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CLIMATE ISSUES BRIEF



RESOURCES
FOR THE FUTURE

**THE ECONOMICS OF
TECHNOLOGY DIFFUSION:
IMPLICATIONS FOR GREENHOUSE
GAS MITIGATION IN DEVELOPING
COUNTRIES**

Allen Blackman

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Resources for the Future
1616 P Street, NW
Washington, DC 20036
Telephone 202-328-5000
Fax 202-939-3460

Climate Issue Briefs are short reports produced as part of RFF's Climate Economics and Policy Program to provide topical, timely information and analysis to a broad nontechnical audience.

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The Economics of Technology Diffusion: Implications for Greenhouse Gas Mitigation in Developing Countries

Allen Blackman, Fellow, Resources for the Future

INTRODUCTION

Recent efforts to forge some consensus on the role that developing countries should play in reducing global greenhouse gas emissions have focused attention on climate friendly technologies (CFTs). Developing countries are expected to supersede industrialized countries as the leading source of greenhouse gas emissions in the next thirty years. Yet their ability and willingness to contribute to abatement efforts is constrained by limited financial resources, weak regulatory institutions, and the perception that they should not have to bear the costs of mitigating a problem primarily created by industrialized countries. CFTs are seen by many as a means of surmounting these obstacles.

Many types of CFTs -- notably, energy efficiency innovations -- not only reduce emissions of greenhouse gases but also cut production costs. As a result, such technologies could conceivably diffuse spontaneously in developing countries, obviating the need for government financing and regulation. Climate strategies that focus on promoting the diffusion of CFTs are likely to garner widespread support since they represent opportunities to enhance productivity and abate local pollution in the eyes of developing countries, and opportunities to boost exports of equipment and expertise in the eyes of industrialized countries.

But how likely is it that technology-based strategies will have a significant impact on greenhouse gas emissions in the near to medium term? In part, the answer depends on whether, once introduced, CFTs would diffuse at a reasonably rapid pace, and whether policy makers will be able to speed the rate of diffusion. This brief summarizes some of the key findings of the extensive economics literature on the diffusion of new technologies, and assesses the implications of these findings for the ongoing debate about technology-based climate change strategies. In short, the literature suggests that a wide variety of policies are likely to speed the diffusion of CFTs, including rationalizing energy prices, improving information, and investing in energy infrastructure.

THE ECONOMICS OF TECHNOLOGY DIFFUSION

Though not all the evidence on technology diffusion is conclusive, there is broad agreement on two points. First, new technologies are never adopted by all potential users at the same time. The widespread diffusion of new technologies can take anywhere from five to fifty years. Second, countless studies have confirmed that the diffusion of new technologies follows a predictable intertemporal pattern -- technologies are adopted rather slowly at first, then more rapidly, and then slowly again as a technology specific "adoption ceiling" is reached. These stylized facts have prompted researchers to focus on two related

questions: Why do some firms adopt a given innovation before others? Why do some innovations diffuse more quickly than others?

Researchers have addressed these questions using a variety of theoretical constructs that emphasize different aspects of the diffusion process. "Epidemic" models focus on the dissemination of information about new technologies via day-to-day contact among firms, likening this process to the spread of a disease. These models imply that some firms adopt before others because they happen to become "infected" first, and that some innovations diffuse faster than others because they are more "contagious" than others by virtue of their profitability and limited riskiness.

So-called "rank" models are premised on the observation that, given differences in capital vintage, size, access to technical information, labor productivity, and environmental regulatory costs, some firms will get a higher return from a new technology than others. Hence, one may rank all potential adopters on the basis of their expected returns. Only firms with a sufficiently high ranking will adopt when an innovation first becomes available. However, over time -- as sector-wide production and information costs fall, the new technology is refined, and the existing capital depreciates -- lower ranked firms will adopt as well.

"Order" models are applicable when there is a fixed critical input into production such as a pool of specially trained labor or a scarce natural resource. In such situations, the order of adoption clearly matters -- initially only first movers who secure access to the critical input will find it profitable to adopt.

Finally, so-called "stock" models are also premised on the idea that early movers obtain higher returns on the new technology. However, they attribute this phenomenon to the fact that as the stock of firms that have adopted a cost-saving innovation grows, average production costs fall, and eventually output prices fall as well. Thus, initially it will only be profitable for a limited number of firms to adopt.

It is important to note that these four types of theoretical models are not mutually exclusive. Indeed, the diffusion of any specific technology is likely to be influenced by some combination of the factors emphasized by the models: information and learning, the characteristics of potential adopters, the characteristics of technology, the scarcity of critical inputs, and the sensitivity of output prices to technological change.

Most empirical (versus theoretical) investigations of technology diffusion have sought to understand exactly how characteristics of new innovations and of potential adopters influence diffusion (thus, they essentially constitute tests of the rank model). They have found that, not surprisingly, relatively profitable, small-scale, and simple innovations are adopted fastest. In addition, they have found that new technologies are adopted fastest by firms that are large, have well-trained staff, incur high regulatory costs when using an existing technology, have infrastructure complementary to the new technology, are in fast-growing industries, invest more in R&D, pay relatively low prices for inputs used intensively by the new technology, and have relatively old existing capital. Despite considerable research, the evidence regarding the impact of market structure (the

degree to which the market is competitive or controlled by a small number of firms) on the timing diffusion is inconclusive.

POLICY PRESCRIPTIONS

What does the current state of knowledge suggest for technology-based climate change policy? Two implications are immediately obvious. First, even if CFTs that significantly lower production costs can be transferred to developing countries, diffusion will not be immediate. Second, developing country firms will not necessarily rapidly adopt CFTs simply because they reduce production costs in industrialized countries. A broad range of firm-level, sector-level, and country-level characteristics determine whether or not and how quickly new technologies are adopted, and there are likely to be systematic differences between developing countries and industrialized countries in nearly all of these characteristics. To give one example, labor is generally much less costly relative to capital in developing countries. Therefore, labor-saving technology that is profitable in industrialized countries will not necessarily be profitable in developing countries.

In addition, it is important to note that faster diffusion of a technology is not necessarily beneficial. As Stoneman and Dierderren point out (see Further Readings), diffusion may be “too fast” if firms adopt a technology before it is profitable to do so, or if firms adopt a new technology today that effectively preempts the adoption of a superior technology in the future.

Given the theory and evidence presented above, there would seem to be seven types of policy levers available to influence the speed of diffusion of CFTs in developing countries. These concern: information, input prices, regulation, credit, subsidies, human capital, infrastructure, research and development, and intellectual property restrictions.

Information. Economic theory suggests that the dissemination of information about the new technology is likely to be a critical determinant of diffusion. (Limited empirical support for the importance of information probably stems only from the difficulty of measuring information flows.) As Stoneman and Dierderren make clear, government intervention to enhance the dissemination of technical information is likely to be justified since virtually every means by which firms acquire information about new technologies is imperfect.

When firms acquire technical information through day-to-day contact with other firms, early adopters supply information about the new technology to later adopters, but the former do not capture any of the benefits from this information transfer themselves. As a result, they do not have proper incentives to make this information available to their rivals. When firms acquire technical information through active search, firms operating independently will engage in inefficient duplication of search efforts. And finally, when firms acquire technical information from advertising, technology suppliers who are concerned about market share, not the diffusion of the technology, have incentives to oversupply technical information, which may lead to too-rapid diffusion of intermediate technology.

Policy options for enhancing the flow of information about new technologies include demonstration projects, advertising campaigns, the testing and certification of new technologies, and subsidies to technological consulting services. Have such mechanisms had a verifiable impact on diffusion? Demonstration projects have received wide application in the context of developing country agriculture, and many industrialized countries have set up regional information clearinghouses to provide consulting services to small- and medium-sized businesses that presumably can least afford search costs associated with adoption. As yet, however, evaluations of these programs have been limited, and we know little about their effectiveness.

Finally, it is worth noting that information-based policies may actually retard diffusion by fostering the expectation that improved technologies are forthcoming, and therefore creating incentives to defer adoption. A similar problem arises when public provision of information about new technologies crowds out private information.

Input Prices. Both theory and evidence attest to the important role that input prices play in the diffusion of new technologies. In particular, energy prices clearly have a critical impact on the adoption of energy saving technologies. In a number of developing and reforming economies, energy is still subsidized. Removing or significantly scaling back energy subsidies in these countries would create strong incentives to adopt energy-saving technologies. In countries where energy prices are not subsidized, taxing energy to raise its effective price above the market price would have the same effect as removing subsidies.

Regulation. As noted above, empirical research supports the hypothesis that firms subjected to stricter environmental regulation are more likely to adopt clean technologies, including CFTs. The opportunities for, and barriers to effective regulation in developing countries have received considerable attention, especially in the last ten years. Two points deserve mention. First, the use of market-based incentives such as pollution taxes and marketable permit systems -- including a credible international greenhouse gas emissions trading system -- is analogous to raising the price of a critical factor of production, namely environmental services. Therefore, the same arguments about the link between factor prices and technology adoption are applicable. Second, even when institutional and financial constraints make formal public-sector-led regulation problematic, private-sector-led "informal" initiatives (such as grassroots efforts to deter polluters by stigmatizing them) can be an effective substitute.

Credit. Lack of access to credit may be a critical barrier to adoption. Subsidizing credit for specific types of investments has been a common policy response. However, thus far these programs -- both public and private -- have had very mixed results. Chronic problems include the diversion of loans by borrowers to non-targeted activities, low repayment rates, the creation of financially unsustainable lending institutions, politicization

* For example, the US Department of Commerce sponsors a network of "Manufacturing Technology Centers." Similar networks have been established in the United Kingdom (the Advanced Information Technology Programme, and the Regional Office Technology Transfer Programme), in France (Centres Regionaux d'Innovation et de Transfer de Technologie), and in the European Union (the SPRINT programme).

of lending decisions, and the undermining of existing credit markets. Since there is growing support for the view that the costs of “targeted” credit outweigh the benefits, a wiser approach to overcoming financial barriers to technological innovation is to focus on improving banking which, in developing countries, is often hamstrung by unstable monetary policy, interest rate restrictions, and weak property rights.

Subsidies. An obvious mechanism for speeding the diffusion of a new technology is for governments to subsidize it. But subsidies, in addition to being quite expensive, are likely to be subject to many of the same problems as targeted credit, namely the politicization and distortion of input markets.

Human Capital, Infrastructure, and Research and Development. Empirical research on the links between early adoption of innovations on the one hand and human capital, infrastructure, and research and development (R&D) on the other suggests there is an argument for subsidizing education, technical training, infrastructure and R&D. This needn’t be a broad-brush strategy if these subsidies are focused on greenhouse-gas-intensive sectors such as energy.

Intellectual Property Restrictions. Intellectual property restrictions such as patents and licenses have countervailing effects on technology diffusion. On the one hand, they stimulate R&D, which in turn stimulates technology diffusion. Perhaps more important for developing countries, they are likely to encourage foreign investment, which can be a significant source of new technologies. But on the other hand, intellectual property restrictions attach significant costs to adoption of new technologies which can retard diffusion. In many developing countries, adaptation of existing technologies, rather than the creation of substantially new ones, accounts for the bulk of productivity growth. Therefore, there is reason to suspect that the negative impact of intellectual property restrictions on diffusion in developing countries could be substantial.

PRACTICAL FIRST STEPS

Of the broad range of policy options presented here, which are likely to be politically practical? As mentioned in the introduction, technology-based strategies will generate political support to the extent they represent obvious “win-win” opportunities for the parties involved. Many of the policies described above fit this description to some degree. Information, human capital and infrastructure policies will enhance productivity; rationalizing energy prices will boost allocative efficiency; improving banking should stimulate saving and investment; and strengthening regulation should produce environmental benefits.

However, some of these policies involve up-front economic costs that are more immediate and payoffs that are more delayed than others, making them unattractive to decision makers with short time horizons. For example, though investments in banking, human capital (broadly defined), and environmental regulation may have tremendous benefits in the long run, they involve substantial up-front costs. Thus, the most practical policy options discussed here would seem to be rationalizing energy prices, improving information, and investing in energy infrastructure.

FURTHER READING

General Interest

Stoneman, P. 1991. "Technological Diffusion: The Viewpoint of Economic Theory," in Mathias, P.; Davis, J., eds., *Innovation and Technology in Europe: From the Eighteenth Century to the Present Day*. The Nature of Industrialization series; Oxford and Cambridge: Blackwell, pp. 162-84.

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Pargal, S., and D. Wheeler. 1996. "Informal Regulation of Industrial Pollution in Developing Countries: Evidence from Indonesia." *Journal of Political Economy*, 104(6), 1314-27.

Stoneman, P. 1983. *The Economic Analysis of Technological Change*. New York: Oxford University Press.

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About Resources for the Future

Resources for the Future (RFF) is an independent, nonprofit research organization that aims to help people make better decisions about the conservation and use of their natural resources and the environment. For the past 45 years, researchers at RFF have conducted environmental economics research and policy analysis involving such issues as forests, water, energy, minerals, transportation, sustainable development, and air pollution. They also have examined, from a variety of perspectives, such topics as government regulation, risk, ecosystems and biodiversity, climate, hazardous waste management, technology, and outer space.

While many RFF staff members are economists by training, other researchers hold advanced degrees in ecology, city and regional planning, engineering, American government, and public policy and management. RFF neither lobbies nor takes positions on specific legislative or regulatory proposals. Its operating budget is derived in approximately equal amounts from three sources: investment income from a reserve fund; government grants; and contributions from corporations, foundations, and individuals (corporate support cannot be earmarked for specific research projects). Some 45 percent of RFF's total funding is unrestricted.

The latest RFF news and information is available on the internet at <http://www.rff.org>.

About RFF's Climate Economics and Policy Program

As international debate intensifies over possible agreements to limit emissions of greenhouse gases, Resources for the Future (RFF) launched its Climate Economics and Policy Program in October 1996 to increase understanding and knowledge of the complex issues that must be addressed to design appropriate domestic and international policies that are effective, reliable, and cost-efficient. The program responds to both the long-term debate about climate change, and the specific debates surrounding the negotiations being carried out under the United Nations Framework Convention on Climate Change.

RFF brings a well recognized and respected reputation for objectivity to this debate. The Climate Economics and Policy Program integrates the many different aspects of climate change with ongoing basic and applied research at RFF involving energy markets, water and forest resource management, air pollution, environmental regulation, and sustainable development.

Drawing on RFF's strengths in environmental and natural resource assessment, economic analysis, and policy design, the climate program focuses on five main areas: economic and environmental consequences of climate change and policies to deal with climate change; domestic and international policy design issues; interactions between climate change and other policies; equity, efficiency, and other criteria used in decisionmaking; development of analytical tools.

PROGRAM OUTPUTS. RFF's climate program includes original basic and applied research, policy analysis, and educational outreach.

Research. Integrating basic and applied research on the economic implications of global climate change with ecological, engineering, scientific, environmental health, geographical, international, and other considerations, an initial set of research projects underway at RFF include:

- Bringing Uncertainty into the Equation When Calculating Climate Change Risks
- Discounting in Intergenerational Decisionmaking (workshop)
- Economic Analysis of Greenhouse Gas Emissions Trading
- Effective Environmental Policy in the Presence of Distorting Taxes
- Electricity Restructuring and the Costs of Controlling CO₂
- Environmental Consequences of Tax System Reform
- Impacts of Climate Change Mitigation on Other Environmental Problems
- Importance of Technical Change in the Economics of Carbon Policy (workshop)
- International Cooperation for Effective and Economic Greenhouse Gas Limitation
- Vulnerability of Low-Income Households to the Hydrologic Effects of Climate Change

Policy analysis. As a response to questions arising in the ongoing international negotiations, RFF will issue a series of short papers on a variety of issues related to policy in 1997. These studies will be based on original research combined with critical reviews of existing literature. Potential questions to be addressed include:

- How should the climate problem be thought about in general?
- How might a domestic emissions trading program be established?
- How does the performance of revenue-raising and non-revenue-raising policy instruments compare?
- How should emissions reductions be scheduled over time?
- What is the potential for technical innovation to substantially lower the cost of greenhouse gas limitations, and what government policies can tap that potential?
- What are the strengths and weaknesses of different modeling approaches for assessing the economic costs of greenhouse gas limitations?

Educational outreach. RFF regularly shares its climate change findings with members of the academic, business and environmental communities, and representatives of local, national and international governments by publishing and disseminating discussion papers and convening educational forums on selected topics. To support a well-informed public, RFF provides regular reports of its climate change activities to the news media, posts program updates and activities on RFF's internet home page (<http://www.rff.org>), and recently launched *Weathervane*, an internet site devoted to the discussion and debate of climate change policy.

Adele C. Morris

03/11/98 10:47:45 AM

Record Type: Record

To: Randall W. Lutter/CEA/EOP, Joseph E. Aldy/CEA/EOP, Jeffrey A. Frankel/CEA/EOP

cc:

Subject: Carbon Investment Fund -Forwarded

I'll cover issues related to role of international financial institutions. (See attached material on the World Bank's Carbon Investment Fund.)

Adele

----- Forwarded by Adele C. Morris/CEA/EOP on 03/11/98 10:00 AM -----



Ray.R.S.Squitieri @ MS01.DO.treas.sprint.com

03/11/98 09:03:00 AM

Record Type: Record

To: Adele C. Morris

cc:

Subject: Carbon Investment Fund -Forwarded

Date: 03/11/1998 09:53 am (Wednesday)

From: Ray Squitieri

To: adele

Subject: Carbon Investment Fund -Forwarded

Here's the note about the meeting on Thurs. You're welcome to attend, though I'd also be happy to fill you in later if you can't make it.

DEPARTMENT OF THE TREASURY
WASHINGTON

March 9, 1998

cc: JA
Am
RM
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MEMORANDUM FOR DISTRIBUTION

FROM: Truman Semans *TS*
RE: World Bank and Climate Change
PAGES: 4 total

The World Bank Board is preparing to consider a new Environment Strategy for the Energy Sector, and Bank management are also proposing the Carbon Investment Fund (CIF) for Board Approval.

Joe Eichenberger will chair an interagency meeting to develop a U.S. position on the CIF and discuss the Strategy. The meeting is tentatively scheduled for this Thursday, March 12, from 2:30 - 4:00 p.m. in Main Treasury, Room 2127. If you plan to attend, please provide your name and birthdate to Ms. Earline Hoffman or Ms. Dianne Graham at 622-1810 (fax 622-1228).

We will circulate a draft position paper on the CIF prior to the meeting. Attached are U.S. comments on the previous draft of the Bank Strategy, sent to Robert Watson on early October. The latest draft strategy can be found at <http://www.worldbank.org/html/fpd/ienpd/ienpd.html>.

The meeting time and place will be confirmed with a following fax.



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	Steve Seidel	343-1162	343-1060
	David Hales	216-3174	712-1750
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DOD	Sherri Goodman	703-693-7011	703-695-6639
	David Weisman	703-614-1158	703-697-1887
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	Bill Antholis	456-5334	456-2198
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	Bill Schuerch	622-2536	622-0154
	Joe Eichenberger	622-1228	622-1810
WB/OUSED	Michael Kaplan	477-2967	548-1549

U.S. Comments: World Bank Energy and Environment Strategy (7/22 draft)

We welcome the opportunity to comment on this important Bank paper, which is the result of a productive dialogue between Bank divisions. We support the goal of “ensuring that energy services are supplied and used at the lowest economic cost including social and environmental externalities.” Please note that we are preparing separate comments on the proposed Carbon Initiative.

Relation to Existing Policy. At the outset, the paper should clearly state that the 1993 electric power sector and energy efficiency policy papers remain binding Bank policy. If changes are proposed in Bank policy, these should be clearly listed and evaluated.

- It might be worthwhile to consider a thorough OED review of Bank implementation of existing energy and environment policies, recommending steps to rectify any shortcoming, including staffing, staff training, and internal incentive structures. We welcome the Bank's views on this.
- The Strategy should clearly state existing Bank policy that countries not willing to undertake fundamental reforms will be ineligible for loans to any part of the energy sector, particularly for use of IDA funds.

The Role of the World Bank Group. The Strategy should clearly distinguish between the Bank Group's role, as a public sector institution, and that of the private sector. When and why are Bank lending services for energy justified? Where should non-lending services be applied?

- The Strategy should encompass all parts of the Bank Group, including IFC and MIGA, helping ensure that sound environmental policy guides all types of Bank Group assistance.
- The Bank should focus on capacity-building and other technical assistance that allow markets to function well and account for costs and benefits to society of energy development. The Bank should also increase both direct lending and technical assistance for energy efficiency and renewable energy.

Country Assistance Strategy. Stronger emphasis on energy and environment issues in the Country Assistance Strategy process is a top priority.

- The “Indicators” should include energy and natural resource data from World Development Indicators such as on demand growth for energy services in key sectors, energy intensity trends, costs and prices associated with energy production and use, etc.
- CASs should be based on integrated energy supply and use strategies that account for local/regional environmental externalities and fully integrate energy efficiency and renewable energy. All planned assistance, regardless of sector or type of assistance, including to transport and other energy end-use sectors, should be consistent with these national energy strategies.

Internal Reforms. The document acknowledges that institutional and capacity factors within the Bank may undermine the Bank's ability to support sustainable energy. The Strategy should propose specific internal improvements that allow the Bank to be more effective.

Sequencing Assistance and Reforms. Restructuring and price reforms should be central pillars of Bank assistance. However, reforms that promote energy efficiency and renewable energy resources should proceed

simultaneously with pricing reform and should be fully integrated into planning for restructuring. Price reforms alone fail to capture large segments of energy efficiency and some approaches to restructuring may yield net negative environmental performance.

- The paper should outline the particular types of Bank Group assistance needed to ensure optimum environmental performance in each main type of energy sector restructuring situation (commercialization, privatization, unbundling, competition).
- In particular, the Bank should aggressively support the development and implementation of energy efficiency codes and standards (or implementation at the national level of existing regional standards) -- especially for appliances, motors, and buildings.

Hydroelectricity. We recommend that discussion of hydro be dropped from the Strategy until the conclusion of the international panel on dams co-sponsored by the Bank. The implication that Bank experience with large hydroelectric projects has been positive is clearly inaccurate. Clearly, no other single type of sectoral project has a more problematic track record, and the recent OED study of hydro has been strongly criticized both within and outside the Bank.

Beyond the issues noted above, we have the following additional comments:

Internalizing Externalities. We welcome analysis on internalizing environmental and other externalities into sectoral and project planning. We believe a useful medium-term objective is to identify and internalize local and regional externalities -- costs to human health, infrastructure, and the environment -- into energy supply and end-use development decisions.

Trade and Investment. The Bank should encourage reduction in barriers to trade and investment in clean energy technologies and pollution abatement equipment. Reforms that facilitate joint ventures may be especially important, since considerable anecdotal evidence indicates extensive application of these technologies won't work with imported equipment.

Procurement. Corruption is an important issue in both public and private operations in the energy sector, with its big-ticket project components and corresponding high stakes for sellers, governments and consumers. We recommend that the Bank Group have a policy on contracting and completion arrangements in private sector operations (as does the EBRD). Also, the proposed industry-linked advisory function raises problems of insider advantage.

Concessions/BOTs/PPAs. To avoid real or perceived corruption, the Bank Group should require "international" competitive bidding (not single source or national competitive bidding or unspecified "competitive" bidding) for the award of all concessions, BOTs, PPAs, etc. in which the Bank Group participates.

Carbon Fund. We are preparing separate comments on the proposed Carbon Initiative. While it has some interesting elements, it raises a number of serious and unresolved issues. Perhaps the greatest concern is that the Bank, with a huge portion of its business in financing fossil fuel-fired power plants, faces a serious conflict of interest in also managing the first and largest international fund for jointly implemented carbon mitigation at the project level. At this stage, it is premature to include this proposal in the Strategy.

Transportation. The document should build on the Transport Sector Review completed in 1995 with specific steps for improved Bank support of environmentally sustainable transport systems.

DEPARTMENT OF THE TREASURY
WASHINGTON

March 11, 1998

cc: JAF
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RK
JA
54

MEMORANDUM FOR DISTRIBUTION

FROM: Joe Eichenberger *JEB*

RE: Global Environment Facility (GEF) Assembly

PAGES: 5 total

This fax is to confirm the meeting tomorrow, March 12, to develop a position on the proposed World Bank Carbon Investment Fund (CIF) and to discuss the the Bank's Energy and Environment Strategy. The meeting is from 2:30-3:30 in Main Treasury Room 2127. If you plan to attend, please provide your name and birthdate by COB Wednesday to Ms. Dianne Graham or Ms. Earline Hoffman at tel: 622-1810, fax: 622-1228.

The proposed agenda is as follows:

1. Proposed U.S. position on the Carbon Investment Fund
2. Initial discussion of three Bank energy/environment policy issues:
 - Shadow pricing
 - Carbon accounting and offsets
 - Quotas for lending
3. Initial discussion on process to address the revised draft Bank Environment Strategy for the Energy Sector

A draft position paper on the CIF is attached. We will try to circulate a paper on the three additional topics prior to the meeting.

attachment

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	David Weisman	703-614-1158	703-697-1887
NEC	Peter Orszag	456-2223	456-5358
	Bill Antholis	456-5334	456-2198
CEQ/NSC	David Sandalow	456-2710	456-6224
Treasury	Jon Gruber	622-2633	622-0563
	Bill Schuerch	622-2536	622-0154
WB/OUSED	Michael Kaplan	477-2967	548-1549

DRAFT
World Bank's Proposed Carbon Investment Fund (CIF)
Proposed USG Position

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Basics of CIF: The World Bank has proposed the creation of a Carbon Investment Fund (CIF), which would act as a market intermediary by pooling government and private sector finance and investing in projects that result in carbon emissions reductions in client countries. The Bank views the CIF as an instrument to finance the "carbon component" of a regular World Bank Group pipeline project. The resulting carbon reductions could be traded or used as offsets for the investors' own emissions. Eventually, the CIF would be a well-diversified portfolio of carbon offsets, which will reduce considerably the risks of investing in carbon reducing projects. With standardized deals, a CIF could limit transactions costs. The Bank claims that a CIF would be competitive with future players in the market; the Bank would not have a privileged position. As competition increases over time, the role of the Bank is intended to gradually diminish.

Proposed USG Position: The CIF has a number of positive features. For one, it has helped develop our thinking about how offsets trade might develop and could further sharpen our views about the operation of such transactions. In addition, it may help shift a portion of Bank-financed projects -- although not necessarily Bank operations -- toward somewhat more advanced energy technologies. Finally, it may help lower initial transactions costs for offset trades. However, there remain a number of unresolved issues and serious concerns about the proposal. We believe these should be resolved before the Bank Board considers approval of the launch of a CIF.

1. **Bank Additionality/Market Impact.** As a general rule, the USG has opposed any Bank operation that would supplant the private sector. The investor and trading functions described in the CIF proposal appears to be roles that, judging from experience with emission trading in the United States, the private sector could easily assume. Therefore, we question what additionality the Bank would bring to the transaction, especially if it uses its pipeline projects as the investments. Moreover, there is a real risk that, given the Bank's dominant role in some countries' economies and its lending relationship to member governments, the CIF could create serious price distortions in the fledgling carbon offsets market and stymie its development.

- As a major market actor and middleman in jointly implemented carbon offset projects, the Bank probably has enough market influence to set the price of offsets in certain markets. If over time the Bank were to pay a higher "rent" on carbon mitigation/sinks projects to host countries than the market would allow, this would undermine the ability of private actors to negotiate best prices and would displace some investors from entry into carbon markets or at least impede their timely entry. This could easily offset the potential benefits from potentially lower transaction cost through Bank-brokered investments.
- Has the Bank sought the views of the private sector as it has developed the CIF? Does the Bank have a clear "exit strategy" to turn over a pilot effort to the private sector?

2. **Potential Conflicts for the Bank.** The CIF proposal has the Bank playing potentially conflicting set of roles: a development bank, a promoter of greenhouse gas reduction, a carbon market regulator and

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trader, and an offset investor. The Bank also has a credibility problem, having long supported fossil fuels development to meet the demands of economic growth, and having failed to follow its own energy and environment policies.

- As a carbon investor, the Bank would face disincentives to require a best-practice baseline, since lenient baselines would reduce the price per unit of carbon offsets. Lower baselines would allow the Bank to expand its CIF business and bring in increased concessional (GEF and CIF generated) financing to its overall energy pipeline and to specific projects. Potential CIF beneficiaries also have an strong incentive to propose the lowest possible baseline energy development scenario in order to gain concessional financing and CIF-generated investment. This appears to reward countries that do not reform or that reform slowly. How would the Bank address these perverse incentives?
 - The Bank's net impact over the past several years has to increase carbon emissions. It is unclear that the CIF would alter this net impact, since carbon investments would still presumably be in the Bank's regular portfolio. Can the Bank credibly advocate and facilitate greenhouse gas (GHG) mitigation while increasing overall GHG emissions?
 - The CIF's proposed regulatory role for the Bank in the emerging carbon market involves ensuring the use of rigorous, transparent methodologies for determining baselines as well as for monitoring and accounting carbon emissions and offsets. Existing Bank policy calls for the Bank to help countries establish integrated energy strategies that fully exploit economically sensible energy efficiency and renewables -- which should be part of energy baselines. However, in very few cases has the Bank ensured that countries "mainstream" win-win environment into their CASs and project pipeline. If the GEF experience is any guide, there is a risk that a new CIF product line could undermine mainstreaming efforts, with the Bank viewing the CIF as a source of revenue rather than a catalyst for energy reform. Given the poor track record in complying with its own mandatory policies, can the Bank act as a credible regulator, or developer of regulatory regimes?
3. **Jumping the Gun?** To date, the international community has not agreed on methodologies needed for carbon markets or the Clean Development Mechanism to function -- determining and adjusting baselines; estimating, monitoring, and verifying emissions reductions/sequestration; accounting carbon credits and settling trades, etc. Nor has it determined how the resulting carbon offsets of IDA or foreign aid projects should be credited.
- Does the Bank propose to operate a CIF in the absence of internationally agreed methodologies? If so, what methodologies would be applied, and at whose cost? What role does the Bank propose to play in developing and implementing international methodologies, and how would these efforts be financed?

4. **Relationship to Bank Board, the GEF and other MDBs.** There are a number of unresolved questions about how the CIF will be governed and how it will related to other institutions, especially the GEF and the regional development banks. There are two concerns from USG perspective: (1) that the

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CIF not undermine other institutions, and (2) that the CIF not weaken Bank accountability to its shareholders.

- The Bank and the GEF have proposed a strategy in which the CIF would focus on short-term mitigation measures like fuel-switching, and the GEF would focus on longer term measures like renewable energy and energy efficiency. However, the CIF offers to fully fund upgrades to cleaner fossil fuel technology plus large additional cash payments, while the GEF only offers grant financing for energy project costs, and regular Bank assistance offers at best small technical assistance grants and IDA concessional loans. Bank staff may tend to prefer CIF involvement over GEF involvement for related reasons. How would these problems be addressed?
- What CIF oversight role does Bank management propose for the Bank Board? Would each project still be subject to normal Board review?

Treasury: OASIA/IDB 3/11/98

INTERNATIONAL FINANCIAL INSTITUTIONS AND CLIMATE CHANGE (Draft 2/17/98)

Importance of the International Financial Institutions

The international financial institutions (IFIs), in particular the World Bank and the regional development banks, represent one of the most promising avenues for promoting cleaner growth in developing country power sectors. Despite increasing private sector funding for large-scale LDC investments in the power sector, loans and loan guarantees by the IFIs, and the policies which guide them, continue to have a major impact on power generation projects. In many cases, private sector investors are unwilling to put their money at risk without at least some IFI involvement; so that even where IFI funding is minimal or only on the level of risk guarantee, the environmental requirements of these institutions drives the environmental baseline of the entire project. Moreover, significant IFI investment in renewable energy and energy efficiency could help speed the development of markets for these clean technologies.

The MDBs recognize these important power sector opportunities, but have had difficulty overcoming LDC resistance to power sector reform (which is clearly the number one impediment) and refocusing their own programs. Obstacles include: weak borrower commitment to policy implementation -- in particular to stated energy efficiency and climate goals; an unsuitable mix of skills among staff; a staff incentive system which favors traditional large power projects; a lack of staff accountability in enforcing environmental standards; and a failure to mainstream and rationalize climate policies. A concerted effort is needed to bring change.

Possible MDB Initiatives

The U.S. could build on its existing aggressive advocacy in the MDBs backed up by high-level Administration support, Executive Board action, and leverage through upcoming replenishment negotiations. Elements of this approach could include:

1. The World Bank Energy and Environment Strategy: The World Bank is currently developing an Energy and Environment Strategy, which provides an important opportunity to influence the Bank's programs into the next century. The strategy is likely to cover a range of issues including the Bank's approach to market-based energy policy reforms, integration of energy and environment considerations into country strategies, and investment in conventional power projects, end-use efficiency and alternative energy. We should consider urging the Bank to add consideration of climate change factors as an integral part of the new strategy. At the same time, we need to increase pressure on the Bank to effectively implement its 1993 Power Sector and Energy Efficiency policies, which many Bank task managers have treated more as best-case guidelines rather than strict lending requirements. Effective implementation of these policies would by themselves have had an extremely positive impact in reducing greenhouse gases, even though that was not their original intent. Donors and Executive Directors will need to hold the MDBs accountable -- and through them, the borrowers -- for implementing environmental policies and strategies in the mainstream lending portfolio.

We expect the next draft of the energy and environment strategy to be made available to governments in March. Participation of USG agencies with relevant technical and policy expertise will be especially important as we review and develop a US position on the strategy.

2. Country Power Sector Development Plans: The World Bank has not implemented existing policies effectively enough to base lending in the energy sector on cost-effective investments in energy conservation (including demand management and end-use efficiency) and renewables. Such policies should be incorporated into all World Bank country assistance strategies, reducing constraints on investment in energy efficiency and renewables, so that more win-win investments will be identified and financed by the MDBs and the private sector. Market sector reforms, especially elimination of subsidies for fossil fuels and support for effective energy regulatory bodies to enforce domestic regulations, should be required by the MDBs as a condition for lending to the power sector.

3. Increase Overall MDB Investment in Environment-Friendly Power Projects: Increasing availability of private financing for conventional power projects has reduced the need for MDB lending, which should provide an opportunity for the MDBs to refocus their lending on win-win investments in energy efficiency and renewable energy. Below are several approaches we could consider, ranging from more market-based to more prescriptive. These approaches are not mutually exclusive, and we may want to propose several of them to increase the likelihood of success:

- Internalization of environmental and social costs into MDB project cost-benefit analysis: The project mix in MDB power sector lending likely would shift if environmental and social costs (e.g., shadow pricing) were incorporated into the cost-benefit analysis for proposed projects, which forms the basis for the banks' project selection criteria.
- Explicit treatment of carbon impact of MDB lending: The MDBs could make systematic estimates of the carbon emission impact of their power sector lending and identify appropriate opportunities for "offset" activities. We need to bear in mind that the responsibility for financing offsets rests largely with the borrowing country.
- Mainstreaming of Global Environment Facility experience into MDB activities: The MDBs, in particular the World Bank, would benefit from greater collaboration with the GEF to finance demonstration and pilot projects in non-traditional areas. Most importantly, the MDBs need to "mainstream" the lessons learned from such pilot projects into ordinary MDB lending.

4. Bundling small projects: Renewable and energy efficiency projects are much smaller than traditional large power projects, so overhead costs can be relatively high. Bundling these projects so that the value of the loan is comparable to that of larger projects would reduce some of these overhead costs and allow the MDBs to provide the necessary international support to overcome domestic LDC obstacles.

5. Strengthening MDB staff-skill mix: We have already made a start on MDB staff skills diversification, and we need to intensify our work in this area. As noted by a draft World Bank OED report on lending to the power sector, strategies to refocus the Bank's portfolio to make it more environmentally benign will "require that Bank staff develop new expertise involving an understanding of end users, the private sector, financial markets, and new technologies." One approach would be to create a specialized unit focusing on the development of projects in energy efficiency and renewable energy (already used successfully in the World Bank's Asia department).

6. More creative use of MDB guarantees and insurance mechanisms: The MDBs' guarantee and political risk insurance mechanisms could be used more creatively to facilitate private sector, climate friendly investments in the power sector. Environmental standards in these institutions, such as the IFC and MIGA (where such standards are not as stringent as those of the direct lending institutions such as IDA and IBRD), are currently under review and could be tightened. Perceived risk is clearly an element inhibiting greater investment in energy efficiency and renewable energy. The MDBs can also help address some of the "national security" concerns that governments may have regarding privatization of their power sectors or transnational energy projects such as gas pipelines. MDB policy advice and participation in transnational projects provides comfort to private investors and governments, who know that the influence of the MDBs will be brought to bear if one of the partners makes unreasonable demands or violates an agreed contract.

7. Targeting corruption in the power sector: Corruption is an important issue in public, concession, and private operations in the energy sector with their big-ticket project components and correspondingly high stakes for sellers, governments, and consumers. All concessions, Buy-Operate-Transfer, and Power Purchase Agreements in which the IFIs participate should be awarded through "international" competitive bidding.

Negotiating Strategy

Replenishment Negotiations: MDB replenishment negotiations may provide leverage for achieving US objectives. Key negotiations include IDA-12 (1998), the MIGA general capital increase (1998), and the GEF replenishment (concludes 4/98). The draft GEF replenishment agreement calls for the World Bank to prepare in 1998 a strategy and timetable for integrating global environment activities in the Bank's policies and programs, including its country dialogue, country assistance strategies, and country economic and sector work.

Bilateral and Multilateral Contacts: Over the past decade, the U.S. more so than any other donor has pressed the MDBs on environmental and social issues, but often without support from other donors. The U.S. should begin to raise the role of MDBs in addressing climate change at every appropriate opportunity, such as the G-8 and in bilateral meetings, with a focus on Ministries of Finance and Foreign Affairs more so than Environment ministries. We should actively engage our most likely and influential allies in the current MDB context, including the Canadians, Scandinavians, Dutch, Swiss and Italians. Also key, but less likely to lend initial support, are

Germany and the UK.

BACKGROUND

Developing Country Power Sector Opportunities

Less-developed countries (LDCs) account for a large and growing share of world greenhouse emissions: 30 percent today, but over half by 2025. Clearly, no international climate initiative will be effective if these countries are not engaged. Many low-cost and even negative-cost opportunities for emissions mitigation are located in LDCs, and tapping these opportunities will be essential in finding globally efficient solutions to the global warming problem. The power sector is a logical place to start because of its importance in carbon emissions and the large scale of its projects. The discussion here reflects conversations with the World Bank, advocacy groups, and private sector contacts.

Market reforms. The elimination of subsidies, price controls, inefficient regulations, and unsound relationships between industrial and financial enterprises represents an enormous win-win opportunity in many countries. Such reforms are recognized as central by the World Bank and sit at the top of the wish list of many private energy sector groups. Many power sector improvements -- from plant design to grid management -- will follow naturally from market reforms. The central nature of market reforms puts them at the head of our agenda despite the fact that large impediments exist -- primarily within LDCs but also within the IFIs -- which have prevented significant headway in this area.

Win-Win Projects. A large number of specific projects represent win-win opportunities for action in the near term. This "low-hanging fruit" includes projects to retrofit existing plants, improve power and heat distribution, and increase end-use efficiency. Together they can significantly reduce carbon emissions. For example, estimates from the World Bank suggest that carbon emissions in China can be reduced by 300 million metric tons in 2020 through low- or no-cost opportunities.

Future Power Generation. Ultimately, LDC carbon emissions will depend on the choice of fuel generation technology. Even in the near term, the IFIs can encourage LDCs to implement advanced coal technologies and renewables at low incremental cost. In addition, early efforts to overcome the national security concerns of some countries (such as China) in relying on external sources for natural gas will provide an essential foundation for appropriate development.

Other Issues:

The World Bank Carbon Fund. The World Bank's Environment Department is actively promoting the idea of a carbon fund, where the Bank would generate (at least initially) and certify all projects; and administer (for a 5% fee) the resultant trading in carbon shares by governments and the private sector. Bank staff have indicated they believe this fund to be compatible with the proposed Clean Development Mechanism (CDM).

In our view, this initiative is inadvisable for several reasons. Perhaps most importantly, it would divert needed effort from reforming the Bank's mainstream power sector portfolio, which has a far greater potential impact on greenhouse gas emissions. It also places the Bank in a position of both generating and benefiting from carbon trading, which represents an inherent conflict of interest: the Bank would have little motivation for decreasing baseline carbon emissions in its power sector projects. Finally, the LDCs themselves appear strongly opposed to any role for the MDBs, especially the World Bank, in the future CDM; and the proposed Carbon Fund appears to have little support among other donors. For all these reasons, we should attempt to refocus the Environment Department and Bank management on addressing the larger, but ultimately more important, problems of the mainstream power sector portfolio.

MDB Lending to China. China presents special difficulties to the US as we try to use the MDBs to advance our climate change objectives. By law, the US cannot support MDB projects in China unless they are focused on meeting basic human needs, and most power sector projects do not meet this test. There are indications that Congress may restrict even further our ability to support MDB projects in China. We also need to be cautious about holding existing Chinese policies up as a model for LDC power sectors, which could limit our ability to push for actions the Chinese have resisted strongly, including privatization and increased transparency in the sector.