus constricting the overall effectiveness. Moreover, projects that have significant impact on increasing renewable energy are generally still in the developmental stages. Nevertheless, these projects have great potential and the developments thus far have shown positive signs.

Overall, the current work on renewable energy in China is not enough to dissipate energy security concerns as renewable energy only consists of only 7.5% of total energy consumption in 2005 and is targeted to reach 15% of total energy consumption by 2020 (Biopact, *China unveils*). Though this increase will ease

dependence on foreign energy imports, any disruption in the global energy supply, particularly of oil, will still greatly impact China due to its energy dependence. China has tried but the current level of international cooperation on renewable energy is not enough. In the long run, the world and China stands to gain from further expansion in the renewable energy sector and although current results may show signs of sluggishness, the increasing severity of the situation will intensify the pace of change.

## Bibliography

- Andrews-Speed, P. (2005). China's energy woes: Running on empty. *Far Eastern Economic Review*, 168/6. Retrieved May 3, 2007, from <http://www.feer.com/articles1/2005/0506/free/p013.html>.
- The Asia-Pacific Partnership on Clean Development and Climate (APPCDC). (2005). *APPCDC*. Retrieved September 10, 2007, from <http://www.asiapacificpartnership.org>.
- The Asia-Pacific Partnership on Clean Development and Climate (APPCDC). (2005). *Project roster: Renewable energy & distributed generation task force*. Retrieved September 10, 2007, from <http://www.asiapacificpartnership.org/REDGTFProjects.htm#REDGTF%20Project%209>.
- Barboza, D. (2005). China backs away from Unocal bid. *International Herald Tribune*. Retrieved September 1, 2007, from <http://www.iht.com/articles/2005/08/02/business/unocal.php>.
- Biopact. (2007). *China unveils \$265 billion renewable energy plan, aims for 15% by 2020*. Retrieved September 17, 2007, from <http://biopact.com/2007/09/china-unveils-265-billion-renewable.html>.
- Calder, K. E. (1996). *Asia's deadly triangle: How arms, energy and growth threaten to destabilize Asia-Pacific*. London: Nicholas Brealey Publishing.
- Chalmers, C. (2006). *Annual Report 2005/6*. Renewable Energy and Energy Efficiency Partnership (REEEP). Hungary: Typonova Kft. Retrieved September 1, 2007, from [http://www.reeep.org/media/downloadable\\_documents/e/6/REEEP%20Annual%20Report%202005-6.pdf](http://www.reeep.org/media/downloadable_documents/e/6/REEEP%20Annual%20Report%202005-6.pdf)
- Chen, M. E. (2007). Chinese national oil companies and human rights. *Orbis*, 51/1.
- China Daily. (2004). *US, China join hands on energy at Games*. Retrieved September 1, 2007, from <http://www.china.org.cn/english/international/84556.htm>.
- China Daily. (2005). *China plans 2nd natural gas pipeline*. Retrieved September 25, 2007, from [http://english.peopledaily.com.cn/200512/21/eng20051221\\_229755.html](http://english.peopledaily.com.cn/200512/21/eng20051221_229755.html).
- China Daily. (2005). *New window for Sino-US energy cooperation*. Retrieved September 1, 2007, from <http://www.china.org.cn/english/international/133874.htm>.
- China Daily. (2005). *Rosy future for west-east pipeline*. Retrieved September 25, 2007, from <http://www.china.org.cn/english/BAT/116944.htm>.

- China Renewable Energy Scale-up Program (CRESP). (2005). *CRESP*. Retrieved September 4, 2007, from <http://www.cresp.org.cn>.
- China Rural Energy Enterprises Development. (CREED) (2004). *CREED*. Retrieved September 10, 2007, from <http://www.c-reed.org>.
- China Sustainable Energy Program (CSEP). (1999). *CSEP*. Retrieved September 10, 2007, from <http://www.efchina.org>.
- Chua, A. (2003). *World on fire: How exporting free market democracy breeds ethnic hatred and global instability*. New York: Doubleday.
- Collins, G. and Ramos-Mrosovsky, C. (2006). Beijing's Bolivarian venture. *The National Interest*. Retrieved September 24, 2007 from <http://www.nationalinterest.org/Article.aspx?id=11912>.
- Cornelius, P. and Story, J. (2007). China and global energy markets. *Orbis*, 51/1.
- DeNavas-Walt, C., Proctor, B. D. and Smith, J. (2007). U.S. Census Bureau, Current Population Reports, P60-233. *Income, poverty, and health insurance coverage in the United States: 2006*. Washington, DC: U.S. Government Printing Office
- Downs, E. S. (2006). *China's quest for energy security*. Santa Monica, CA: RAND Corporation.
- Ebel, R. E. (2005). *China's energy future: The middle kingdom seeks its place in the sun*. Washington, DC: The Center for Strategic and International Studies Press.
- Embassy of the People's Republic of China in the United States of America. (2006). *China, U.S. hold 2nd-round energy policy dialogue*. Retrieved September 25, 2007 from <http://www.china-embassy.org/eng/gyzg/t271710.htm>.
- Engdahl, F. W. (2006). The US's geopolitical nightmare. *Asia Times Online*. Retrieved September 24, 2007 from <http://www.atimes.com/atimes/China/HE09Ad01.html>.
- Environment News Service. (2005). *Beijing enlists U.S. help to green the 2008 Olympic Games*. World-Wire. Retrieved September 4, 2007, from <http://www.ens-newswire.com/ens/apr2005/2005-04-18-04.asp>.
- Feigenbaum, E. A. (2004). China's military posture and the new economic geopolitics. *China and Long-range Asia Energy Security: An Analysis of the Political, Economic and Technological Factors Shaping Asian Energy Markets*. Retrieved May 4, 2007, from [http://www.rice.edu/energy/publications/docs/AsianEnergySecurity\\_ChinaMilitaryPosture.pdf](http://www.rice.edu/energy/publications/docs/AsianEnergySecurity_ChinaMilitaryPosture.pdf).
- Feller, G. (2006). China's wing power. *EcoWorld*. Retrieved on September 25, 2007, from <http://www.ecoworld.com/home/articles2.cfm?tid=390>.

- Forbes. (2006). *China natural gas import demand seen at 20 bln cubic meters by 2010 – report*. Retrieved on September 25, 2007, from <http://www.forbes.com/home/feeds/afx/2006/12/06/afx3234584.html>.
- Friedberg, A. L. (2006). “Going out”: China’s pursuit of natural resources and implications for the PRC’s grand strategy. *NBR Analysis*. 17(3). Retrieved July 12, 2007, from *NBR Analysis*. 17(1). Retrieved July 12, 2007, from <http://www.nbr.org/publications/analysis/pdf/vol17no1.pdf>.
- Giragosian, R. (2006). Sino-Japanese competition for Russia's far east oil pipeline project. *Energy Security*. Retrieved May 3, 2007, from <http://www.iags.org/n0119063.htm>.
- Goldstein, D. (2006). A transition to renewable energy sources is necessary. In B. Passero (Ed.) *Energy alternatives*. New York: Greenhaven Press.
- Harbert, K. (2006). *US-China policy dialogue*. Foreign Press Center Briefings, US Department of State. Retrieved September 25, 2007, from <http://fpc.state.gov/fpc/72880.htm>.
- Heitz, E. and Wooley, D. (2006). *Annual report: Energy and climate strategy: Don't start by losing*. The Energy Foundation. Retrieved September 15, 2007, from [http://www.ef.org/documents/2006\\_Annual\\_Report.pdf](http://www.ef.org/documents/2006_Annual_Report.pdf).
- Herberg, M. (2004). Asia’s energy insecurity: Cooperation or conflict? In *Strategic Asia 2004-2005: Confronting Terrorism in the Pursuit of Power*. 339-378. Retrieved July 12, 2007, from [http://www.nbr.org/publications/strategic\\_asia/pdf/sa04\\_11energy.pdf](http://www.nbr.org/publications/strategic_asia/pdf/sa04_11energy.pdf)
- Klare, M. T. (2001). *Resource wars: The new landscape of global conflict*. New York: Henry Holt and Company.
- Klare, M. T. (2004). *Blood and oil*. New York: Penguin Books.
- Krause, S. (2006). *Official urges increased U.S.-China energy security cooperation*. Bureau of International Information Programs, U.S. Department of State. Retrieved September 1, 2007, from <http://usinfo.state.gov/xarchives/display.html?p=washfile-english&y=2006&m=August&x=20060806115016ASesuarK0.2069513>.
- Lee, S. (2007). China's low-key jump onto biofuel bandwagon. *Asia Times Online*. Retrieved September 25, 2007 from [http://www.atimes.com/atimes/China\\_Business/IE23Cb02.html](http://www.atimes.com/atimes/China_Business/IE23Cb02.html).
- Lieberthal, K. and Herberg, M. (2006). China’s search for energy security: Implications for US policy. *NBR Analysis*. 17(1). Retrieved July 12, 2007, from <http://www.nbr.org/publications/analysis/pdf/vol17no1.pdf>.
- Lobe, J. (2005). Too much for Mother Earth. *Asia Times Online*. Retrieved January 15, 2007, from <http://www.atimes.com/atimes/China/GC25Ad08.html>.

- Manning, R. A. (2000). *The Asian energy factor: Myths and dilemmas of energy, security, and the Pacific future*. Hampshire: Palgrave.
- McDermott, R. (2007). China asserts counter terrorist credentials in Central Asia. *Eurasia Daily Monitor*. Retrieved September 24, 2007 from [http://www.jamestown.org/edm/article.php?article\\_id=2372269](http://www.jamestown.org/edm/article.php?article_id=2372269).
- Meier, P. (2006). *Renewable energy policy formulation and implementation in China*. Retrieved September 1, 2007, from [http://siteresources.worldbank.org/INTTHAILAND/Resources/333200-1089943634036/475256-1151398840534/2006aug\\_peter\\_meier.pdf](http://siteresources.worldbank.org/INTTHAILAND/Resources/333200-1089943634036/475256-1151398840534/2006aug_peter_meier.pdf).
- Ogden, D. (2004). *Annual report: China's energy challenge*. The Energy Foundation. Retrieved August 15, 2007, from [http://www.ef.org/documents/AR2004\\_Final.pdf](http://www.ef.org/documents/AR2004_Final.pdf)
- Oster, S. (2007). In China, new risks emerge at giant Three Gorges Dam. *The Wall Street Journal Online*. Retrieved September 25, 2007 from <http://online.wsj.com/article/SB118824657324010144.html>.
- Pei, M. (2006). The dark side of China's rise. *Foreign Policy*. Retrieved May 2, 2007, from <http://www.carnegieendowment.org/publications/index.cfm?fa=view&id=18110>
- Pellerin, C. (2005). *Beijing cleans air for 2008 Olympics with U.S. help*. Bureau of International Information Programs, U.S. Department of State. Retrieved September 1, 2007, from <http://usinfo.state.gov/eap/Archive/2005/Apr/15-468002.html>.
- People's Daily Online. (2005). *China's coal imports expected to increase next year*. Retrieved on September 1, 2007, from [http://english.peopledaily.com.cn/200511/04/eng20051104\\_218987.html](http://english.peopledaily.com.cn/200511/04/eng20051104_218987.html).
- People's Daily Online. (2006). *China's national per capita income reaches US\$1,740*. Retrieved on September 1, 2007, from <http://en.chinagate.com.cn/english/48305.htm>.
- Petratherm Limited. (2007). *Report for the quarter ending 30 June 2007*. Retrieved on September 10, 2007, from <http://www.petratherm.com.au/reports/downloads/PetrathermLimitedQuarterlyReportJune2007.pdf>.
- RELAW Assist. (2006). *Renewable Energy in China*. Retrieved on September 25, 2007, from <http://www.reeep.org/index.cfm?articleid=1535&navarticleId=30>.
- RELAW Assist. (2007). *Issues Paper - Renewable Energy Law in China*. Retrieved on September 25, 2007, from [www.bakernet.com/NR/rdonlyres/B06FB192-EF10-4304-B966-FBDF1A076A8C/0/relaw\\_issues\\_paper\\_jun07.pdf](http://www.bakernet.com/NR/rdonlyres/B06FB192-EF10-4304-B966-FBDF1A076A8C/0/relaw_issues_paper_jun07.pdf).

- REN21 Renewable Energy Policy Network (2005). *Renewables 2005 global status report*. Washington, D.C.: Worldwatch Institute. Retrieved on September 11, 2007, from <http://www.ren21.net>.
- REN21 Renewable Energy Policy Network (2005). *REN21*. Retrieved on September 11, 2007, from <http://www.ren21.net>.
- REN21 Renewable Energy Policy Network (2006). *Renewables global status report: 2006 update*. Washington, D.C.: Worldwatch Institute.
- Reuters. (2007). *Russia: 1/3 of oil pipeline to China built*. Retrieved on September 24, 2007, from [http://www.chinadaily.com.cn/china/2007-04/29/content\\_863300.htm](http://www.chinadaily.com.cn/china/2007-04/29/content_863300.htm).
- Rose, T. J. (2004). Saudi Arabia cuts oil sales to the US, ups China. *Energy Bulletin*. Retrieved September 24, 2007 from <http://www.energybulletin.net/2348.html>.
- Seymour, J. D. (1998). Human rights in Chinese foreign relations. In Samuel S. Kim (ed). *China and the world: Chinese foreign policy faces in the new mellenium*. Boulder: Westview Press.
- Sheridan, M. (2006). China chokes on a coal-fired boom. *Times Online*. Retrieved September 24, 2007 from <http://www.timesonline.co.uk/tol/news/world/article1265343.ece>.
- Siang, C. C. (2007). *China's medium to long-term renewable energy development plan – Promotion of bio-ethanol introduction and future strategic developments –* New Energy and Coal Group, Strategy and Industry Research Unit, The Institute of Energy Economics, Japan. Retrieved September 11, 2007, from <http://eneken.ieej.or.jp/en/data/pdf/383.pdf>.
- Sinton, J. E., Stern, R. E., Aden, N. T., Levine, M. D., Dillavou, T. J., Huang, J. et al., (2005) *Evaluation of China's energy strategy options*. Berkley: China Energy Group. Retrieved September 26, 2007, from <http://china.lbl.gov/publications/nesp.pdf>.
- Spratly Islands dispute. (1997). *The inventory of conflict & environment (ICE) case studies*. Case no.12. Retrieved on April 18, 2007, from <http://www.american.edu/ted/ice/ice.htm>
- Stares, P. B. (ed). (2000). *Rethinking energy security in East Asia*. Tokyo; New York: Japan Center for International Exchange.
- Stockholm Environment Institute (SEI). (2005). *Environment and sustainable development in Asia 2005*. Stockholm: Swedish Ministry for Foreign Affairs.
- Taylor, A. and Li, Z. (1996). *Geothermal resources in China*. Bob Lawrence & Associates, Inc. Retrieved on September 25, 2007, from [www.bl-a.com/ECB/PDFFiles/China1996.PDF](http://www.bl-a.com/ECB/PDFFiles/China1996.PDF).

Technology Marketing Corporation (TMC). (2006). *China's utilization of geothermal energy ranks first worldwide*. Retrieved on September 25, 2007, from <http://www.tmcnet.com/submit/2006/05/03/1636164.htm>.

Teske, S., Zervos, A. and Schäfer, O. (2007). *Energy [R]evolution: A sustainable world energy outlook*. The Netherlands: Greenpeace International, European Renewable Energy Council (EREC).

The Beijing Organizing Committee for the Games of the XXIX Olympiad (BOCOG). (2007). *Environment supplement*. Retrieved on September 26, 2007, from <http://en.beijing2008.cn/bocog/publication/n214161373.shtml>.

The Energy Foundation. (1990). *The Energy Foundation*. Retrieved September 1, 2007, from <http://www.ef.org>.

The Energy Foundation. (2007). *The China Sustainable Energy Program*. Retrieved September 15, 2007, from <https://www.cof.org/files/Documents/Conferences/AC2007/Environmental%20Grantmaking%20in%20China.pdf>.

The James A. Baker III Institute for Public Policy of Rice University (1999). Main study. *China and long-range Asia energy security: An analysis of the political, economic and technological factors shaping Asian energy markets*. Retrieved May 4, 2007, from [http://www.rice.edu/energy/publications/docs/AsianEnergySecurity\\_MainStudy.pdf](http://www.rice.edu/energy/publications/docs/AsianEnergySecurity_MainStudy.pdf).

The Kyoto Protocol. (1997).

The People's Republic of China. (2006) *The renewable energy law*.

The Shanghai Cooperation Organization (SCO). (2001). *Official website of SCO summit*. Retrieved September 24, 2007 from [http://english.scosummit2006.org/en\\_bjzl/2006-04/24/content\\_246.htm](http://english.scosummit2006.org/en_bjzl/2006-04/24/content_246.htm).

United Nations-Energy (2007). *Sustainable bioenergy: A framework for decision makers*. United Nations.

United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) (2006). "Section II A: Eco-efficiency and resource productivity: Concepts, indicators and trends in the Asia Pacific" *Second Green Growth Policy Dialogue: The Role of Public Policy in Providing Sustainable Consumption Choices: The Resource-Saving Society and Green Growth*. Green Growth.

United Nations Environment Programme (UNEP). (2003). *The REED report*. Retrieved September 25, 2007 from [http://www.uneptie.org/energy/projects/REED/REED-Media-Kit/docs/reed-sept\\_newssummary.pdf](http://www.uneptie.org/energy/projects/REED/REED-Media-Kit/docs/reed-sept_newssummary.pdf).

- U.S. Department of Energy. (2006). *DOE assistant secretaries in China to discuss energy cooperation*. U.S. Department of Energy Press Releases. Retrieved on September 5, 2007, from <http://www.energy.gov/news/4154.htm>.
- U.S. Department of Energy, Energy Information Administration (EIA). *Renewable energy*. Retrieved on May 5, 2007, from <http://www.eia.doe.gov/kids/energyfacts/sources/renewable>.
- U.S. Department of Energy, Energy Information Administration (EIA). (2005). *Figure 1.3: Energy consumption by source*. Retrieved on April 16, 2007, from [http://www.eia.doe.gov/emeu/aer/pdf/pages/sec1\\_8.pdf](http://www.eia.doe.gov/emeu/aer/pdf/pages/sec1_8.pdf).
- U.S. Department of Energy, Energy Information Administration (EIA). (2006). *International energy outlook 2006*. Washington, D.C.: US Department of Energy.
- U.S. Department of Energy, Energy Information Administration (EIA). *Table E.1: World primary energy consumption (quadrillion Btu), 1980-2004*. Retrieved on April 16, 2007, from <http://www.eia.doe.gov/emeu/international/energyconsumption.html>.
- Vidaeus, L. (2001). *China: Renewable energy scale up program (CRESP). Submission for work program inclusion*. Work Memorandum. World Bank. Retrieved September 5, 2007, from [www.gefweb.org/Documents/Council\\_Documents/GEF\\_C17/China\\_CRESP.doc](http://www.gefweb.org/Documents/Council_Documents/GEF_C17/China_CRESP.doc).
- World Bank. (2005). *China Renewable Energy Scale-up Program (CRESP). Projects and Operations*. Retrieved September 25, 2007, from <http://web.worldbank.org/external/projects/main?pagePK=64283627&piPK=73230&theSitePK=40941&menuPK=228424&Projectid=P067625>.
- World Bank. (2005). *Follow up to CRESP phase I. Projects and Operations*. Retrieved September 25, 2007, from <http://web.worldbank.org/external/projects/main?Projectid=P096158&Type=Overview&theSitePK=40941&pagePK=64283627&menuPK=64282134&piPK=64290415>.
- World Bank. (2007). *World development indicators 2007*. Retrieved on June 10, 2007, from <http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:21298138~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html>.
- World Watch Institute (2005). *Vital signs 2005: The trends that are shaping our future*. New York: W. W. Norton & Company.
- Xinhua News Agency. (2004). *China accelerates nuclear energy development*. Retrieved September 24, 2007, from <http://www.china.org.cn/english/government/108139.htm>.

- Xinhua News Agency. (2004). *Vice Premier calls for closer energy cooperation with US*. Retrieved September 12, 2007, from <http://www.china.org.cn/english/international/84557.htm>.
- Xinhua News Agency. (2006). *Kazakhstan-China oil pipeline opens to operation*. Retrieved September 24, 2007, from [http://news3.xinhuanet.com/english/2006-07/12/content\\_4819484.htm](http://news3.xinhuanet.com/english/2006-07/12/content_4819484.htm).
- Yamaguchi, K. and Cho, K. (2003). Natural gas in China. *The Institute of Energy Economics, Japan*. Retrieved September 24, 2007, from <http://eneken.ieej.or.jp/en/data/pdf/221.pdf>.
- Yergin, D. (1991). *The prize: The epic quest for oil, money and power*. New York: Simon & Schuster.
- Yergin, D. (2006). Ensuring energy security. *Foreign Affairs*. Retrieved April 28, 2007, from [http://www.un.org/ga/61/second/daniel\\_yergin\\_energysecurity.pdf](http://www.un.org/ga/61/second/daniel_yergin_energysecurity.pdf).
- Zhong, W. (2007). China aims to diversify oil sources. *Asia Times Online*. Retrieved June 7, 2007, from [http://www.atimes.com/atimes/China\\_Business/IB28Cb02.html](http://www.atimes.com/atimes/China_Business/IB28Cb02.html).
- Zweig, D. and Jianhai, B. (2005). China's global hunt for energy. *Foreign Affairs*, 85/5. Retrieved May 3, 2007, from [http://www.cctr.ust.hk/articles/200509-10\\_workPaper5.htm](http://www.cctr.ust.hk/articles/200509-10_workPaper5.htm).