A SUGGESTED MODEL FOR IMPLEMENTING THE CLEAN DEVELOPMENT MECHANISM

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EXECUTIVE SUMMARY

This paper presents a proposal for a major collaborative effort by the United States and China to reduce CO_2 emissions in the Chinese electric power sector within the framework of the recent Kyoto Protocol (KP) to the United Nations Framework Convention on Climate Change (FCCC). The proposal is conceived as a possible approach to implementing the Clean Development Mechanism (CDM) established by Article 12 of the Protocol. The CDM is a new and untested mechanism for encouraging cooperative multinational efforts to reduce atmospheric levels of greenhouse gases. To prompt further discussion and refinement of the CDM, and to encourage the United States and other developed countries to begin investment in clean development projects, this paper proposes a model for initial implementation of the CDM. The proposed implementation strategy is designed to produce:

- large emission reductions in the relatively near term;
- significant transfers of technology and financial resources from developed to developing countries; and
- increased understanding of the CDM's potential benefits and possible problems.

We use a notional U.S.-China project to illustrate the practical steps necessary for successful operation of the CDM. The proposal focuses on the Chinese electric power sector because it is growing rapidly and affords ample opportunities for technological improvements that would reduce greenhouse gas emissions. At the same time, measuring CO_2 emissions from central station power generation facilities is comparatively straightforward, so monitoring and verification problems are minimized.

I. BACKGROUND

It is now widely recognized that climate change attributable to greenhouse gas (GHG) emissions resulting from human activities is a serious global problem with potentially catastrophic consequences.[1] The harmful effects of GHGs do not depend on the location of emissions, because in contrast to many other pollutants, GHGs are uniformly mixed. That is, regardless of where they are emitted on the earth's surface, GHGs diffuse throughout the atmosphere.

Developed countries are currently the largest emitters of GHGs, and the United States alone accounts for almost a quarter of the world's total annual emissions. These countries will continue for a long time to have the highest emission rates *per capita*, but early in the next century several industrializing countries are likely to overtake developed countries in total quantity of emissions. Forecasts suggest, for example, that by the year 2015, China will be the largest GHG emitter in the world, exceeding the United States in aggregate emissions, though *per capita* emissions will still be far lower in China than in the U.S.[2] It is therefore important that developed countries cooperate with China and other developing countries in the effort to reduce GHG emissions while simultaneously fostering these countries' rapid pace of economic development.

A. The Framework Convention on Climate Change

In 1992, the Framework Convention on Climate Change (FCCC) created an international institutional system for dealing with climate change. The Convention was opened for signature in June 1992, and as of January 28, 1998, 174 countries, including China and the United States, have ratified the treaty.

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[1] IPCC, *Policy Implications of Global Warming*, National Academy Press, 1992.

[2] World Bank/

Parties to the FCCC undertook different obligations, depending largely on their relative development status. Industrialized countries, which are listed in Annex I of the Convention (Annex I countries), pledged to adopt policies and measures "with the aim of" reducing GHG emissions to 1990 levels by the year 2000.[3] It now seems clear that most of the Annex I countries will not meet these goals.[4] By contrast, developing countries made no GHG abatement commitment under the FCCC. Like the developed countries, though, they undertook to prepare national emission inventories and to report to the FCCC on their domestic policies and activities for reducing atmospheric GHG levels.

The Convention provided for early review of the "adequacy" of these commitments, and the first meeting of the Conference of the Parties (COP) held at Berlin in 1995 decided that the commitments of Annex I countries – even if met – were not adequate to meet the goals of the Convention. The COP mandated negotiation of a protocol to establish quantitative targets and timetables for reductions of GHG emissions of Annex I countries, to be ready for signature within two years.

B. The Kyoto Protocol, Cooperative Abatement Efforts and the Clean Development Mechanism

The Berlin Mandate initiated a two-year process of negotiation culminating in the adoption of the Kyoto Protocol (KP) to the Framework Convention on Climate Change at the third meeting of the COP in December, 1997. The Protocol establishes binding commitments for the Annex I countries to reduce GHG emissions by an average of almost

[3] Annex I countries must also provide inventories of GHG emissions and report their domestic policies and their progress in reducing greenhouse gases to the FCCC Secretariat. The OECD countries (Annex II countries) assent in addition to contribute to a fund to defray the agreed incremental costs of GHG abatement activities undertaken by developing countries. The fund is administered by the Global Environment Facility, an institution established for this and other purposes.

[4] Currently, only two Annex I countries are likely to meet this target: Britain and Germany.

6% below 1990 levels during the period 2008-2012.[5] Although the Protocol does not introduce new GHG reduction commitments for non-Annex I countries, it does reaffirm all countries' existing FCCC obligation to compile national emission inventories. Finally, the KP contains a number of new mechanisms that permit all Parties to the Convention to implement GHG reduction policies cooperatively with other Parties.[6]

One of the most important of these new features is the Clean Development Mechanism established by KP Article 12 to provide a schematic framework for cooperative GHG abatement efforts between Annex I and developing countries. The CDM is intended to help developing countries achieve sustainable development, decrease local pollution and reduce GHG emission levels, and to assist Annex I countries in complying with their emission reduction commitments. To forward these goals, Article 12 states that "certified" emission reductions resulting from a clean development project in a developing country may be used by Annex I countries "to contribute to compliance with part of their . . . reduction commitments." Both private and public entities are eligible to participate in the CDM and to benefit from resulting emission reductions. Together, these provisions provide economic incentives for Annex I countries to encourage private firms to invest in GHG reduction efforts in developing countries. This private investment, in turn, should result in large-scale transfers of technology, expertise and private capital to developing countries, while simultaneously reducing the costs of GHG abatement worldwide.

Article 12 states that to be eligible under the CDM, projects must meet the following requirements:

- voluntary participation in the project;

[5] Specific commitments for each country are defined in KP, Annexes A and B.

[6] As of February 1998, the Kyoto Protocol has not yet been ratified. For the purposes of this paper, we assume that Annex I countries will accept the emission reduction obligations set out in the Protocol, and that both Annex I and developing countries will accept the Protocol's timetables and emission crediting regime.

- approval of the project by all involved Parties;
- real, measurable and long-term benefits related to mitigation of climate change;
- real emission reductions additional to any that would occur in the absence of the project activity; and
- substantial transfers of capital, technology and expertise to developing country participants.

The CDM is to be supervised by an Executive Board (Article 12 (4)), and the COP must certify any emission reductions resulting from project operation (Article 12 (5)). A share of project proceeds are to be used to cover administrative costs and to assist particularly vulnerable developing countries in adapting to future adverse effects of climate change.

Properly implemented, these requirements will help to ensure both that cooperative projects result in real and significant transfers of financial, intellectual and technological resources to developing countries and that these projects effect real reductions in GHG levels. It is therefore vital to the success of the CDM that both the activities of the Executive Board and the emission certification process be widely perceived as equitable and well-administered. Successful global implementation of the Clean Development Mechanism will require considerable field experience. We hope the successes and problems of the U.S.-China effort proposed here will provide valuable information for further refinement of the CDM.

II. COMPARATIVE COSTS AND AVAILABLE TECHNOLOGIES

Reduction of GHG emissions often entails significant economic costs. The motive force for cooperative, multinational GHG reduction efforts in the CDM is the variance in the cost of comparable emissions reductions in different places. Cost estimates for GHG reductions range widely depending on the specific location, level of economic and

technological development, economic sector and method for measuring emissions. Reducing GHG emissions is cost-effective in some circumstances but prohibitively expensive in others. Cost estimates in industrialized nations, for example, range from tens to hundreds of U.S. dollars per ton of carbon saved. Consequently, U.S. adoption of the Kyoto Protocol's GHG abatement obligations will create a strong incentive to seek the least costly emission reduction opportunities.

Many opportunities for low cost emission abatement are located in developing countries, so industrialized states may be able to obtain GHG abatement at lower cost by investing abroad, depending on the relative cost of greenhouse gas abatement in the specific developed and developing countries in question. Before describing the institutional framework and mechanics of the proposed U.S.-China cooperative emission reduction project, therefore, we examine the potential cost differentials -- and resulting investment incentives -- in the specific case of the United States and China.

Studies of the Chinese energy sector emphasize the large opportunities for emissions savings in other aspects of Chinese energy production, transmission and consumption. These include limiting transmission losses, demand side savings, fuel switching possibilities, and regulation of small boilers and local and provincial generating plants. The potential gains in some or all of these areas may be greater than those in the state-owned central station power sector. But these other areas present severe difficulties for systematic cooperative effort under the CDM, at least until additional experience has been accumulated. We therefore limit our proposal to large central station generating plants because they seem to us to represent the simplest opportunity for making a prompt start on a large and effective CDM program.

1. Chinese perspective

China is expected to increase its overall capacity for energy production between 12 and 17 GW per year, for at least the next ten years.[7] Currently, China generates some 70% of

[7] Energy Efficiency Improvements in China: policy measures, innovative finance and technology development: 7. Paris: OECD/IEA; Washington, D.C.: OECD Washington Center [distributor] 1997.

it's power from coal and has the largest coal reserves in the world. In addition, China is concerned about energy security and fearful of relying excessively on imported fuels. Although China plans to exploit its hydroelectric generating potential and the limited near term natural gas availability, all these factors mean that China will meet the great bulk of its increasing energy demand by building additional coal-fired plants.

The likelihood that China will build many new coal-fired plants in the next decades creates an opportunity for a cooperative U.S.-China effort to minimize greenhouse gas emissions from those plants. In addition, three other Chinese government policies may foster such a joint effort. First, China is attempting nationwide to increase its energy production efficiency in order to produce more energy at lower cost. Second, China is striving to develop more effective methods of combating its major urban air pollution problem, predominantly from SO_2. And third, China would like to increase foreign investment in the energy sector by as much as 25% to facilitate new plant growth.

2. U.S. perspective

The Kyoto Protocol requires the U.S. to reduce its annual GHG emissions to 1,276 Mt C, 7% below the 1990 level of 1,372 Mt C, between 2008-2012. To meet this commitment, the U.S. government must induce private actors – individuals and firms – to reduce emissions of CO_2 and other GHGs. Estimates of the costs of achieving this reduction domestically range widely, from $US 20 to $US 150 per ton of carbon saved.[8] Under the KP, however, the United States can use emission reductions achieved in CDM projects to assist in achieving compliance with its emission abatement commitment, though the details of this system have yet to be worked out. Together, high cost of meeting its full KP reduction commitment domestically and the possibilities opened up by the CDM should encourage the United States actively to seek lower cost opportunities to reduce GHG emissions in countries like China. This in turn implies that the United States will need to develop an incentive system to encourage U.S.-based investors to fund activities

[8] Jaccard, Mark and W. David Montgomery, "Costs of Reducing CO_2 in the US and Canada," *Energy Policy* 24(10-11) 889-898. It should be noted the range of US $20-150 is based on a carbon tax that would yield a result of CO_2 reduction down to 1990 levels by 2010.

abroad that directly reduce GHG levels. Possible investment incentives are discussed in section III (C) (1), below.

3. Opportunities and barriers within China's electric generation sector

Several considerations make the Chinese electric sector – particularly the likely new coal-based plants – an ideal arena in which to test U.S.-China cooperation within the CDM. First, China's electric sector is clearly expanding. There are also straightforward options for improving existing Chinese power-generation technologies. In addition, measurement of GHG emissions should, in theory, be easier to accomplish in the state-owned electric power sector than in many other areas (e.g. personal coke-fired stoves). Finally, China's concern with the human health and environmental effects of local pollution and the U.S. need for low cost emissions reductions create clear opportunities for synergy.

The cooperative venture proposed here will not be feasible, however, unless the costs of GHG reductions in China are less than the costs of those reductions in the United States (or in other countries). How to calculate these costs, and, in turn, how to determine the resulting emissions reductions, are matters of some debate. Before presenting the range of projected figures, however, it is important first to identify the factors that need to be considered in arriving at reliable estimates of costs and emission reductions. These factors include:

the range of costs of CO_2 emission reductions in the United States;
projected increases in China's energy-generating capacity in the next 8-12 years;
projected increases in carbon emissions resulting from this growth in capacity, assuming China will for the most part use available, conventional domestic technologies;
feasible technological alternatives for increasing Chinese capacity,
probable savings in CO_2 emissions resulting from using an alternate technology;
predicted costs of alternative technologies;
fuel costs and trends, both in China and in the United States; and
probable transaction costs.

Some of these issues are especially troubling. China still heavily subsidizes coal. If reforms remove or reduce this subsidy, plants with higher fuel efficiencies will become increasingly cost-effective and presumably more attractive to investors. The outcome of this matter is purely at the discretion of the Chinese government but will significantly impact the operating costs of various types of coal-fired plants. Transaction costs, especially in China, are also a potentially formidable barrier. The CDM framework proposed here (as discussed in Section III) is largely aimed at minimizing the program's transaction costs.

4. Costs of carbon reduction with different technologies and coal quality

Given the high levels of uncertainty surrounding each of the above-mentioned factors, the estimates presented below provide only a ballpark approximation of the GHG emission reductions and associated costs to evaluate the feasibility in principle of a US China cooperative investment program in China's coal-fired electric generation sector.

Carbon dioxide emissions from coal-based plants depend on two things: the efficiency of the plant and the carbon content of the coal. As a base-case, we use a conventional domestic Chinese technology: a 300MW or larger sub-critical steam plant with an electrostatic precipitator (ESP).[9] China has used a comparable technology in a number of recent large power plants and will probably continue to use it in the near future (with marginal improvements), in the absence of more efficient alternatives available at competitive capital costs. With this base case we compare four alternative coal-based technologies, currently available in developed countries, though not yet in China. These technologies, listed in order of increasing fuel efficiency (and cost) are:

pulverized coal combustion, 300MW or above, with an ESP

pulverized coal combustion, 300MW or above, with an ESP and a scrubber

atmospheric fluidized bed combustion

integrated gasification combined cycle

[9] The ESP and additional mechanisms to control local pollutants may be added as China attacks the problem of urban air pollution. End of the pipe pollution reduction methods add expense and reduce efficiency of a plant as a whole.

For each of these technologies, we calculate the CO_2 emission savings per GW of capacity (savings per year x estimated 20 year useful life of plant) using three different fuel qualities: low sulfur coal (Lcoal), high sulfur coal (Hcoal) and washed coal (Wcoal). We make separate calculations for operation at 74 per cent capacity and 80 per cent capacity.[10]

On the cost side, our analysis is limited to capital costs, leaving out operation, maintenance and fuel costs. There are two reasons for this limitation. First, reduced fuel costs due to increased efficiency will offset some or all of the likely increased operation and maintenance costs of the new technology. The parties to any project of course may take account of these costs in their contractual arrangements, in which case they will have to calculate the costs in detail for the particular plant and technology involved. Second, China is currently reforming fuel prices. If subsidies are removed, higher prices will make more efficient plants more attractive, but we don't know where or how these prices will shift over the estimated 20 year lifetime of a plant.

To find the projected cost of one ton of CO_2 emission reductions for each technology/ fuel/capacity combination, we divide the projected incremental capital cost of the more expensive technologies by the tons of carbon saved. The results are summarized in the accompanying tables and graphs. They suggest that many of these combinations may produce reductions of CO_2 emissions at less than $US 30 or even less than $US 10 per ton. At that rate, the reductions would likely be less costly than all but the cheapest U.S. domestic reduction possibilities. If these projections are reasonably accurate, therefore, the possibility for a successful U.S.-China CDM program should exist.

[10] Operation at 80% capacity is a standard assumption for evaluating power plant efficiency; the 74% figure was chosen based on calculations made by Professor Rogers in his study.

III. THE STRUCTURE AND OPERATION OF THE CLEAN DEVELOPMENT MECHANISM

Three major institutional components must be considered in implementing the proposed U.S.-China Clean Development Program. First is the relationship of the program to the FCCC and its organs. Second is the form of agreement between the participating states. Third is the national actions that have to be taken within each participating country to make the program work.

A. The Role of International Institutions

The CDM is only vaguely sketched in KP Article 12. Nevertheless, it is clear that the Mechanism will require clear guidelines for project implementation and strict oversight of project operation, to ensure both that developing countries benefit from the transfer of technology, capital and expertise, and that developed countries and participating private investors receive accurate emission credits for GHG abatements achieved. The role of the Parties to the Kyoto Protocol in defining, approving and monitoring CDM projects is therefore pivotal. The following section discusses that role in general terms, relevant both to the U.S.-China program suggested here and to subsequent applications of the CDM.

1. The COP's Role

The COP's authority to define and implement projects under the CDM derives largely from Articles 12 and 13 of the Kyoto Protocol (KP). Article 13 states that the Conference of the Parties shall serve as the meeting of the Parties to the Protocol and further that the COP shall "facilitate, at the request of two or more Parties, the coordination of measures

CARBON DIOXIDE EMISSION REDUCTION & COST PER TON/ GW, OVER 20 YEAR PLANT LIFETIME
COMPARED TO 300MW OR LARGER DOMESTIC STEAM WITH ESP

80% Capacity Case

Technology	Capital Cost Increment	Emissions Reductions/ over 20 yrs./ GW			Cost per ton of CO2 reduction		
	(millions of dollars)	(000s of tons)					
		Hcoal	Lcoal	Wcoal	Hcoal	Lcoal	Wcoal
Imported Pulverized coal combustion 300MW and above with ESP	200	11583	14403	10626	$ 20.72	$ 16.66	$ 22.59
Imported Pulverized coal combustion 300MW and above with ESP and Scrubber	350	7943	9876	5461	$ 52.88	$ 42.53	$ 76.91
Imported atmospheric fluidized bed	250	15027	18685	10626	$ 19.96	$ 16.06	$ 28.23
Imported integrated gasification combined cycle	250	32326	40195	36575	$ 9.28	$ 7.46	$ 8.20

* Initial Numbers, with exception of capacity, courtesy Dr. Peter Rogers, Harvard University

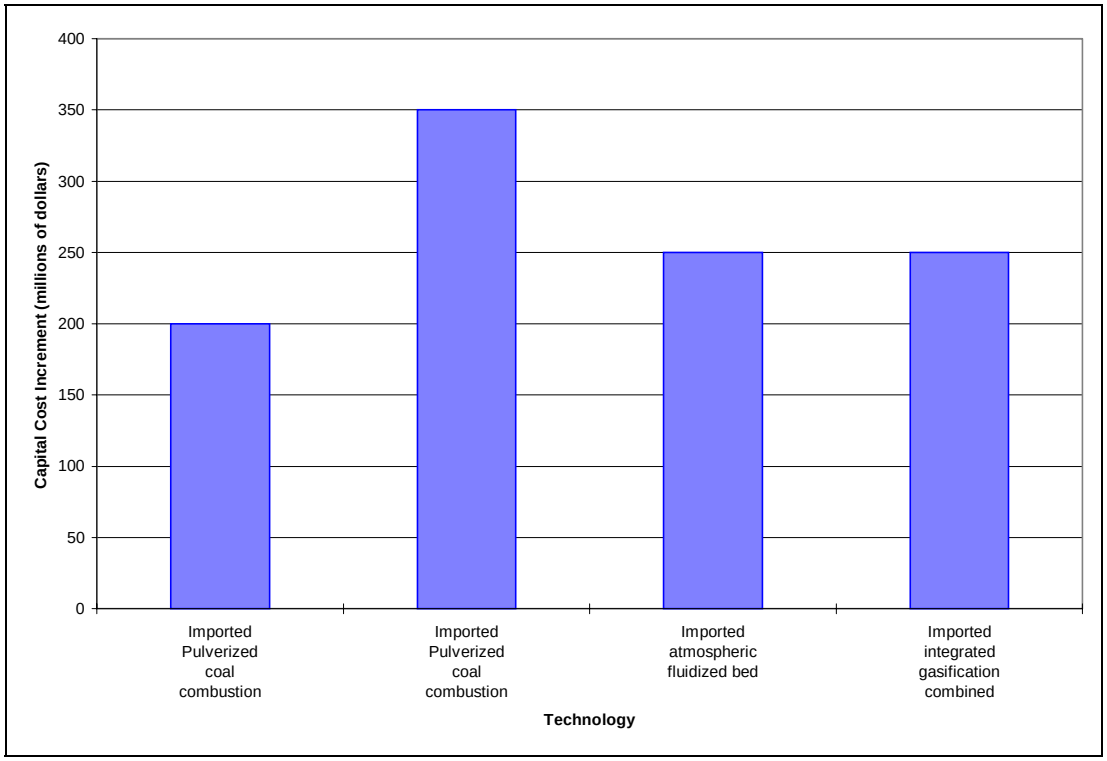
CARBON DIOXIDE EMISSION REDUCTION & COST PER TON/ GW, OVER 20 YEAR PLANT LIFETIME
COMPARED TO 300MW OR LARGER DOMESTIC STEAM WITH ESP

74% Capacity Case

Technology	**Capital Cost Increment**	**Emissions Reductions over 20 yrs./ GW**			**CO2 Reduction, cost per ton**		
	(millions of dollars)	(000s of tons)					
		Hcoal	Lcoal	Wcoal	Hcoal	Lcoal	Wcoal
Imported Pulverized coal combustion 300MW and above with ESP	200	10744	13359	9856	$ 32.43	$ 26.08	$ 35.35
Imported Pulverized coal combustion 300MW and above with ESP and Scrubber	350	7367	9161	5065	$ 82.76	$ 66.56	$ 120.38
Imported atmospheric fluidized bed	250	13938	17331	9856	$ 31.25	$ 25.13	$ 44.19
Imported integrated gasification combined cycle	250	29983	37281	33923	$ 14.53	$ 11.68	$ 12.84

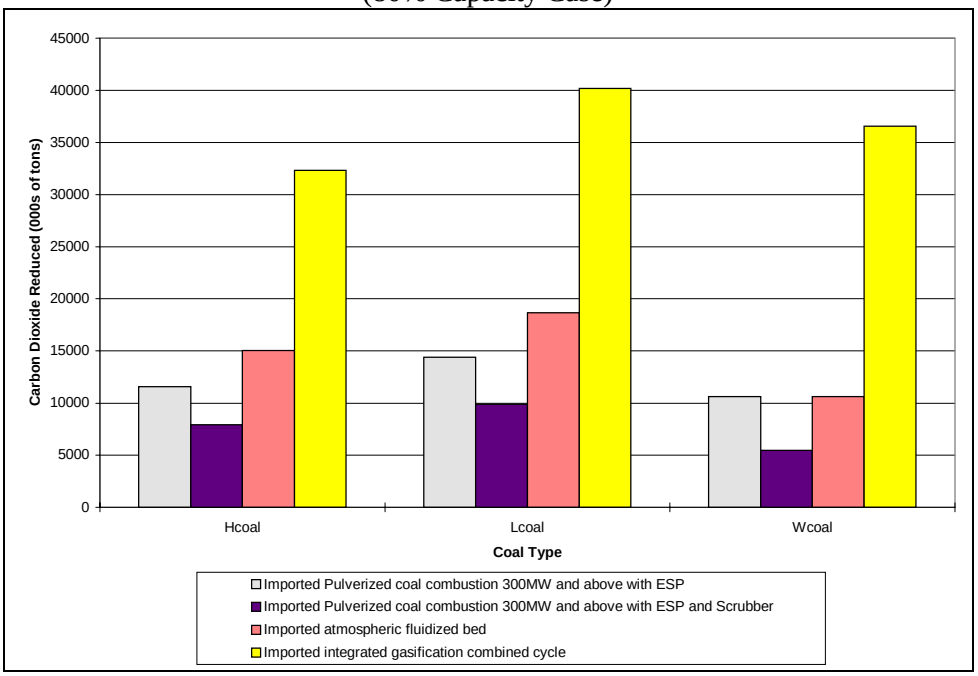
* Initial Numbers Courtesy of Dr. Peter Rogers, Harvard University

CAPITAL COST INCREMENT
COMPARED TO 300MW OR LARGER DOMESTIC STEAM WITH ESP



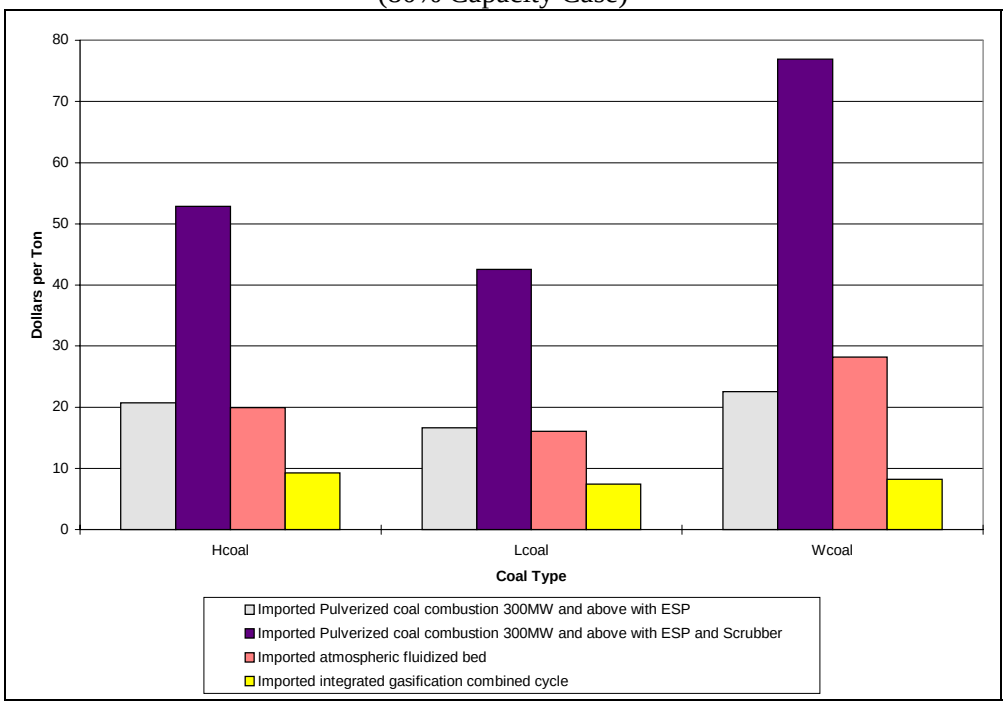
CARBON DIOXIDE EMISSION REDUCTION/ GW, OVER 20 YEAR PLANT LIFETIME
COMPARED TO 300MW OR LARGER DOMESTIC STEAM WITH ESP

(80% Capacity Case)



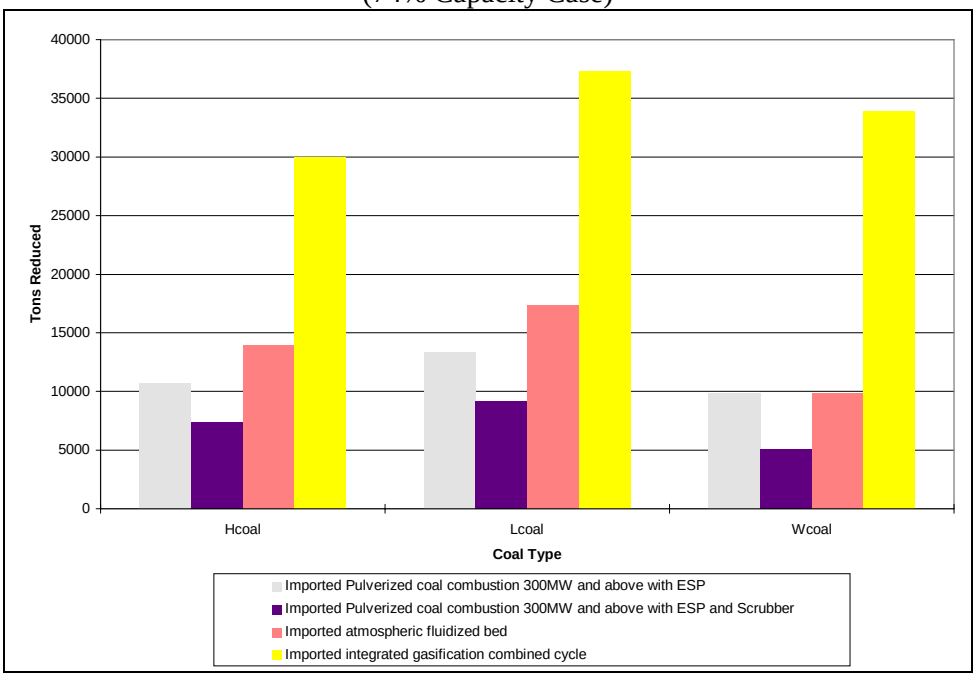
COST PER TON OF CARBON DIOXIDE REDUCED
COMPARED TO 300MW OR LARGER DOMESTIC STEAM WITH ESP

(80% Capacity Case)



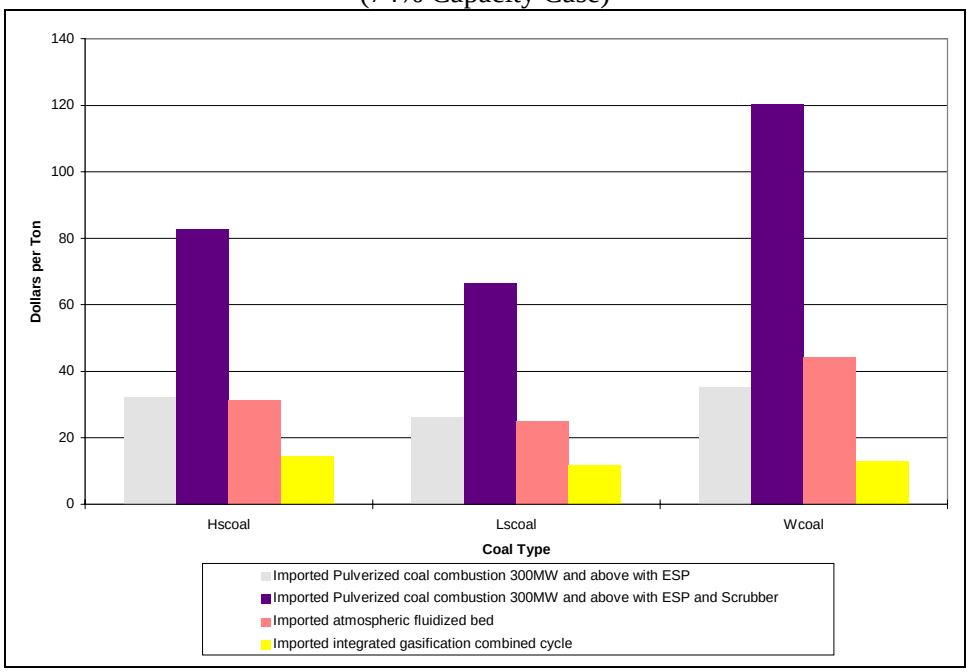
CARBON DIOXIDE EMISSION REDUCTION/ GW, OVER 20 YEAR PLANT LIFETIME
COMPARED TO 300MW OR LARGER DOMESTIC STEAM WITH ESP

(74% Capacity Case)



COST PER TON OF CARBON DIOXIDE REDUCED
COMPARED TO 300MW OR LARGER DOMESTIC STEAM WITH ESP

(74% Capacity Case)



adopted by them to address climate change and its effects." (Article 13 (4) (d)). With respect to the CDM in particular, Article 12 requires that the CDM be "subject to the authority and guidance" of the COP (Article 12 (4)) and be supervised by an Executive Board established by the COP. Further, Article 12 requires the COP to "elaborate modalities and procedures [for the CDM] with the objective of ensuring transparency, efficiency and accountability through independent auditing and verification of project activities." (Article 12 (7)).

2. The Executive Board

Though Article 12 mentions an Executive Board, the KP gives no hint of the composition or procedures of this Board. These matters are to be decided by the COP under authority of KP Articles 12 (4) and 13 (4) (h). It is therefore not possible to say at this juncture just how the Executive Board will operate. However, it is likely that the COP will follow the models of the Executive Committee of the multinational fund under the Montreal Protocol and the Council of the Global Environmental Facility, which perform roughly similar functions. These boards consist of a small number of members chosen by the Parties, 20 in the Executive Committee of the Montreal Protocol and 32 in the GEF. They are chosen to provide broad geographical representation and divided roughly equally between developed and developing country members. Decisions of these boards are generally made by consensus, but if a vote is required, concurrent majorities of both developed and developing country components are necessary for approval. Provision must also be made for the relationship of the Executive Board to the standing subsidiary organs established under the KP.

3. Possible CDM project criteria

The first challenge facing the COP in setting up a successful CDM program is to define criteria to guide the development and approval of CDM proposals. To be approved, a CDM project proposal should demonstrate that it meets each of the criteria established by

the COP. Some of these are already established in general terms by Article 12 of the Protocol. The list below includes those mentioned in the KP as well as others that seem desirable to ensure a workable system for developing effective CDM projects and certifying GHG abatement credits.

- The governments of both host nations and other participating nations must approve and voluntarily accept project proposals;
- A proposed project must complement and support the host nation's environmental and developmental priorities;
- Sources of funding for proposed projects must be additional to investing countries' existing obligations to support transfers of financial and technological resources to the host country; and finally
- Any proposed project must be likely to result in significant, identifiable financial and technological transfers from the investing countries to the host country.
- A CDM project must be is likely to result in long-term reductions in atmospheric GHG levels;
- These reductions must be additional to any that would occur in the absence of the project; and
- GHG abatement due to project operation should be measurable through use of an accurate and reliable GHG emission baseline with which the project's performance can later be compared.

The COP will also have to establish modalities to ensure that a share of the proceeds of each project is set aside for administrative costs of the CDM and for assistance to the most vulnerable developing countries, as provided in Article 12 (6) and (8).

4. The CDM project approval process

At least initially, the COP itself ought to grant final approval of a proposed project, after analysis and recommendation by the Executive Board. The Board should be charged with

determining in the first instance (1) whether a proposed project meets the established project criteria and (2) in particular whether the proposed GHG abatement baseline and measurement techniques are workable. The Executive Board should consult the Subsidiary Body for Scientific and Technological Advice (SBSTA; see Article 15 of the KP) on these issues of baseline definition and measurement techniques. The SBSTA might also be asked to specify "good practice" for the proposed project, to ensure that participating parties do not receive credits for illusory GHG abatement, resulting, for instance, from temporary suspension of project operation or operation at reduced capacity.

Projects approved by the Executive Board should subsequently be reviewed by the full COP at its annual meeting. It would also be desirable to allow an appeal to the COP for projects disapproved by the Board, if a stated number of Parties to the Protocol agree.

5. Evaluation of project performance and certification of credits

COP involvement in Clean Development projects cannot end with approval. Continuous oversight is required to ensure that a project is implemented and operated as detailed in its proposal. The COP ought not, however, be directly involved in performance verification. Instead, parties financing and operating the project should submit reports to the Executive Board, annually (or if necessary more frequently) detailing project activities and claimed GHG abatement.

These reports could be audited by an approved third party, such as a private international auditing entity, which would compare the project's performance with the approved project baseline to determine the number of GHG abatement credits owed. Project reports should be made publicly available for comment by interested governmental, international and non-governmental organizations, and the auditing body should receive and address these comments in its own report. The auditor should report its determination to the

Executive Board, where parties would have the opportunity to challenge the findings of the auditors. When its review is completed, the Executive Board would forward the project report, auditor's report and its own recommendations to the COP for final action. Funding for the audit process would be a project expense.

6. Granting of GHG abatement credits

Based on the project report, the auditor's report and the Executive Board recommendations, the COP would certify the emissions reductions eligible for use by the investing Annex I country in accordance with Article 12. There would be no need to allocate credits among private investors within the investor countries. This distribution process would instead be handled individually by participating countries through a domestic emissions trading system or other incentive devices as discussed in section C(1) below. In order to attract private investors to back clean development projects, however, it is clearly necessary that participating countries have functioning domestic incentive systems based on the value of the credits the country has received from the CDM project.

B. The Umbrella Agreement

We conceive that the U.S.-China Clean Development Program and other future CDM efforts would be initiated by an umbrella agreement, concluded by the participating countries at the highest levels and outlining the scope, objectives and basic principles and practices of the program. These agreements would streamline the identification, planning and approval process for potential CDM projects, significantly reducing transaction costs and lowering bureaucratic hurdles. For the U.S.-China program proposed here, the umbrella agreement would state that the object of the program is to promote U.S. private investment in China's power industry, on mutually agreeable and beneficial terms, in order to reduce the industry's GHG emissions below those projected on the basis of existing Chinese technology.

An initial question to be determined by the umbrella agreement is the scope of the program. In our view, as an experimental, initial implementation of the CDM, this U.S.-China program should be narrowly focused – limited to new construction of large, state-owned central station power installations. Such a limitation would minimize the difficulties of determining, monitoring and verifying GHG reductions and would reduce the transaction costs of dealing with provincial and local governments. Obviously, U.S. investors should not and could not practically finance all of the new state-owned, coal-fired electricity generation plants that are likely to be built in China during the next 15 to 20 years. Moreover, other developed countries, notably Japan, Canada and France, have already begun to invest in China's power industry and will continue to do so. An umbrella agreement between China and the United States, however, might well involve up to 20% of the new plants to be built – still a very large proportion. If this initial program is successful, the arrangements described here could later be expanded, or adapted to other economic sectors.

In addition to addressing the scope of the proposed program, the umbrella agreement should also provide a broad framework to govern specific projects and to guide the continuing evolution of the U.S.-China Clean Development Program. Some of the most important elements to be elaborated in the agreement would be:

- A Joint Commission, consisting of a senior official on each side to exercise broad supervisory jurisdiction over CDM projects and make overall policy decisions. The Commission would periodically review and evaluate program results and would make adjustments and adaptations to deal with major problems as they arise. The Commission member from each country would manage and expedite that country's national procedures and actions in support of the CDM program.
- A generalized system for establishing baselines for projects and for computing and allocating credits for emissions reductions generated by a project.
- "Fast track" project approval processes for use in China and the U.S.

- Procedures governing the transfer of expertise, operating methods and technology related to program activities. These procedures could include transfer of knowledge and equipment related to monitoring and evaluating the air pollution effects of new power plants; and
- A dispute resolution process covering not only disagreements between the United States and China but also possible disputes between private investors and either government.

Each of these elements warrants further elaboration.

1. The Joint Commission

In our view, the U.S.-China program cannot succeed without continuous, high level attention from the participating governments. Ideally, each government would designate a senior official whose exclusive responsibility would be the supervision and management of CDM programs. This official would act to energize and stimulate national activities pursuant to the program, break bureaucratic gridlock and bring major policy issues before the head of government for decision. In addition, this commissioner would maintain continuous liaison with the commissioner of the other participating country to ensure smooth coordination and to sort out problems as they arise. The Joint Commission would meet periodically, at intervals that would be determined by the size of the CDM program.

2. Baselines for calculating emission reductions

Under the joint U.S.-China CDM framework proposed here there is no need to compute a national emission baseline for China.[11] Instead, an individual baseline would be

[11] As noted above, the KP contains no quantitative commitments as to emissions limitation for non-Annex I countries, like China. The emission limitations for Annex I countries are set at a fixed percentage of a historical emission level, i.e. emissions as of 1990. This approach may be reasonable for industrialized countries, like the United States, which are comparatively rich, have a stable developed industrial base, and face relatively small changes in industrial development during the next few decades. For developing countries, however, any emissions ceiling based on historical performance would imply a cap on economic development and would therefore be unacceptable. An alternative approach to calculating emission reductions in developing countries would be to measure reductions against the projected growth in GHG emissions in the absence of any treaty based limitation effort. This type of baseline would allow for continuing development while simultaneously generating pressure for energy efficient development. There

computed for each power plant in the program based on a projection assuming conventional technologies were used. It might be possible to agree on a "standard" baseline for a "standard" power plant, but efficiencies vary among plants, even within a given technology. In addition, even without foreign investment, China would likely alter its technology-of-choice over time. Thus it would be desirable to make separate baseline calculations for each project, taking account of the particular circumstances surrounding that plant. Then, emission reductions could be calculated by comparing actual plant performance with that plant's projected emissions baseline.

One of the advantages of confining initial implementation of the CDM to central-station power plants is that China's extensive historical experience with the relevant technology should permit relatively simple and accurate forecasts of the necessary numbers. More accurate projections might be generated over time by an iterative process that could be carried out jointly by the U.S. and Chinese authorities, taking account of dynamically changing technological, economic and climatic conditions. In this paper, a simple approach based on historic performance of the technology is used to calculate baselines for Chinese power plants

3. Fast-track approval

Under the umbrella agreement, a CDM project would require the approval of authorities from both participating countries. It would be desirable for each country to centralize responsibility for expediting this approval process in its member of the Joint

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are obvious problems with this method, however, including inadequacies in data and methodology (Edward A. Parson and Karen Fisher-Vanden, "joint Implementation and its Alternatives: Choosing Systems to Distribute Global Emission Abatements and Finance," Environment and Natural Resources Program Paper, April 1997) and incentives to exaggerate economic growth projections and thus projected growth in GHG emissions under business-as-usual. For these reasons, and because it would be impossible to trace the impact of reductions from particular power plants in national aggregates, we rejected the idea of using a national baseline in the U.S.-China Clean Development Program in favor of the individual plant baselines described in the text.

Commission. Even if this were done, however, a complex interagency process would be involved on both sides in reviewing and approving investment applications.

Investor and host countries are likely to weigh the various considerations differently in deciding whether to approve project proposals. For example, for this U.S.-China program, the United States would need to satisfy itself that a project is likely to produce real and measurable abatements of GHG emissions that would not occur in the absence of the project. The question whether the project will be cost-effective compared to domestic alternatives would presumably be a decision for the investor. Thus, a simple approval process is feasible. In contrast, China would need to ensure that a project is compatible with national development priorities; transfers significant and desirable financial and technological resources, as well as expertise; and meets or beats applicable environmental standards. Approvals from development, environment and CDM-related authorities at multiple levels of government may be required, often in a context in which the institutional and political relationships among the authorities are unclear to investors.

Previous experience demonstrates that the project approval process – in both the U.S. and China – generates significant transaction costs that can make the difference between success and failure for foreign investment activities. The umbrella agreement for the U.S.-China program should therefore commit both countries to drastic simplifications of domestic approval processes. These simplifications will require far-reaching actions at the national level, discussed in section C below.

4. Technology transfer

In addition to the financial transfers involved in U.S. investment in Chinese power stations, access to expertise and new technologies is an important incentive for the central Chinese government and other actors to participate in the U.S-China Clean Development Program. The umbrella agreement's guidelines should therefore make clear that an expected element of any project is the transfer both of sophisticated clean coal technology

and of the knowledge and skills needed to maximize returns from this technology. Within these guidelines, individual investors would make arrangements with the approving agencies in China for each individual project. These arrangements would be included in the final project proposal and would be a significant factor on which approval of a project proposal would depend.

In terms of environmental gains, reduction of acid rain and air pollution is likely to be of much greater interest to Chinese authorities than is greenhouse gas reduction. Clean coal technology can result in significant improvements in local and regional emissions of air pollutants like SO_2 and NO_x. The present Chinese air pollution monitoring network has many gaps, however, so it is difficult to determine whether technological changes actually improve atmospheric conditions. The U.S. government (through such agencies as the EPA) and investors could increase the salience of these improvements – thereby increasing awareness of the link between air pollution and climate change issues – by providing technical support, equipment and expertise in evaluating and monitoring air pollution and human health effects in the vicinity of new power plants.

5. Dispute settlement

Disputes between the two parties to the umbrella agreement should be settled by consultation and, failing that, perhaps by reference to the appropriate procedures and organs of the KP. Disputes between the investors and the Chinese central, provincial or local authorities are another matter. It is a question for careful further consideration whether the umbrella agreement should contain a commitment to third party mediation and/or arbitration for such disputes.

C. Required Actions by National Governments

Before Kyoto, Parties to the FCCC tried several approaches to cooperative GHG emission reductions. The most important reason for the failure of these prior efforts was the absence of concrete incentives for investor participation. Given the political risks and economic uncertainties, private investors in the Chinese power industry typically have

demanded an internal rate of return (IRR) of 17 to 20%. Yet it is difficult to achieve an IRR of that level in the Chinese power industry, due to artificially low electricity tariffs for industrial and residential consumers and the apparent reluctance of the Chinese authorities to allow investments in infrastructure that exceed an IRR of 15%. Thus to have a chance of significant success, the U.S.-China program must provide concrete investment incentives in the form of direct financial rewards and reduced transaction costs, both for initial approval and for subsequent relations with the host country. The first must come from the U.S. government's shaping of domestic environmental policies and GHG abatement regulations. The second must be provided primarily by the Chinese authorities' streamlining of project search and approval processes.

1. Restructuring U.S. investment incentives[12]

The incentive for the United States government to undertake a joint emission reduction program with China is that the U.S. can gain credit for low cost emission reductions against its KP- mandated ceiling on emissions. It is not usually noted in discussions of the subject that these credits at the governmental level do not automatically translate into financial incentives for private investors. Thus, an essential element of the Clean Development Program must be U.S. national legislation to convert the emissions credits earned by the government into concrete financial incentives for the investor. In effect, these incentives would bridge the gap between the 20 percent plus IRR demanded by U.S. investors and the lower rates available on foreign investment in China.

If the U.S. establishes a domestic emissions trading program, as seems presently to be projected, the solution is simple. The government would issue emissions permits to the investor in the amount of the approved emission reductions credited as a result of the

[12] Although the U.S. approval process is a good deal simpler than the Chinese, there is considerable room for improvement.

project in China. The investor could then either use the permits to cover its own excess U.S. emissions or trade the permits on the market.[13]

In the absence of a domestic emissions trading system, the government would have to provide one (or several) of the more familiar investment incentives to induce investors to favor projects in the U.S.-China program over other direct investment projects. Among the incentives that might be employed are:

- Relief from regulatory obligation to abate these emissions inside the investor country;
- Relief from taxes on carbon or GHG emissions if and when they are imposed;
- Relief from taxes, charges and regulations not connected with controlling GHG emissions (such as ordinary corporate taxes or other environmental regulations);
- Preferential loans, guarantees, governmental purchasing or other advantages in government and capital markets; or
- Direct subsidies.

The amount of the incentive would be measured by the value to the United States of the carbon saved. The choice of instrument depends on considerations of administrative feasibility and political acceptability. President Clinton's FY 1989 budget contains $6 billion for incentives to encourage domestic GHG emissions reductions. Any such program could readily be adapted for use with the CDM.

The provision by a country of incentives and subsidies in international trade and investment transactions is regulated by OECD guidelines and to a degree by the World Trade Organization. But it may be argued, however, that the measures discussed above are not strictly speaking subsidies within the meaning of these regulations, but instead

[13] At this moment, rumor has it that the projected U.S. emission trading program will have a built-in price ceiling. If so, the issue of emissions permits to U.S. investors in respect of their Chinese investments may have to be supplemented by other incentives.

constitute payment for services, measured by the value to the U.S. of the carbon saved through CDM projects.

2. Streamlining China's project approval process

The Chinese process for approving cooperative GHG reduction projects and other foreign investments is complex, confusing and opaque. It poses a daunting prospect for anyone contemplating major investment in the Chinese economy. The political and economic changes occurring in China also make it hard to predict the institutional and economic arrangements a future investor will face.

At present, the function of approving cooperative GHG abatement projects is distributed across a number of government agencies and departments, with regard to technical, economic, environmental and political factors. There is no single inter-agency body to bring together all the interested governmental parties. Nor are there published standards which the Chinese authorities are required to consider in approving cooperative, multinational projects. The decision-making stages of the approval process are not easily distinguished, because projects must be referred to various central government agencies and also to provincial and municipal or local governments for approval. It is unclear where the approval process begins and ends.

Currently, potential foreign investors in China's electric power sector must submit an application to the Chinese State Planning Commission (SPC), which is the most important economic and development agency in the central Chinese government. This submission is required for any power sector project involving foreign investment, although in theory, the SPC is only required to consider power plant projects that exceed a certain investment threshold. Applications are then likely to be referred to other central government agencies, such as the Ministry for Electric Power (which regulates the electric power generation and transmission sector), the Ministry of Foreign Economic

Relations and Trade (which oversees joint-venture power projects), or the National Environment Protection Agency (which has become increasingly powerful in policy making since the later 1980s, and which is responsible for overseeing environmental regulations).

At present, the interactions among these bodies are largely unclear to U.S. investors and the U.S. government. In addition, many extraneous considerations may affect the approval process. There was a period during the mid-1990s, for example, when the SPC was reluctant to grant approvals for foreign investment projects with an IRR that exceeded 12 percent. Many project were therefore held up indefinitely. From mid-1996, however the central Chinese government is no longer officially capping the IRR of projects funded by foreign investment, although there may be a lingering reluctance to allow higher rates. Further, China has doubled the amount of foreign investment that is allowed.

In recent years, the regulatory and institutional landscapes have undergone significant changes, at least at the central government level:

- A new State Power Corporation was formed in January 1997 to take over all the ownership functions of the Ministry of Electric Power. In turn, as a holding company, it owns about 30 provincial and regional power companies, which own local and municipal power companies. Many local, municipal and provincial governments also own power generation facilities, adding to the confusion of the Chinese power sector. Each of the power groups and provincial companies now carry out their own planning and decision-making. They are legal enterprises in their own right and are often the bodies that decide to build a new power plant, and to enter into joint ventures with foreign investors, rather than the State Power Corporation.

- A new State Power Investment Corporation (SPIC), based in Hong Kong, was created in June 1996. To date, the SPIC has been assigned ownership of at least six power generation plants and has begun to broker deals with foreign investors.
- The Ministry of Electric Power is now largely responsible for regulating the power sector and is not supposed to make decisions concerning the approval and construction of new power plants. As a result, the Ministry of Electric Power no longer plans a proprietary role, since its former regulatory, investment and ownership functions have been separated as part of an ongoing corporatization process. There are reports that the Ministry of Electric Power may be abolished during 1998, and its regulatory functions given to other central government agencies
- A new Electricity Law, enacted in April 1996, created a stronger system for control of pricing to replace part of the previous system in which power tariffs were set arbitrarily by local government bureaus. This law also protected the rights of foreign investors in power generation plants and transmission grids by giving them the right to request local and provincial governments to take up their output into power transmission grids.
- The SPC has drafted regulations to allow new forms of direct foreign investment. In particular, foreign investors can now be majority shareholders in power sector projects, or even own projects outright. Foreign investors can also engage in Build-Operate-Transfer (BOT) projects, in which they build a power plant, operate it for some period of years, and then transfer the operating rights to the owner (usually the provincial or municipal power company). The first BOT project was approved during 1996.

As a result of these recent reforms, the approval process for direct foreign investment has been improved somewhat, but it remains labyrinthine, since many of the approvals must come from the provincial and local or municipal governments. These bodies often still own their own power companies, together with the companies ultimately owned by the

SPC and the SPIC. As a result, these bodies often choose to build their own small plants to serve smaller cities and localities.

Investors also need to obtain approvals of both the environmental and developmental aspects of any proposed project. The situation is complicated because central government agencies no longer necessarily play a driving role in development and economic decision-making. It is the provincial and local governments that now make many of the key development decisions and seek out potential investment opportunities for foreign investors. The local power bureaus participate in the approval process as well as the central agencies. Formerly, provincial and local governments themselves provided the capital for investment, but increasingly, private companies have independent resources. Thus, local development and power bureaus do not necessarily know everything about the projects being planned in their jurisdictions.

Moreover, because environmental laws and policies are largely enforced and implemented at the local level in China, foreign investors may need to negotiate with the local environment protection bureaus (EPBs) to ensure that project proposals undergo environmental impact assessments and are seen to meet environmental standards. The position of EPBs is equivocal, because they are both part of the national system (reporting to the National Environment Protection Agency) and part of the local government system. Typically, EPBs are less able to impose rigorous environmental standards on larger projects, especially if powerful and politically well-connected interests are involved.

Ultimately, the State Planning Commission finalizes approval of any cooperative power industry ventures. (See attached diagram, Appendix A).

Because of the opaque and complicated nature of the Chinese decision making process, high approval and search costs are likely to be incurred, and potential U.S. investors may be deterred from considering cooperative GHG abatement efforts in China.. It is clear

that significant decreases in these transaction costs will be needed if the U.S.-China program is to make significant headway.

IV. CONCLUSION

Current cooperative GHG abatement efforts, primarily under the aegis of the Activities Implemented Jointly (AIJ) pilot phase, are small-scale and involve minimal investment. None of the major developing countries have participated strongly in these projects. If these countries are to join whole-heartedly in cooperative clean development efforts, they must be assured of massive transfers of technological expertise and financial resources. Further, to encourage an influx of private capital, developed countries must create incentives for firms to invest in cooperative projects. The Clean Development Mechanism outlined in the Article 12 of the Kyoto Protocol offers a possible means to meet both goals, but there is not yet a clear, detailed, workable framework for implementing the Mechanism. A number of different approaches to Article 12 have been discussed in general terms. These approaches are by no means mutually inconsistent, and multiple approaches could be followed simultaneously, assuming each meets the requirements of the Article.

As a step toward defining one such approach, this paper proposes a Clean Development Program between the United States and China directed at China's state-owned, coal-fired electricity generation plants. For the purposes of this paper, we assume that both the United States and China will ratify the Kyoto Protocol, and further that the COP will take prompt action at its fourth meeting in Buenos Aires in late 1998 to implement the CMD in accordance with Article 12 of the Protocol. In addition, the program proposed here has the following elements:

- A bilateral umbrella agreement between the U.S. and China;
- Creation of a Joint Commission to oversee the evolution of the U.S.-China investment relationship;
- Creation of economic incentives in the United States to encourage preferential investment in clean development projects; and

- Streamlining of search and approval processes in both China and the United States.

There is a clear need for cooperative, multinational projects aimed at reducing GHG emissions by transferring energy efficient technology to developing countries, especially as the major developing countries are projected to surpass industrialized nations in aggregate annual emissions early in the next century. The U.S.-China program discussed here provides a possible framework for implementing the Clean Development Mechanism quickly and cost-effectively, to foster increased involvement in GHG abatement efforts by both developed and developing nations.

APPENDIX

THE CHINESE APPROVAL PROCESS FOR AIJ PROJECTS IN THE POWER GENERATION SECTOR