A Realistic Policy on International Carbon Offsets

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Summary

As the United States designs its strategy for regulating emissions of greenhouse gases, two central issues have emerged. One is how to limit the cost of compliance while still maintaining environmental integrity. The other is how to "engage" developing countries in serious efforts to limit emissions. Industry and economists are rightly concerned about cost control yet have found it difficult to mobilize adequate political support for control mechanisms such as a "safety valve;" they also rightly caution that currently popular ideas such as a Fed-like Carbon Board are not sufficiently fleshed out to reliably play a role akin to a safety valve. Many environmental groups have understandably feared that a safety valve would undercut the environmental effectiveness of any program to limit emissions of greenhouse gases. These politics are, logically, drawing attention to the possibility of international offsets as a possible cost control mechanism. Indeed, the design of the emission trading system in the northeastern U.S. states (RGGI) and in California (the recommendations of California's AB32 Market Advisory Committee) point in this direction, and the debate in Congress is exploring designs for a cap and trade system that would allow a prominent role for international offsets.

This article reviews the actual experience in the world's largest offset market—the Kyoto Protocol Clean Development Mechanism (CDM)—and finds an urgent need for reform. Well-designed offsets markets can play a role in engaging developing countries and encouraging sound investment in low-cost strategies for controlling emissions. However, in practice, much of the current CDM market does not reflect actual reductions in emissions, and that trend is poised to get worse. Nor are CDM-like offsets likely to be effective cost control mechanisms. The demand for these credits in emission trading systems is likely to be out of phase with the CDM supply. Also, the rate at which CDM credits are being issued today—at a time when demand for such offsets from the European ETS is extremely high—is only one-twentieth to one-fortieth the rate needed just for the current CDM system to keep pace with the projects it has already registered. If the CDM system is reformed so that it does a much better job of ensuring that emission credits represent genuine reductions then its ability to dampen reliably the price of emission permits will be even further diminished.

We argue that the U.S., which is in the midst of designing a national regulatory system, should not to rely on offsets to provide a reliable ceiling on compliance costs. More explicit cost control mechanisms, such as "safety valves," would be much more effective. We also counsel against many of the popular "solutions" to problems with offsets such as imposing caps on their use. Offset caps as envisioned in the Lieberman-Warner draft legislation, for example, do little to fix the underlying problem of poor quality emission offsets because the cap will simply fill first with the lowest quality offsets and with offsets laundered through other trading systems such as the European scheme. Finally,

[1] We thank Kyle Danish, Michael Levi, Chris Mottershead, Billy Pizer, and Tauna Szymanski for their valuable comments on early versions of this manuscript; errors and opinions are fully our own.

we suggest that the actual experience under the CDM has had perverse effects in developing countries—rather than draw them into substantial limits on emissions it has, by contrast, rewarded them for avoiding exactly those commitments.

Offsets can play a role in engaging developing countries, but only as one small element in a portfolio of strategies. We lay out two additional elements that should be included in an overall strategy for engaging developing countries on the problem of climate change. First, the U.S., in collaboration with other developed countries, should invest in a Climate Fund intended to finance critical changes in developing country policies that will lead to near-term reductions. Second, the U.S. should actively pursue a series of infrastructure deals with key developing countries with the aim of shifting their longer-term development trajectories in directions that are both consistent with their own interests but also produce large greenhouse gas emissions reductions.

INTO THIN AIR

After years of indecision, the United States is on the verge of adopting substantial limits on its emission of greenhouse gases. Federal legislation to cap U.S. emissions is under consideration in both houses of Congress. Many states are already far advanced on their own schemes. All the presidential contenders promise vigorous action on the problem. At the same time, the U.S. has been playing a more active and constructive role in international negotiations. The Bush administration signed the Bali Roadmap for international climate negotiations under the United Nations Framework Convention on Climate Change (UNFCCC) while also attempting to build other, complementary international systems to coordinate climate policies. The G8 has the climate issue at the top of its agenda every year. The central question in America's policy debate is no longer "if" the country will regulate greenhouse gases; rather, today's questions center on "how."

Two key political issues that drive features of any U.S. market-based system are cost-control and engagement with the rest of the world, especially developing countries. A precondition for achieving both objectives is maintaining the environmental integrity of the system. Most debates over cost control focus on the designs for a cap-and-trade system and levy special attention on various schemes to put a ceiling on emission prices because such schemes make it possible to assure industry that the cost of buying needed emission credits won't be excessive and will be predictable. The experience in the European carbon Emission Trading Scheme (ETS)—where prices have been unpredictable—has kindled interest in such devices since it will be hard to plan compliance when the cost of emission credits is unknown and highly variable.[2] Developing country engagement, especially with key trading partners such as China and India, is essential in order to insure that the U.S. doesn't fix the problem at home only to find that "free riders" on U.S. climate policy efforts in the developing world enjoy its benefits without actually changing their own behavior as well. Real climate policy must contend with many other factors, such as setting the overall level of emissions and allocating the emission credits, but cost control and engagement for developing countries lie at the center of any politically viable plan to control U.S. emissions.

To date, both have been addressed primarily using one tool – carbon offsets.[3] International carbon offsets have been thought to be a "win-win"solution in that they offer developed countries a source of low-cost emission reductions and offer developing countries a source of funding to alter their development paths to a climate friendly orientation. Indeed, the architects of the European Union ETS have embraced both those goals and allowed extensive use of offsets.[4] Economic modeling of proposed cap-and-trade bills in the United States has shown that, theoretically, offsets have the

[2] David G. Victor and Danny Cullenward, *Making Carbon Markets Work*, SCIENTIFIC AMERICAN, Sept. 24, 2007.

[3] The greatest experience to date is with the EU ETS, where cost control is accomplished via offsets. The Liebermann-Warner bill accomplishes cost control via a mix of domestic offsets and "international credits." International credits are defined in the bill as allowances from other cap-and-trade schemes. If such schemes allow for the use of offsets, as in the EU, then this provision amounts to laundering of offsets via prior conversion into another nation's carbon "currency." Thus, cost control in that bill is also via offsets, both directly and indirectly. *See*, S. 2191, 110th Cong. § 2501 (2008).

[4] Although recently released draft guidance on the EU ETS for the post-2012 period indicates that the European Commission has grown substantially less enthusiastic about the use of offsets for cost control purposes, mainly because of a desire to foster domestic abatement. *See* Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community, 2008/0013 (COD) at 26, *at* http://ec.europa.eu/environment/climat/emission/ets_post2012_en.htm.

potential to allow sharp reductions in costs.[5] At the same time, there is nearly unanimous support from developing countries and development banks applauding the ways that offsets channel funds to developing countries.[6]

Our argument is that the theoretical benefits of lower costs and broader engagement of developing countries through the extensive use of offsets are an illusion. They are based on the assumption that it is possible to administer an offsets system so that it rewards only bona fide reductions. This assumption is valid for only a fraction of the real offsets market.

We make the case by looking to the world's largest existing offset market, the UNFCCC's Clean Development Mechanism (CDM). Many studies have shown that this market is far from perfect.[7] We will document the fuller extent of its flaws. At root, the CDM and other offset schemes are unable to determine reliably whether credits are issued for activities that would have happened anyway while also keeping transaction costs under control and assuring investor certainty. We will document some ways to tighten the CDM rules, but we will also underscore that the CDM is structurally unable to engage developing countries in ways that would actually make a dent in emissions. We will also show that the administration of CDM makes it a very poor cost control mechanism because credits are issued only after long delays and in unpredictable quantities; the cost and response in generating CDM credits beats to drummers that are, at best, poorly attuned to what is needed for an effective cost control mechanism. Because of the need for stringent and complex regulatory oversight, offset markets cannot respond quickly to a price shock in cap-and-trade markets they serve.[8] As a consequence, other simpler cost control schemes, such as an explicit safety valve, are likely to be much more effective.

Nevertheless, experience with the CDM suggests that international carbon offsets will have an important role to play in engaging developing nations in the project of climate change. But close study of outcomes in the CDM strongly suggests that the role that project-level offsets plays should be more limited than at present, and that a variety of other incentive programs will be required in order to both

[5] Recent EPA analysis estimates that the inclusion of offsets and international credits in the Liebermann-Warner bill reduces the predicted allowance price for capped sectors from $77 to $40 in 2015. US ENVIRONMENTAL PROTECTION AGENCY, EPA Analysis of the Liebermann-Warner Climate Security Act of 2008, S. 2191 in 110th Congress (March 2008); US ENVIRONMENTAL PROTECTION AGENCY, EPA Analysis of the Climate Stewardship and Innovation Act of 2007 (July 2007); US ENERGY INFORMATION ADMINISTRATION, Energy Market and Economic Impacts of S.280, the Climate Stewardship and Innovation Act of 2007, Report #: SR-OIAF/2007-04 (August, 2007); S. Paltsev et al., Assessment of U.S. Cap-and-Trade Proposals, MIT Global Change Joint Program Report 146 (April 2007, updated February 2008); Richard G. Richels et al., Managing the Transition to Climate Stabilization, AEI-Brooking Joint Center Working Paper No. 07-01 (January 2007).

[6] Karen Capoor and Phillippe Ambrosi, World Bank Carbon Finance Unit, State and Trends of the Carbon Market 2007 (May, 2007); PointCarbon, Carbon 2007 – A New Climate for Carbon Trading (March, 2007).

[7] Lambert Schneider, Oko-Institut e.V., Is the CDM fulfilling its environmental and sustainable development objectives: An evaluation of the CDM and options for improvement, prepared for WWF (November, 2007); Barbara Haya, International Rivers Network, Failed Mechanism: How the CDM is subsidizing hydro developers and harming the Kyoto Protocol (November, 2007); Axel Michaelova and Pallav Purohit, Additionality Determination of Indian CDM Projects: Can Indian CDM Project Developers Outwit the CDM Executive Board (2007); Michael Wara, Is the Global Carbon Market Working?, 445 NATURE 595 (2007).

[8] It is possible that offsets might have short-term stabilizing effects even if their supply can't respond to price volatility because in the presence of banking, they will increase the willingness and lower the costs of borrowing allowances from future trading periods. However, borrowing against future offset delivery can only work if future deliveries are themselves predictable. Because future offset supplies themselves are likely to be uncertain, borrowing costs would likely be extremely high.

insure that U.S. funds are used cost-effectively and to produce real change in developing nation emissions of greenhouse gases (GHGs). Ultimately, the experience from the global offset market points to a niche role for offsets both as a tool for cost control within cap-and-trade systems and as one of a portfolio of tools for engaging developing nations in the problem of climate change.

THEORY AND PRACTICE: STORIES FROM A REAL CARBON OFFSET MARKET

The Kyoto Protocol is one of the most complex multilateral environmental agreements ever negotiated. At its core was a bargain between developing countries (whose participation is essential to any long-term effort to control emissions) and developed countries (who accepted binding limits on emissions). That core deal was cemented with flexible compliance mechanisms involving carbon offsets generated either in economies in transition (so-called "joint implementation, JI") or in the developing world (so-called "clean development mechanism, CDM"). Of these alternative compliance mechanisms, the CDM has become by far the largest emissions offset market ever created. The JI market (involving emission credits from Russia, Ukraine and the other economies in transition) will play a role in compliance for some nations, but current estimates are that the CDM will be nearly ten times larger in both volumes produced and financial values during the Kyoto Protocol's compliance period (2008 to 2012).[9] At the same time, the enormous diversity of projects participating in the CDM when compared to JI and the special circumstances of the Russian and Ukrainian economies makes CDM a more representative offset market for considering the likely impacts of U.S. participation in a post-Kyoto global carbon market. Finally, many of the rules for JI implementation have been copied wholesale from the CDM. If one wants to study offsets in the real world, one studies CDM.

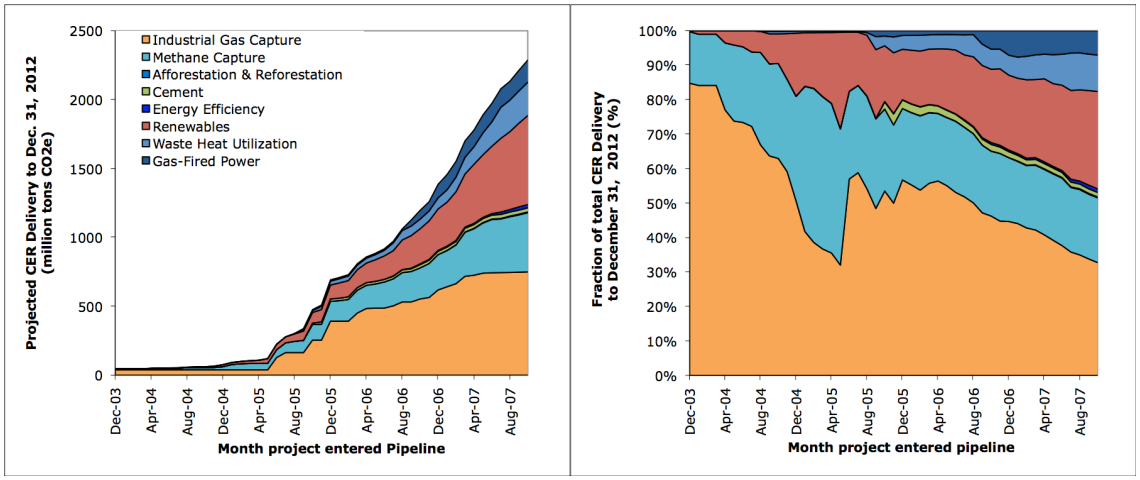
The growth of the CDM has been truly extraordinary. In 2007, the value of the CDM market totaled €12 billion, more than triple the previous year's figure.[10] The CDM project pipeline has grown in four years from essentially nothing to more than 3000 projects either registered or in the process of achieving the necessary regulatory approvals. The project design documents for these projects together project that the CDM market will deliver more than 2.2 billion CERs to the end of the Kyoto Protocol's compliance period (see Figure 1).

Certified Emission Reductions (CERs) are the CDM's currency—they are the measure of the quantity of emissions that has been avoided ("offset") by CDM projects. If all of those CERs bubbling through the pipeline actually come to fruition, and if they represent real emissions reductions, then the CDM would be the largest source of GHG reductions produced by the Kyoto Protocol. It is instructive to look at the role of CERs in the European Union's Emision Trading Scheme, for that system is the largest source of global demand for CERs. While it is difficult to make a precise assessment, on current trajectories, import of CERs could account for up to ten times the actual reductions of emission reductions from within the EU cap-and-trade. Total required reductions to meet the limits under the EU's ETS during the 2008-2012 period are expected to be about 700 million metric tons ("tonnes") of CO_2-equivalents, of which perhaps only a small percentage would be accounted for through actual reductions within EU borders. The EU, to be sure, is making a serious effort to control emissions at home, but those emission controls are proving much more costly than importing CERs. The EU member states have adopted allocation plans that could, in theory, allow all their "reductions" under the

[9] CDM projects now registered or in the process of becoming registered are projected to supply 2.6 billion CERs to 2012 while JI projects are projected to supply less than 0.2 billion ERUs. *See* Jørgen Fenhann, UNEP-Risø Centre, CDM-JI Pipeline Database, *at* http://www.cdmpipeline.org.

[10] PointCarbon, CDM-JI Monitor, 23 January 2008, pg. 6.

ETS to be met with CERs, although we do not expect that extreme outcome to occur for reasons we will discuss below. [11]



a. b.

Figure 1: Participation in the Clean Development has grown explosively over the past four years. Shown in (a) is the projected volume of Certified Emissions Reductions (CERs) delivered to the end of the Kyoto Protocol as a function of time. Different colors indicated different project types. Shown in (b), the same data, but expressed in percentage terms. Early on, industrial gas capture projects, most notable HFC-23 capture projects, dominated the supply of credits. More recently, renewable power and natural gas-fired power projects have been growing in importance.[12]

In the next section, we will illustrate that many of these reductions could have been accomplished at a far lower price; that many credits are probably not backed by real reductions; and that the promise of such a massive supply of credits is extremely unlikely if even the current (poor) level of environmental quality of the program is to be maintained. Our three stories point to the need for reform within the CDM but also for the inclusion of multiple new tools for engagement with the developing world in both U.S. climate policy and any post-Kyoto international architecture. They also

[11] The rules set for the National Allocation Plans for individual European nations allow substantial imports of CERs, potentially in excess of required cuts below business as usual emissions. Verified emissions in 2005 and 2006 averaged about 2.2 billion tonnes. Required reductions from this level to meet the cap in the 2008-2012 period will average 133 million tonnes per year, but allowed imports of CDM and JI credits total 278 million tonnes per year, allowing for a net increase of emissions within the EU ETS compensated by reductions in developing countries. At the same time, early indications are that greenhouse gas emissions within the EU ETS actually increased in 2007, by approximately 1%. *See*, Lambert Schneider, Is the CDM Fulfilling its Environmental and Sustainable Development Objectives?, Öko-Institut e.V. Report Prepared for WWF (Nov. 5, 2007); *EU ETS emissions likely to have increased in 2007: CITL Data*, POINTCARBON, April 2, 2008.

[12] Data courtesy of Jørgen Fenhann, UNEP-Risø Centre, CDM-JI Pipeline Database, *at* http://www.cdmpipeline.org.

point to the need to limit the dependence of a U.S. cap-and-trade scheme on cost control derived from the CDM or other offsets program.

a. *HFC-23: end of pipe activities, perverse incentives, and overpayment*

The early history of the CDM is primarily the story of an obscure gas called trifluoromethane or HFC-23. This gas is a potent GHG and is produced mainly as a waste product during the manufacture of another gas (HCFC-22). The HCFC-22 is used in some air conditioners and as a feedstock for high performance plastics; it is a partial replacement for other gases that are being phased out because they harm the ozone layer. HFC-23 is 11,700 times more potent a greenhouse gas than CO_2. Projects that cut HFC-23 emissions are extremely valuable because they generate enormous volumes of carbon offsets, or in the CDM's terminology, Certified Emissions Reductions (CERs) at very low cost. In the early development of the carbon market, these projects made up the bulk of emissions reductions. (See Figure 1). They also accounted for the vast majority of financial value in the nascent, rapidly growing CDM market in 2004-2006 that sparked early excitement about carbon offsets as an investment opportunity.

The costs of capturing and destroying HFC-23 at refrigerant plants are non-zero but extremely low. In the U.S. and Europe, many factories producing this waste gas have since the 1990's voluntarily eliminated their emissions of HFC-23.[13] In the developing world by contrast, until the CDM, refrigerant factories simply vented this potent GHG. Because of the low costs of destroying the gas and its high potency, initially it was thought these projects would be ideal offset projects for the CDM scheme. At the same time, our work along with the highly successful fund within the Montreal Protocol on the ozone layer (which funded an analogous phaseout of industrial chemicals) suggested that these types of emissions should be handled outside of the Kyoto market system via a dedicated fund.[14]

Unfortunately, close scrutiny of the economics of HFC-23 projects revealed that they were, in many senses, too good to be true. Our work[15] and the work of others[16] showed that the sale of carbon credits generated from HFC-23 capture is far more valuable than production of the refrigerant gas that leads to its creation in the first place. Thus, refrigerant manufacturers were transformed overnight by the CDM into ventures that generated large volumes of CERs, with a sideline in the manufacture of industrial gases. In response to these perverse incentives, the CDM Executive Board implemented a number of restrictions that limited, but failed to eliminate, the perverse incentive to produce refrigerant in order to produce waste HFC-23, capture this waste, and so create enormous quantities of CERs.

In the case of HFC-23 abatement, the CDM was also a startlingly inefficient means for

[13] Indeed, technologies developed and deployed voluntarily in U.S. plants are the same as those that have been adopted in the CDM. A. McCulloch, *Incineration of HFC-23 Waste Streams for Abatement of Emissions from HCFC-22 Production: A Review of Scientific, Technical and Economic Aspects*, 18 (2005) *at* http://cdm.unfccc.int/methodologies/Background_240305.pdf (last visited April 14, 2008).

[14] David G. Victor and Gordon J. MacDonald, *How to Make Kyoto a Success*, 389 NATURE 777 (1997); David G. Victor and Gordon J. MacDonald, *A Model for Estimating Future Emissions of Sulfur Hexalfuoride and Perfluorocarbons*, 42 CLIMATIC CHANGE 633 (1999).

[15] Michael Wara, The Performance and Potential of the Clean Development Mechanism, PESD Working Paper #56 (2006), *available at, http://pesd.stanford.edu/cdm.*

[16] UNEP Technical and Economic Assessment Panel, Response to Decisiion XVIII/12, Report on the Task Force on HCFC Issues (with particular focus on the impact of the Clean Development Mechanism) and Emissions Reduction Benefits Arising from Earlier HCFC Phase-Out and Other Practical Measures (August 2007).

achieving emissions reductions in the developing world. Payments to refrigerant manufacturers, the Chinese government (which heavily taxes these CDM projects), and to carbon market investors by governments and compliance buyers will in the end total approximately €4.7 billion while estimated costs of abatement are likely less than €100 million. Given limited funds to invest in developing world climate abatement, we conclude that there is a need for mechanisms to access extremely low-cost emissions reductions via more cost-effective mechanisms. Elsewhere we have outlined such systems, which could include a project fund such as was done in the highly successful multilateral fund under the Montreal Protocol on Substances to Deplete the Ozone Layer.[17]

b. Beyond HFCs: the new CDM market

Over the last two years, awareness of the HFC-23 problem has grown and governments have tried to clamp down on these projects. By stemming the flow of HFC-23 credits while encouraging growth in other types of offset projects, it was thought, the CDM would at last encourage investment in activities that would deliver more fundamental changes in technology, leading to reductions in emissions. For example, it was thought that countries would invest in new energy systems that had much lower carbon emissions. Indeed, the CDM market has shifted, as shown in Figure 1—today, HFC-23 projects account for less than half of projected project deliveries, and that fraction is declining. The good news, in theory, is that most of the growth in CDM has been outside the HFC-23 sector (and projects involving other industrial gases with similar drawbacks). The bad news is that these new projects reveal even deeper problems with the CDM mechanism—problems that, for projects that could theoretically deliver the largest reductions in emissions, can't be fixed.

We focus our discussion on China because it is the most important developing nation in terms of GHG emissions and because current market trends indicate that more than half of all emission credits will likely originate in reduction projects based there.[18] We focus on the energy sector because it is fundamental to making a dent in GHG emissions and because it is where the fastest growth in the Chinese CDM pipeline is occurring. Energy projects are crucially important, and under the current rules such projects offer the greatest potential for future growth in the CDM.

In China, coal-fired power plants generate approximately 80% of all electric power. Most of the existing plants are older, inefficient designs, but most new plants being built are state of the art. And China is building new power plants at a truly astonishing rate. During each of the past two years, approximately 100 GW of new electric generating capacity was constructed in China; rapid buildout of coal plants is expected for the foreseeable future in the country.[19] The astonishing rate of growth is equivalent to building the entire U.S. power plant fleet in less than a decade.[20] This new demand has put enormous strain on China's coal supply system, including its mines and railroads, as evident in the spate of blackouts in January. After many years as a coal exporter, China is now a net importer of coal.

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[17] Michael Wara, *Is the Global Carbon Market Working*, 445 NATURE 595 (2007); RICHARD ELLIOT BENEDICK, Ozone Diplomacy: New Directions in Safeguarding the Planet, (2nd ed., Harvard University Press 1998).

[18] As of January 1, 2008, 53% of CERs issued to 2012 will be created in China, assuming that all projects currently undergoing validation are registered. Jørgen Fenhann, UNEP-Risø Centre, CDM-JI Pipeline Database, *at* http://www.cdmpipeline.org.

[19] On the rate of power plant construction in recent years see: Keith Bradsher, *China's Green Energy Gap*, NEW YORK TIMES, October 24, 2007. For projections see International Energy Agency, 2007, *World Energy Outlook 2007* (Paris: IEA).

[20] The U.S. power plant fleet had a total nameplate generating capacity of 955 GW in 2006. *See* Energy Information Administration, Annual Energy Outlook 2008 (Revised Early Release).

In addition to unreliable power, combustion of coal with dirty technologies contributes to the country's soaring rates of childhood asthma and the other ills of air pollution.

In response to these problems, the Chinese government has implemented a series of policies to both reduce the country's dependence on coal and to reduce the environmental impacts of electricity generation. China's current five-year plan, in fact, calls for major investments in hydro, wind, nuclear[21], and natural gas-fired power in order to diversify away from excessive reliance on coal. A 4,000 km long pipeline from the country's western gas fields to the booming cities in the east has been completed. A second, even larger pipeline is now under construction. In 2006, a Renewable Energy Law entered into force that provides strong financial incentives for development of new wind farms in China and sets explicit capacity expansion goals for the wind sector. Since 2004, China has been on a dam building spree, with 10 GW of new hydro power plant capacity being completed each year.

These changes in China's goals are evident not only in energy policy but also in China's CDM projects. Today, as illustrated in figure 2, essentially all new hydro, wind, and natural gas fired capacity is applying to claim credit for emissions reductions under the CDM. These power plants are at least potentially eligible for the difference between their emissions and the electricity they "displace" on the Chinese electricity grid. Under the rules of the CDM, each new dam, wind farm, or natural gas power plant applies individually and makes the argument that it would not have been constructed but for the financial incentives produced by the sale of carbon offsets.

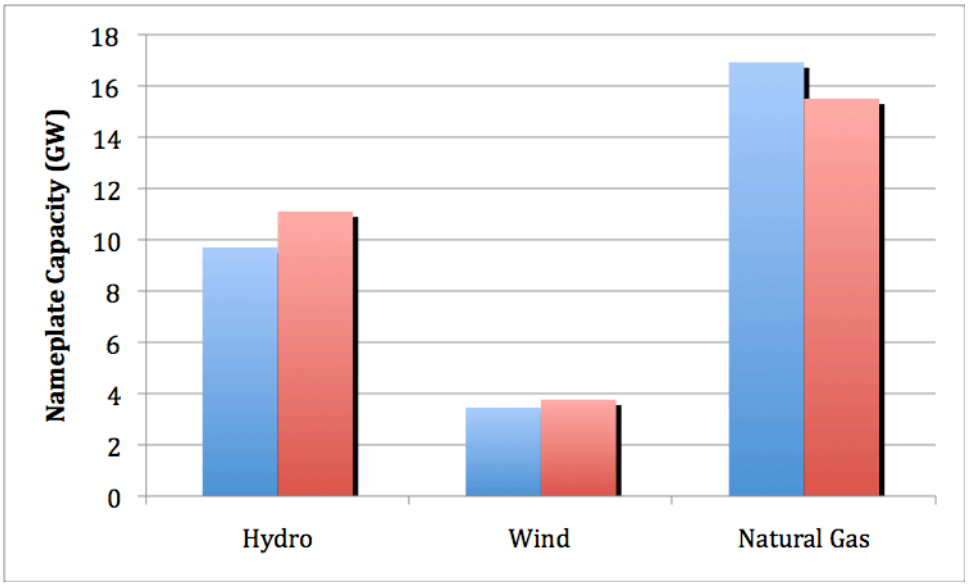

Figure 2: Hydro, wind, and natural gas fired power plants built or under construction in China compared to applications for CDM crediting for these projects. Essentially all new capacity (blue bars) is applying for CDM offset credit (red bars). Issued credits are based on the difference between these new energy sources and the Chinese grid GHG emission intensity. Shown are new capacity and CDM applications for Chinese hydro and wind power in 2007, and for natural gas-fired power in 2005-2008.[22]

[21] Nuclear power, although a source of low-carbon energy, is ineligible to participate in the CDM under the current rules.
[22] Hydro and wind CDM applications exceed new capacity additions in part because some plants applying for credit in 2007

Taken individually, these claims may make sense—because, individually, any particular power plant utilizing non-coal sources of energy probably faces greater hurdles than new coal-fired generation or may be financially marginal, and the ability to sell CERs offers the prospect of being able to compete toe-to-toe with coal.[23] Taken collectively however, these individual applications for credit amount to a claim that the hydro, wind, and natural gas elements of the power sector in China would not be growing *at all* without help from CDM. This broader implication is simply implausible in light of the state policies described above. That so many plants would come forward to claim credit as marginal indicates systemic problems with the CDM project evaluation and approval process. These problems are probably just the beginning, as efforts are under way to apply a methodology that would allow investors to gain credit for installing more efficient "supercritical" coal-fired power plants in China—despite the fact that many such plants are already being built without CDM credits and such plants are probably cost-effective in many Chinese power markets on their own.[24]

These problems are not peculiar to the Chinese context. They reflect a fundamental challenge in any offset system. The host governments and investors that seek credit have a strong incentive to claim that their efforts are truly additional. The regulator—in this case, the CDM Executive Board—can't in many cases gather enough information to evaluate these claims. These problems of asymmetrical information are compounded in the CDM, to be sure, because the CDM Executive Board is massively under-staffed and the CDM system relies on third-party verifiers to check the claims made by project proponents. In practice, these verifiers, who are paid by the project developers, have strong incentives to approve the projects they check. Further, there is scant oversight on the integrity of the verification process and no record of punishing verifiers for misconduct. Lacking any other source of information about individual projects and facing pressure from both developing and developed country governments, the CDM Executive Board is prone to approve projects. Asymmetries of information are rampant; the incentives mostly align in favor of approval.

This challenge is made all the more formidable by the sheer number of projects upon which the Board must decide. The CDM EB, on average, registers about one project every day as eligible to generate CDM credits. Thus the Board cannot afford to spend large amounts of time evaluating the complexities of financial data presented to justify a project's eligibility for CDM credits nor can it delve into a project's relationship to state energy policy. Furthermore, the CDM EB faces a financial limit on the costs it can reasonably impose on individual offset projects. In order to remain viable, relatively small carbon offset projects cannot afford the cost and uncertainty that would accompany truly extensive scrutiny. Indeed, there is strong pressure from CDM investors to limit such transaction costs and speed up approval.

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were built earlier and in part because some plants that applying for credit experienced construction delays. Data Sources: National Development and Reform Council; International Gas Union; International Energy Agency; Jørgen Fenhann, UNEP-Risø Centre, CDM-JI Pipeline Database.

[23] Additionality within the CDM is evaluated in a variety of ways. Projects show they are additional by comparing the proposed activity to what is required by regulation, to what is the most financially attractive activity under the applicable circumstances, and by assessing any other barriers to implementation of the project.

[24] In September, 2007, the CDM EB approved a methodology for crediting supercritical and ultra-supercritical coal fired power plants. *See* http://cdm.unfccc.int/methodologies/DB/C7O6IUA9OTNRUK4X619VX2A6OS4DU7/view.html. China has also been pushing construction of these plants as a response to the severe shortages of coal in southern China. *See* Information Office of the State Council of the People's Republic of China, China's Energy Conditions and Policies, (December 2007); *See also*, Keith Bradsher, *China's Green Energy Gap*, NEW YORK TIMES, October 24, 2007.

It is hard to see how any offset system can dramatically reduce these problems of asymmetrical information, distorted incentives and transaction costs. One proposal, now being embraced cautiously within the CDM system, is to allow for so-called "programmatic" initiatives—that is, to offer credits for broad policy reforms or for clusters of activities within whole sectors, rather than on a project-by-project basis. This approach would cut transaction costs and, in theory, allow for greater scrutiny. For many offset project types, however, information asymmetries are likely to be pervasive. Indeed, if the current system is unable to assess whether the current large projects in gas, hydro and renewable power in China are truly additional in their promised emission reductions it is hard to see how a programmatic approach would be much different for these types of projects. Such problems are likely to recur for any large-scale carbon offset regime, domestic or international, that operates at the relatively fine-grained level of the individual emission reduction project, at least in sectors where additionality determinations are particularly challenging.

Our paper focuses on international offsets, but we caution that these problems are unlikely to be substantially different for a domestic offsets program—such as a scheme to allow offset credits through changes in land use. A conventional wisdom has emerged that land use changes and other highly dispersed sources and sinks should be handled in a domestic climate policy through the use of offsets because these sources are too difficult to monitor or regulate with the precision needed for full-blown inclusion within the cap-and-trade. However, offsets carry enormous costs due to the difficulty of determining additionality, which is a problem magnified by the asymmetrical incentives that are intrinsic to an offsets system. The offsets approach encourages project hosts to gain credit when net emissions happen to be declining (whether or not they are actually declining due to some additional effort) but leaves the source unregulated when net emissions are rising. For certain discrete projects, such as changes in land use and some methane reduction projects, an offsets system could play a useful transition role because the cost of certifying individual projects may be lower than tracking all emissions from the sector.[25] However, we are mindful that offsets systems create asymmetrical incentives that encourage only some activities to "opt in" to regulation while leaving other emissions unchecked; a domestic regulatory system, like an international system, should move as rapidly as feasible towards including all sources and sinks under a cap.

c. The Credit Issuance Bottleneck

So far we have outlined the early troubles with HFC-23 and today's more disturbing troubles in identifying whether important energy projects are yielding actual reductions in emissions below the level that a developing country would have experienced in the absence of the CDM project. These are daunting problems. But a third challenge is looming. To date, more than 950 individual carbon offset projects have achieved registration in the CDM, the final step after which credits can be generated. A further 2000 projects are at various stages of seeking registration. But registration of large numbers of projects is not the last hurdle that a project must overcome. Registered projects must operate and produce actual reductions in emissions that are then verified, leading finally to issuance of CERs by the EB.

This final issuance process is the key to the CDM fulfilling its role as a mechanism for generating supplies of emission credits and thus containing the cost of compliance. To date, the CDM has not shown that it is up to this task. Early indications are that this final bottle-neck in the process

[25] Daniel S. Hall, Issue Brief 15, Offsets: Incentivizing Reductions while Managing Uncertainty and Ensuring Integrity, *in* Assessing U.S. Climate Policy Options (Raymond Kopp and William Pizer eds., Resources for the Future, 2007).

may prove the undoing of both the companies that are promising to supply CERs to the European ETS (the largest source of demand for CERs today)[26] and to the firms that must comply with ETS limits and are counting on the availability of CERs to help reduce the cost of compliance. [27]

As of this writing, the CDM EB has issued almost 130 million CERs, in response to slightly less than 550 individual requests for issuance. These issuances occurred over a period of approximately 2 years. Almost half of the CERs come from 11 HFC-23 reduction projects that request large blocks of credits every six weeks to two months. The remainder originated from a much larger number of small projects that request issuances of much smaller volumes of credits on a semi-annual or annual basis. But this fifty-fifty split is not representative of the pipeline as a whole, where HFC-23 projects make up just a quarter of projected volume and more than 900 smaller projects make up the remainder. Given the pattern of issuance requests to date, in order to actually issue CERs from all registered projects, the CDM EB will likely have to respond to between 5 and 10 thousand issuance requests, depending on whether they come annually or bi-annually over the next five years. This is between 20 and 40 times the rate at which issuance has been occurring. If additional projects are registered, and there are approximately 2000 that are in the process of achieving registration, then the required rate of issuance must be even higher. Assuming the proportions of project types stay about the same, the actual rate of issuance by the CDM EB is only about 1% to 2% of the actual rate needed to issue all the CERs in the CDM pipeline in a timely manner.

The necessary level of issuance will be extremely difficult to achieve for two related reasons. The first is that there is a lack of additional capacity on the part of third-party verifiers to do the verification audits and certifications that are a precondition for issuance of credits in the CDM. Third-party verification teams take substantial amounts of time to train and so adding additional capacity will be a slow, incremental process. Furthermore, there is a constant brain drain from verification firms to project development firms, which can offer substantially better compensation to these key personnel. Putting more pressure to boost the supply of third-party verification will probably just worsen the already endemic problem that verifiers lack the right incentives to focus on quality. Second, many project proponents have complained that the CDM is slow to respond to the current level of requests for issuance of credits, even when third-party verification has been done. Thus the CDM EB is apparently also stretched thin by current demands on its attention, let alone more than ten times the level of requests for decisions.

The looming bottleneck in CER supply points to a more general characteristic of carbon offset programs. In order to insure their environmental credibility, offset programs must incorporate stringent regulatory review to ensure that projects represent real reductions; such oversight is, by necessity, much more stringent than in a cap-and-trade system where individual trades needn't be reviewed for their integrity. These multiple hurdles, by their very nature, generate risk that projects will fail to generate the level of expected emission credits. They also create substantial potential for lags between

[26] On February 21, 2008, AgCert, one of the first of the CDM project developers to list publicly on the London Stock Exchange, went into receivership because of an inability to produce adequate supplies of CERs to meet its commitments to compliance buyers. *See*, *Trade in Agcert shares suspended, company seeks government protection*, POINTCARBON, Feb. 21, 2008.

[27] It's important to note that most CERs are traded on a forward basis and that compliance buyers within the EU ETS do not need to have CERs in hand until April 30, 2013, the compliance deadline for the second phase of trading. Our point is that physical settlement of these forward trades will require issuance of CERs sufficient to meet the contracted demand.

the demand for credits and their credible supply. Even in the presence of strong demand for credits due to a price shock, a carbon offset scheme that is designed to ensure strong environmental credibility will be unable to mobilize the credits necessary to assure cost-control on a time scale that is economically relevant. Indeed, phasing differences between demand and supply introduced by these regulatory controls could actually cause offset schemes to magnify volatility in cap-and-trade systems. At the same time, high prices in a cap-and-trade scheme are likely to create strong political pressure to loosen the rules and grease the wheels of issuance, thus potentially undermining a key component of an offset system's environmental effectiveness.

Far from being a credible means of containing costs, real-world carbon offset schemes such as CDM are likely to provide relatively uncertain, relatively unstable flows of offsets, leading to highly imperfect cost-control. Experience under the CDM suggests two reasons for this outcome. First, persistent doubts about the additionality of offsets will be impossible to resolve practically in important sectors due to the severe information requirements needed to reach defensible conclusions for approving projects, the weak incentives to provide that information, and the high transaction costs of gathering it. Second, in any system designed to assure high quality—a standard that CDM is far from meeting—there are likely to be continuing risks that supply will not meet demand in a timely or continuous fashion and pressure to lower quality in order to meet sudden increases in demand. Third, most of the analysis and debate to date have concentrated on the ways that offsets such as CDM can contain costs in an emission trading system and have assumed that demand will be high and thus developing countries that host such projects will necessarily earn useful revenues. But mismatches in phase suggest that there will periods when prices crash, and in those settings developing countries will rightly wonder whether CDM-like systems are a useful way to be "engaged" in the global effort to control emissions.

Several conclusions follow from these observations. Among them is that offsets are likely to be a poor primary mechanism for cost control. If the architects of cap-and-trade systems want cost control they should rely mainly on mechanisms that control costs directly—rather than schemes that, by design, work with different phasing. Relying on an offsets system for cost containment will create strong pressures when markets are tight to relax the rules, such as by adopting looser rules for registration and issuance—such rules will not only indirectly erode environmental integrity but will also create expectations that will be hard to roll back.

DOWN TO EARTH: LEARNING FROM EXPERIENCE

a. Cost control

To date, discussions of cost control have focused on the theoretical ability of offsets to provide additional supplies of emission credits and thus contain compliance costs. Many constituencies oppose an explicit safety valve because they fear that it would set a price level that is too low, and that the additional credits issued through the safety valve will undermine the environmental integrity of the emission cap. At the same time, these same groups have been more supportive of emission offsets as a way to contain costs while also ensuring environmental integrity. We suggest that this enthusiasm is misplaced because any offset market of sufficient scale to provide substantial cost-control for a cap-and-trade program will involve substantial issuance of credits that do not represent real emissions reductions.

Offsets are a poor substitute for an explicit cost control mechanism. The simplest and most transparent mechanisms for cost control would impose direct limits on the allowable price of emission credits. Price ceilings, perhaps in combination with other instruments such as price floors, could be applied by direct adjustment of the supply of allowances available to the market; adjusting supply, in turn, would affect scarcity and hence prices. A system that is aimed at a single goal and designed for that purpose would be more effective than relying on offsets to play this role. Already, the CDM offsets market has not created a predictable limit on prices in Europe; prices are lower, but the presence of the CDM has not improved the predictability of prices or even, perhaps, reduced volatility in the ETS. Moreover, the long and uncertain path from project investment to CER issuance makes it difficult to rely on the CDM, or any other offset mechanism with an elaborate regulatory oversight system, to deliver emission credits in the timely way needed for reliable cost control.[28]

b. Engagement with Developing Countries

Engagement with developing countries on the problem of global warming is critical both for realizing the great potential for reducing global emissions of greenhouse gases at an acceptable cost and for ensuring that, in time, all countries impose some level of required effort on their economy. This test is politically very important as part of a viable U.S. policy, not least because some of the largest emitters are major economic competitors of U.S. firms.

We doubt the CDM is an effective means of engaging developing countries for two reasons. First, fundamentally, the CDM works mainly by encouraging countries to avoid broader commitments and thus rewards exactly the opposite behavior that should govern the long-term efforts to build an effective regime for regulating emissions of greenhouse gases. Second, the CDM does not seem to be working well.

These problems will be difficult to fix; yet some more effective scheme for engaging developing countries will be essential. We propose a two-pronged approach, while recognizing that there may be other fruitful additional tools that could be applied to the problem of developing country emissions. First, the CDM needs to be tightened and focused on activities where it is likely to be most effective. The U.S. can play an important role here since it is potentially the largest buyer of credits. Second, the U.S. and other western countries should focus on better engagement strategies. Our proposal for a better engagement strategy would have two elements—both intended to engage developing countries on the activities that are most likely to yield large reductions in emissions. The first element would be an explicit funding mechanisms to support projects and activities that do not lend themselves to the emission credits (and thus carbon finance through offsets) but are nonetheless environmentally effective and cost-effective. Explicit funds are thought to be politically toxic, which is partly why politicians have embraced CDM-like carbon finance—because they think it hides the real size of financial transfers. But that conventional political wisdom rests on the incorrect assumption that carbon finance has been effective or, indeed, itself transparent. The other element is a series of creative bi-lateral agreements on key technological and infrastructural investments that would help key developing countries shift to wholly new development paths that are more climate friendly. These deals would be tailored to particular circumstances and might involve actions far outside the realm of

[28] It's worth noting that one oft cited reason for avoiding a safety-valve, namely that it complicates linkage with other cap-and-trade schemes such as the EU ETS applies equally to systems that utilize offsets. If two schemes with un-harmonized offset provisions are linked, then prices and domestic abatement will fall in the more stringent of the two programs until they equalize with the less stringent system. Because cap-and-trade systems in effect create a carbon currency, Gresham's Law applies – bad money drives out good.

usual climate diplomacy; because they would be complex they must be limited in number and concentrate, initially, on the most important countries. Both approaches—a better CDM and a new engagement strategy—would work together. The former would encourage carbon finance where such projects would be credible and could yield legitimate carbon credits. The latter would help put developing countries on better trajectories so that, in time, they adopted binding limits on emissions and were confident of their ability to implement those limits.

1. Tighten the CDM

As has been described above, the CDM, as currently structured, has serious problems with both the cost-effectiveness of its interventions in developing countries and with the credibility of the reductions these interventions produce. The system can work better, if not perfectly, provided it pursues substantial reforms. First, the 3rd party verification system that lies at the heart of the CDM needs to be fixed. Currently, many projects are undergoing supplementary review after 3rd party verification because the CDM EB does not believe the auditors.[29] This has been held up as a toughening of standards within the CDM and a sign of its growing environmental credibility. We believe, instead, that it points to dysfunction in the operation of verification services, mis-aligned incentives, and confusion about the role of verifiers. Currently, 3rd party verifiers are paid by project developers, with whom they do repeat business and thus are loathe to contradict. Further, they face an increasingly competitive market for their services, with severe downward pressure on price and few effective controls on quality. At the same time, 3rd party verifiers face difficult retention problems for highly qualified staff because project developers can pay them far higher salaries. All three problems point to a need to shift payment for third party verification services from project developers to the CDM EB itself—or to some other truly independent verification scheme. Rather than second guess the verifiers, as it is doing through supplementary review, the CDM EB should act to align their incentives so that these key actors perform as expected.

Second, the CDM should be concentrated on a smaller (and more manageable) number of larger projects, which would allow greater oversight resources to be concentrated on crucial tasks such as ensuring environmental integrity of projects. In turn, projects that yield larger emission reductions can amortize these higher administrative costs over larger volumes. In part, this reform would adopt the lesson learned nearly a decade ago when the World Bank sought to catalyze the early CDM through its Prototype Carbon Fund (PCF), which included rigorous (if still highly imperfect) project-by-project oversight. In this same spirit, we endorse efforts to shift CDM to include so-called Programmatic CDM projects. Programmatic CDM projects are activities involving large numbers of dispersed emissions that cumulatively add up to substantial reductions. Common proposals involve distribution of efficient solar powered cook stoves to replace biomass cooking or the distribution of compact fluorescent light bulbs as an alternative to inefficient incandescent lamps. Historically, these projects have been hard to implement via the CDM because of the difficulty of precisely monitoring and verifying emissions reductions. The conference of the parties to the Kyoto Protocol and the CDM EB are hard at work at reforms to encourage the growth of Programmatic CDM.

[29] The rules implementing the CDM are designed around the assumption that the CDM EB can and should rely on reports provided by 3rd party verifiers except in unusual circumstances. Recently, perhaps because of widespread concern about non-additional projects being approved, the CDM EB has instead made supplementary review of projects the norm rather than the exception.

Third, the CDM rules should be liberalized to allow all forms of carbon reductions. At present, the CDM has an eclectic (but growing) array of methodologies, many concentrated on projects that deliver small volumes of credits for projects of dubious additional effort. Adding other large sources of reductions for which it is easier to assign additionality—such as CCS projects as well the growing array of possible forest-based net reductions in emissions—would ease the task of reorienting the CDM to a smaller number of projects with higher integrity.

It is important also to emphasize one reform that is often suggested but will do nothing to solve the problem – limits on the use of carbon offsets within cap-and-trade systems. This has been the strategy adopted by the EU and by the Liebermann-Warner Bill. A numerical or percentage limit on the number of offsets that can be used by firms within a cap-and-trade system doesn't solve the problems with offsets because it does not address the underlying quality issue. In some cases, numerical limits, because they will tend to favor those projects with the lowest costs, can even make things worse because non-additional projects will by definition have extremely low costs since they would have happened even in the absence of the program. At best, numeric and percentage caps on the use of offsets limit the damage that they can do to an overall climate policy and tend to encourage abatement within capped sectors. However, these limits are extremely problematic if offsets are also relied upon as the major source of cost-control for a cap-and-trade regime. The fixes we suggest are both superior and qualitatively different from numerical limits on offsets because they address the underlying problems that lead many to propose such limits in the first place.

The United States, were it to become a major buyer of CERs, could play an important role in advocating for these and other reforms. It might do this by pushing for change both at the CDM EB and at meetings of the Conference of the Parties to the UNFCCC. It could also exercise significant influence by simply refusing to allow the use of CERs from projects it deems suspect. As currently drafted however, the Lieberman-Warner bill essentially foregoes this potentially influential role for the U.S. by allowing import of large volumes of international credits from countries with cap-and-trade systems but not directly from the CDM.[30] Because other cap-and-trade systems, most notably the EU ETS, presently treat CERs as fungible with domestic emissions allowances, this provision allows for laundering of CDM credits via foreign emissions trading markets while ceding any influence the U.S. might have on the regulation and quality of credits. The fungibility of such credits will, in turn, create strong pressure for the EU to allow even greater volumes of CERs into its home market, which will probably yield even lower standards for quality. The only practical solutions to these problems start with close cooperation with the ETS, today's largest CDM market and likely to be the second-largest market after the U.S.

If such reforms are successful, an improved CDM would most likely be substantially smaller than today's market. Fundamentally, the question of environmental integrity is nearly impossible to address in today's CDM because for most projects, regulators will never be able to obtain enough information to determine whether CDM projects are truly additional without expanding transaction costs to the point that renders many projects economically prohibitive. The niche where additionality can be determined both rigorously and at reasonable cost is likely to be further restricted if CDM itself is curtailed in the largest emerging markets to create stronger incentives for those countries to adopt broader limits on emissions.

[30] S. 2191, 110th Cong. §2501 *et seq*. (2007).

2. Approaches beyond offsets

An effective CDM system will be relatively limited in the scale at which it can be applied. Offsets such as CDM work only where clear baselines can be established at reasonable cost and only where the payments do not generate perverse incentives for developing countries to avoid more stringent commitments in future. Offset mechanisms are designed to function at the installation or project level, and thus they work well mainly where the emission reductions occur in discrete projects or when the particular decision needed to change emissions is easy to identify and can be influenced by the price signal from the offset. Many sources of emissions however, are either widely dispersed or are best influenced not at the individual facility level but by changing the whole context in which firms and individuals make decisions about technologies and behavior. Examples include tropical deforestation or efforts to improve energy efficiency of buildings—both activities that involve rectifying a series of market failures and coordination problems that simple price signals, alone, can't adequately encourage.[31] These are also the areas where there is great potential leverage on emissions from developing countries. Getting that leverage will require instruments beyond an offsets system.

We propose two broad classes of activities to effectively address and reduce these sources of emissions. One, a climate fund, focuses on those situations where offsets are an inappropriate tool but where investment is basically all that is needed drive a change in developing country activities. The other, an infrastructure deals program, takes aim at cases where more than just money will be required to assist developing countries in achieving low-carbon development. This engagement strategy, with its two elements, is an essential compliment to a reformed, tightened, and more limited future CDM.

To realize the emission reductions opportunities where offsets are inappropriate but where investment will be required, a special fund and administrative mechanism will be needed. The most successful example of such a fund in international environmental diplomacy is the Multilateral Fund of the Montreal Protocol, established to pay the agreed incremental costs of developing country compliance with this agreement – essentially the cost of changing from ozone-destroying to ozone-friendly technologies. To date, the fund has funded more than 5500 projects in 144 countries.[32] This successful source of funding and administration for a wide range of activities aimed at reducing emissions of ozone depleting substances is a useful starting place for addressing global warming actions that are beyond treatment in an offsets system.

Many others have proposed similar funds – for example the recent U.S., U.K., and Japanese proposal - and we urge that governments give these ideas fuller attention.[33] We also note that while there is a growing array of proposals for funds there has been much less attention on the crucial issues surrounding how a fund would be administered. Such a Climate Fund, perhaps administered by the World Bank or a stand-alone institution, could function by accepting contributions from developed country governments and private firms. Perhaps, with time and attention to creating the necessary monitoring system, the Fund could even yield compliance credits for its donors that would be fungible with allowances in cap-and-trade systems. The Fund would invest in particular projects and technologies—ranked according to their ability to make reductions in greenhouse gases (and whether

[31] Some of these cases might be reframed into programmatic CDM projects and be eligible for offset credit—issued with tighter regulations along the lines suggested above. But many of these activities are beyond careful monitoring because they involve, in effect, changing the baseline and thus would be impractical to include in an offsetting system. .

[32] *See*, Multilateral Fund for the Implementation of the Kyoto Protocol, *at* http://www.multilateralfund.org.

[33] Henry Paulson, Alistair Darling, and Fukushiro Nukaga, *Financial bridge from dirty to clean energy*, FINANCIAL TIMES, Feb. 7, 2008; *see also*, Thomas Heller, Mandates Markets and Mechanisms (in the negotiation of a post-2012 climate agreement, manuscript in preparation.

such reductions are eligible for carbon finance and thus unworthy of the fund's attention). This would allow for both more complete coverage of certain classes of emissions but also for the ability to spend larger sums on determining the counterfactual baseline against which emissions reductions should be calculated and credits generated, a key limitation in the CDM context.

This approach is under consideration in the tropical deforestation context but should be broadened to include sectors that are currently within the rubric of the CDM. Further, a fund need not give up some of the market efficiencies present in offset systems. By holding periodic requests for proposals and then choosing projects via a reverse-auction process, a fund could be highly cost-effective, perhaps more cost-effective than the current system. Had HFC-23 emissions been addressed via a competitive bidding process like that for a Climate Fund rather than via the market mechanism of the CDM, the payments for abatement would likely have been one to two orders of magnitude lower than actually occurred by using CDM-based carbon finance. Moreover, such a system would have eliminated perverse incentives to overproduce HCFC-22 in order to generate credits would not have been present. The money saved could in turn have been used to fund additional meaningful reductions in developing countries.

Together, a Climate Fund and a reformed CDM could credibly and cost-effectively reduce emissions from a much wider range of developing country activities than either could alone. The CDM would yield direct market incentives for a niche of projects that can withstand the high transaction costs of close scrutiny. The Fund would work on a wide array of other activities that CDM itself could not encourage directly. But these tools will inevitably tend to focus on quantifiable near term emissions reductions where financial investment is all that is needed to change behavior.

Funding can play an important role, but often the bottlenecks are not simply money. A wider array of financial, diplomatic, and political efforts are often needed to allow fundamental changes in the activities that give rise to emissions. To help mobilize these efforts, we suggest an array of "deals" that focus on large-scale shifts in infrastructure needed to gain significant leverage on GHG emissions in critical developing countries. These deals would, in effect, change these countries' baselines— leading to lower emissions in ways that are particularly difficult to calculate in the normal offset calculus, which relies on measuring changes in emissions against a largely static baseline. By their very nature, major infrastructure deals would be few in number, thus limiting their scope to interventions in key sectors of the largest developing countries. We have outlined the logic for this "deals" approach elsewhere, and a number of similar diplomatic efforts concentrated on the largest emerging market emitters are already under way.[34]

We have previously described the contours of several exemplary deals involving nuclear technology in India and natural gas-fired power plants in China.[35] The key to making these deals and others like them cost effective is an attention to situations where developing country interests align with developed country concerns regarding climate change. For example, in China, there is growing concern about the health impacts of local air quality; yet alternatives to the coal-fired power plants normally built are not widely embraced for a variety of reasons— the cost of the necessary

[34] David G. Victor, 2007, "Fragmented Carbon Markets and Reluctant Nations: Implications for the Design of Effective Architectures," in Joe Aldy and Rob Stavins, eds., *Architectures for Agreement: Addressing Global Climate Change in the Post-Kyoto World*, chapter 4 (Cambridge: Cambridge University Press).

[35] Mike Jackson, Sarah Joy, Thomas C. Heller, and David G. Victor, Greenhouse Gas Implications in Large Scale Infrastructure Investments in Developing Countries: Examples from China and India, PESD Working Paper #54 (2006), *at http://pesd.stanford.edu/publications/deals/*

infrastructure for delivering the gas to market, China's current inability to produce the gas turbines that are the key technology involved in electricity production using gas, and concerns about reliability and cost of gas supply. By comparison, coal infrastructure has more predictable costs and is easier to scale up from the current large base. In this context, both by making or facilitating key investments in infrastructure and by facilitating the sale (and exchange) of key technologies to China, a U.S.-China infrastructure deal on natural gas-fired power might produce enormous reductions in GHG emissions over the medium to long-term by shifting the Chinese electricity sector away from a near total reliance on coal and towards a lower carbon alternative.[36] Similarly, the proposed U.S.-India nuclear partnership could be seen as a large infrastructure-changing deal that would put India on a path to lower emissions. To the extent that such deals encourage new infrastructures and lower emissions they will also make the process of international cooperation with emerging markets much easier because they will transform those negotiations from an effort to convince countries to take actions they view as inconsistent with their primary interests into the much easier task of reinforcing underlying development patterns. Critical to the distinction between these deals and a CDM or Climate Fund approach is the essential investment of political and diplomatic capital on the part of developed country governments in order to insure their success.

The deals approach, which focuses on the key infrastructural and technological barriers to climate friendly policies in developing countries, is a complement rather than an alternative to carbon offset and climate fund approaches. It will succeed by removing barriers to shifting baseline development paths and trajectories of growth rather than altering individual investment decisions at the margin. Implementing such an approach will require a concerted scientific, policy, and diplomatic effort on the part of both developed and developing countries to identify opportunities for cooperation. It would also require a concerted effort to tailor the "deals" to the particular circumstances of individual countries and sectors within the countries—focusing on settings where government and private enterprise were actually able to administer the deal. When paired with a climate fund, it would provide the ability to reduce emissions from a wide variety of sectors and activities that are unlikely to be amenable to an improved and more stringent CDM.

CONCLUSIONS

Serious efforts to address the climate challenge face several daunting tasks. Among them is the need to design national cap-and-trade systems so that the costs of compliance are sufficiently predictable that industry can plan investment and so that costs do not unexpectedly spiral up to levels that are politically unsustainable. Another major challenge is the engagement of developing countries—in particular the emerging markets such as China and India that account for a substantial and growing share of world emissions of greenhouse gases.

Efforts to implement the Kyoto Protocol have combined these two challenges through the mechanism of CDM offsets. Similar ideas are gathering steam in the U.S. debate, with many parties keen to allow liberal use of offsets—including international CDM-like offsets—so that it will be less costly to comply with a cap on emissions. These ideas are misguided. Experience with the CDM suggests that many CDM projects do not reflect real reductions in emissions. Moreover, the actual issuance of emission credits through the CDM mechanism operates at a pace and with exposure to severe administrative bottlenecks that make it unlikely that CDM can supply the emission credits

[36] BinBin Jiang, The Future of Natural Gas vs. Coal Consumption in Beijing, Guangdong, and Shanghai: An Assessment Utilizing MARKAL, Program on Energy and Sustainable Development Working Paper #62 (2007).

needed, with sufficient reliability, to be a good cost control mechanism. A more transparent "safety valve," focused solely on the task of cost control, would be much superior.

It is possible to fix the CDM and the U.S. should use its leverage in carbon markets to push for much needed reforms. Improving the quality of the CDM would require much stronger regulatory oversight and much improved verification systems. That approach will also imply that CDM will become a smaller market with a possibly even less predictable supply of emission credits. Such conclusions underscore the need for a separate cost control mechanism since failure to have such a mechanism will generate strong political pressure to relax and ease the CDM rules to generate needed supplies of emission credits and keep compliance costs in a cap-and-trade system within politically sustainable limits.

Finally, we have raised concerns about offsets as a mechanism to engage developing countries. Ultimately, in order to address climate change on a global basis, the energy sectors of all major emitters will have to accept binding limits on their emissions of greenhouse gases. Currently however, most important developing countries are unwilling to enter into discussions that contemplate such limits because they are seen as inconsistent with their development path. Ideally, the financial incentives provided by carbon offsets along with other financial and diplomatic tools would encourage changes in behavior now that will ultimately make the transition to binding emissions limits easier for these understandably reluctant nations. Our analysis of CDM energy sector projects indicates that just the opposite may in fact be happening. The CDM encourages countries to avoid binding limits on emissions and to concentrate emission-reduction activities on marginal investments for which it is easiest to assert that the investment is "additional." Serious reductions will require a different strategy involving multiple approaches including a tighter offsets program, a climate fund to finance reductions not amenable to the offsets approach, and investments in more radical changes in energy infrastructures whose effects are necessarily difficult to measure at the margin. Finally, all U.S. efforts towards reducing developing country GHG emissions should be made with a focus on eventual inclusion of these emerging markets in a system of binding limits.