Title: Show them the money: Incentives for greener infrastructure.

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Abstract

Development banks and governments play key roles in developing energy and transportation infrastructure. They also are fundamental actors in promoting environmental quality. These two sets of goals can come into conflict and when they do, governments and lenders need good tools for balancing them. Economic feasibility studies and environmental assessments are the main tools available during the process of infrastructure planning. This paper argues that better long-term planning and disclosure of detailed information from economic feasibility studies can improved infrastructure projects' sustainability. However, the most important advance banks and public agencies must accomplish is to deploy financial incentives for infrastructure developers and operators to meet and exceed environmental standards. Without such incentives, improvements in environmental assessment and planning will be largely meaningless. A variety of possible incentives is explored.

1. Introduction

Energy and transportation are building blocks of development. Energy infrastructure provides a key input to every industrial process, most agriculture and to the convenience and comfort of people at every economic level. Roads, railways and shipping permit trade, exploitation of comparative advantage and the mobility of labor. Governments and public lending institutions play key roles in both building and encouraging others to build power plants, energy distribution systems and transportation works because these projects often entail long-term payoffs, a substantial degree of risk, natural monopolies and/or satisfaction of basic needs.

Providing energy and transportation infrastructure often collides with another governmental goal, that of conserving environmental resources. The conflict arises because infrastructure can catalyze the rapid and often chaotic conversion of biologically diverse natural environments to ones dominated by human activity. That change is, in fact, the goal of much transportation infrastructure, not a by-product. The environmental cost of infrastructure development stems from the loss of biodiversity, alternation of indigenous culture and emission of greenhouse gases, as ecosystems are penetrated and forests burned to make way for crops and pasture.

The concept of sustainable development applied to infrastructure is simple: maximize the improvement in human welfare derived from transportation, energy and communications, while minimizing the cost to the environment. Planners have two tools to pursue this goal: economic feasibility studies and environmental impact assessments (EIA). Economic feasibility studies evaluate whether the benefits of a project outweigh its costs for the society of a particular country. Such studies usually exclude environmental costs. EIAs determine the severity of environmental and social damage expected as a result of a project, without necessarily putting it in monetary terms. Environmental economics offers a suite of methods for calculating the monetary value of impacts, so in theory EIAs and feasilibity studies could be melded into a single accounting of costs and benefits. This kind of all-encompassing study is called a social cost-benefit analysis, and, because of the expense and difficulty of monetizing some environmental values, remains largely an ideal.

Nonetheless, government authorities and lenders can weigh the results of the pair of studies to decide whether a project should proceed. A “sustainable” project fitting into the upper left box of Table 1 has positive net economic benefits and does little harm to the environment, or maybe even does some good. Its opposite, in the lower right contributes nothing to development, may even worsen poverty and has a large environmental footprint. It should clearly not be chosen. The decision is harder where an environmentally benign project is economically inefficient and where an efficient project has large environmental impacts, represented by the upper right and lower left boxes, respectively.

Table 1 – Economic and environmental sustainability scenarios		
Economic feasibility* Environmental costs	Benefits > costs	Benefits < costs
Low	Sustainable: Low impact, efficient	Low impact, inefficient
High	High impact, efficient	Unsustainable: High impact, inefficient

*Excluding environmental costs and benefits
Source: Author

Why environmental assessments don't prevent environmental damage. Environmental assessments are potentially a powerful tool. They are designed to look at a project's impacts across the full range of environmental values, from biodiversity to human health to cultural resources and more. In theory they provide a technical framework for legal and policy action to protect the environment. In practice, assessments have served less as a decision tool than as a pro forma step on the way to approval of development projects. The bulk of many a voluminous study is simply cut and pasted from others and mitigation recommendations are weak. EIA consultants are hired by project developers, and damage their chances for future work if they recommend costly mitigation measures. Developers, on the other hand, may feel that the EIA is a bureaucratic obstacle that allows any project to be delayed indefinitely, costing millions, whether there are legitimate environmental concerns or not.

In the 1990s, development banks began using a new assessment tool, the Strategic Environmental Assessment (SEA). The World Bank has promoted the SEA as a means to "upstream" environmental and social issues in policymaking. The SEA is supposed to take an early look (upstream in time) at policies, plans and programs with a heavy dose of public participation and input to the process. A traditional EIA, by contrast, would take a highly technical look at a specific project, informing the public of findings only once the study is completed. Ahmed et al. (2005) provide a brief and useful overview of SEAs, underscoring the qualities characteristic of a good SEA. These include the integration of biological economic and other sciences, identification of sustainable policy and program options, concentration of most important issues, ownership taken by implementing agencies, public participation throughout the process, early delivery of information before political decisions are made, and success in influencing policy.

Both EIAs and SEAs represent important advances on the road to sustainable infrastructure, but they won't get us there. That's because there is usually no absolute decision-maker impartially weighing their results. In fact, infrastructure decisions emerge from the encounter of the very divergent interests of the actors involved. Governments and banks that fail to acknowledge these differences can be expected to fail that institute procedures to balance them.

Table 2 – Diverse interests in infrastructure planning	
Group	Interests
Development bank	Reduce poverty Get loans approved quickly Secure repayment
Political leaders	Build popular projects
Public works agency	Maintain/increase share of budget Build projects
Environmental agency	Conserve biodiversity Maintain/increase budget Minimize conflict with stronger agencies
Private owner/operator	Make profits from operation Minimize uncertainty
Contractor	Make profits from construction Minimize uncertainty
Environmental assessment consultant	Build reputation for quality and flexibility to win future contracts
Environmental NGO	Conserve biodiversity and culture
Affected (including indigenous) people	Gain access to new jobs Minimize damage to resources Retain control/ownership of resources

Source: Author

This table is obviously a caricature of the interest groups. However it illustrates that in many cases there is only one party with a strong interest in economic feasibility, namely the lender, which is interested in repayment of the loan and has an institutional life that lasts longer than do most governments. Privately operated works bring a concessionaire with an even more keen interest in feasibility, though it is *financial* feasibility only that matters (an economic infeasible project can be made financially attractive with public subsidies). Further, there is only one party, the environmental NGO, with a reliably strong interest in the conservation of nature (other types of NGOs may take different stances). They may be joined by environmental authorities, but often are not, as the latter bows to pressure from stronger agencies to approve the EIA for a project. The NGOs may also find themselves allied with local people affected by the project if the environmental damage threatens resources important for economic of cultural reasons. This is more common with dams, whose environmental costs are highly localized and benefits widely dispersed, than with roads, where benefits are more local and costs spread broadly. Biodiversity for its own sake, however, rarely draws communities to the NGO cause.

By contrast, there is a natural coalition of political leaders, officials from public works (or other economic) agencies, contractors and concessionaires. In Brazil, the confluence of interest is seen in terms of political support: construction firms are the biggest donors to political campaigns, with R$ 66.4 million in contributions to candidates in the October 2006 elections (http://congressoemfoco.ig.com.br/Noticia.aspx?id=11626). Neither environmental nor efficiency criteria need weigh heavily, as these actors have limited personal exposure to negative project outcomes, either financial or environmental. Affected people may join this side if they see the prospect of jobs, access to markets and to services. Lenders, finally, are in the business of "producing" loans and may join project promoters as long as their worst fears are put to rest.

In the face of this confluence of interests, EIAs and SEAs represent a flimsy procedural safeguard against unsustainable projects. Feasibility studies sometimes help ensure that only projects with at least high development value are built. Unfortunately, through, feasibility studies are not routinely made public, the way environmental assessments are. That means that NGOs and even environmental agencies may not have access to the fundamental economic justification for a project that threatens natural areas. When these studies are made public, they often contain staggering methodological errors (See Box 1).

Box 1: The value of independent analysis. An official feasibility study for the Apolo-Ixiamas road in Northwestern Bolivia found that the $94 million project was not feasible. And that it *was* feasible. The project analysis showed a high internal rate of return and a negative net present value. These are the two most commonly used indicators of feasibility, and they're calculated with the same numbers. The net present value is simply the flow of benefits of a project minus its costs, with both "discounted" using an interest rate to put them in today's currency. Feasible projects have a positive net present value, and an internal rate of return higher than the interest rate used to discount the cash flows. A project with a negative NPV must have an IRR lower than the discount rate. Unless there's a mistake. That mistake was found only after the study for the project – which would pass through the Madidi National Park – was made public and subjected to independent analysis (Fleck et al. 2007).

The rest of this paper suggests a set of measures designed to promote sustainable infrastructure development. I will argue that the solution does not lie in more complex legal procedures, nor more exhaustive impact studies. Rather, countries and banks need to prioritize early and publicly according to clear environmental, social and economic criteria, must make economic feasibility studies as openly available as environmental assessments, and, most importantly, put in place a set of financial incentives that encourage project developers to deliver on environmental commitments.

2. Long-term, transparent planning

Sharing maps

When conservation and development planners draw up future projects, their maps may have no more in common than their country's political boundaries. Protected areas may be absent from the vision of the latter, while prime dam sites are excluded by the former.

Conservation NGOs have lately become much more strategic, carefully mapping current and future development that threatens biologically important areas (see Killeen 2007, and Laurance et al. 2001, for example). CAF has worked to consolidate competing visions of the landscape within its Condor tool, which permits online users to overlay projects such as roads on biological data layers, thus revealing the places where infrastructure and conservation are most likely to clash. A similar effort is underway at the time of this writing in which the Inter-American Development Bank (IDB) and major international NGOs are developing an "decision support" mapping tool that will alert planners to conflicts before project planning advances too far (personal communication, R. Curtis, 2008).

Spatial awareness of the conflicts is a positive development. It is a precondition to integrated planning in which conservation and infrastructure priorities can be considered together over long-term planning horizons, and reconciled to a greater degree than they are today. Acting on this rich new set of information requires a change in culture and formal procedures within planning and public works agencies. In their description of the Condor tool, Olivieri and Matinez (2001) emphasize its importance in circumventing the inertia and centralizing culture that typifies government agencies and impedes information gathering by interested parties from other agencies or outside government. Condor and similar efforts may indeed help analysts get around these obstacles, but make only a small impact in the decision-making process, and don't change the underlying interests of stakeholders portrayed in Table 2. Those require real internal reform.

This paper is not going to delve into the details of organizational change at the agency level. However, one step that might draw divergent agencies together to plan infrastructure would be national infrastructure planning councils. They could be convened to assemble multi-year investment portfolios based on environmental ranking, economic feasibility, and social equity. There are objective criteria in all three areas that can be applied. Environmental criteria can include affected biodiversity, species endemism and projected habitat loss based on one of the many spatial models now readily available. Economic criteria should be maximized net present value for a given portfolio size. And social equity can be measured in terms of numbers of projects beneficiaries, stratified by income level, as well as corresponding numbers of those negatively affected. Such councils would include members from public works, energy, and environment agencies, indigenous organizations, NGOs and lenders. Development banks would not have to recreate these exercises at a regional scale, but could provide then technical support and give priority to projects promoted by credible councils.

In fact, Strategic Environmental Assessments are meant to do exactly these councils would – take a long-term and sector-wide view. In the Latin American transport sector, however, they have ended up as glorified EIAs, focusing on specific projects very likely to be implemented regardless of the SEA's findings. These include the Bolivia's Northern Corridor and Pailon-Puerto Suarez roads and Panama's Bayano-Yaviza road.

Make economic information public

In most countries, law requires that environmental assessments be made public. Citizens can leaf through a well-done EA and learn how the environment may be affected and what mitigation measures have been recommended. The ambitious reader can delve into the multiple volumes that make up more EAs for minute detail on the ecosystems and people affected. This information is insufficient to guide judgments about balancing development and conservation. It does not permit people to answer the question, are the costs worth the benefits? Economic feasibility studies can complete the picture.

There is no general practice of disclosure of feasibility studies in developing countries. Sometimes they are published and widely circulated, but more often only their conclusions are disclosed. Readers have no way to verify that the data support those conclusions. Why the secrecy? The main justification advanced for keeping economic information confidential is that it could harm a company promoting a project if their cost data were disclosed. Another is that publishing such estimates could compromise a public bidding process by revealing the government's own estimates of costs and revenues, which could bias a company's bid where there is insufficient competition.

Neither of these explanations is robust. Corporate secrets are not at risk in publicizing the estimated costs and revenues of a project. For one, public companies have to divulge relatively extensive financial data to regulators in any case. Even where this is not the case, or where private companies are concerned, cost data can be slightly aggregated to secure sensitive information while retaining enough detail for public consumption and analysis. In the case of public bidding, agencies can calculate ranges of economic and financial return and present assumptions of each case for public debate, while still maintaining aggressive ceilings for actual bids.

Greater openness with economic information is needed to foster genuine debate on balancing infrastructure needs with environmental goods and services. Reid's (1999) analysis of the proposed Bala dam in Bolivia found that the investment promoted as an economic boon could end up incurring losses of up to $1 billion for the country. In Belize, officials claimed that the Chalillo dam would lower residential electricity rates by as much as 20 percent. Independent analysis showed that rates were likely to rise (Reid et al. 2000). Findings like these reframe the debate from one in which nature is pitted against development to one in which the fiscal risk of the projects comes into focus. Other CSF analyses have shed light on distributional impacts, environmental costs, and national stakes in a bi-national project.

Stakeholders have to understand the economic information for it to do any good. For the last ten years, Conservation Strategy Fund has been working to address this problem by offering basic economics education to conservation professionals throughout the tropics. Directed at government and non-governmental professionals from diverse educational backgrounds, the training includes market theory, environmental and natural resource economics, and cost-benefits analysis. Participants generally emerge as competent consumers of economic information, equipped with the language to discuss it with developers.

The measures described so far will help societies to select projects with greater promise of efficiency, equity and sustainability. Implementation is the next hurdle.

3. Financial incentives for environmental performance

Project developers' incentive for environmental performance dissipates before they have had a chance to act on it. Once environmental and approval and financing are won, governments and lenders have limited tools, and shown limited willingness to use those they have, to enforce promises made in the environmental assessment process. The following case illustrates this point.

In 1996, officials from the Brazilian state of Bahia were planning a road between the coastal towns of Ilhéus and Itacaré. The route passed through areas of relatively intact Atlantic Coastal Forest that had registered the highest level of tree diversity on Earth (Thomas 2008). Financing was sought from the Inter-American Development Bank and the Banco do Nordeste, under the Prodetur tourism development program. Based recommendations from local researchers, the IDB established a set of conditions to avoid deforestation, the most important being the establishment of a new 7,000-hectare state park adjacent to the road. The state and federal governments agreed. IDB provided extra funds in the loan in order to free up state counterpart money to buy the land (IDB can't buy land). In 1997 the Serra do Conduru State Park was decreed and the road built. Bahia state's government purchased a portion of the area but, as soon as the loan was fully disbursed lost interest in dedicating financial resources to buy the remaining land and to support an effective park management unit, as needed to fulfill the agreement. Eleven years later, it remains mostly a paper park, supplying illegally logged timber to build "eco" hotels in Itacaré. Despite disregarding IDB's environmental demands, Bahia has continued to have access to credit from the bank (M. Dourojeanni, personal communication, 2008).

It's possible to turn good plans into good projects. Many in banks and governments wish to see them implemented, but rules and wishful thinking will not do the trick – incentives are needed. The World Bank environmental assessment procedure illustrates just how little leverage a bank has:

> *The TT [task team] ensures that environment-related covenants are included in the monitoring system. It also ensures that reports provided by the borrower on project progress adequately discuss the borrower's compliance with agreed environmental actions, particularly the implementation of environmental mitigation, monitoring, and management measures. The TT, in consultation with the RESU [Regional environment sector unit] and LEG [Legal Department], reviews this information and determines whether the borrower's compliance with environmental covenants is satisfactory. If compliance is not satisfactory, the TT discusses an appropriate course of action with the RESU and LEG. The TT discusses with the borrower actions necessary to correct the noncompliance, and it follows up on the implementation of such actions. The TT advises Regional management of the actions taken and recommends any further measures. During*

> *implementation, the TT obtains the RESU's concurrence with any change in environment-related aspects of the project, including environment-related conditions cleared by LEG.* (World Bank 1999). http://wbln0018.worldbank.org/Institutional/Manuals/OpManual.nsf/toc2/C4241D657823FD818525672C007D096E?OpenDocument

Choosing the right incentives

What stands out about the procedure is that the bank staff has no obvious leverage to compel – or encourage – compliance. There is no mention of sanctions, nothing on incentives generally. The environmental and financial agreements between bank and borrower are not adequately integrated, even if they are in the same loan contract. That brings us to this question: What kind of incentives might work? It depends on the project, and a few guidelines should be kept in mind:

- Scale the incentives to the cost of environmental protection. Incentives that are too small are unlikely to reduce damage. For example, Akella and Cannon (2004) show that the expected cost of fines in Brazil is too low to persuade people to incur the expense of avoiding environmental damage – for example, by not logging valuable timber in a legal reserve. It works the same way with positive incentives; a $5 subsidy for environmental behavior that costs $10 will be ignored. On the other hand, too-large positive incentives needlessly expend financial resources, "overpaying" for performance. Draconian negative incentives can cause a backlash against governments environmental programs.
- Keep incentives in place during the same time horizon as the environmental risk. In the case of a road, the critical period may be during construction and the first decade thereafter, when the heaviest wave of deforestation usually takes place. Maintaining ecological flows downstream of a dam, in contrast, is an issue for the entire lifetime of the project.
- Avoid pushing projects to lenders with lower standards. If only punitive incentives are used, projects may seek financing from sources with lower environmental standards, or a lower likelihood of enforcement, even if interest rates are higher. The net effect of incentives should be to make the overall cost of money lower for an environmentally sound project than for an irresponsible one. So, where projects have financing options, positive incentives, or a mix or positive and negative ones should be used.
- Aim for fair and politically feasible cost sharing between lenders, private companies, governments and receivers of environmental services. Strictly speaking, there is no "correct" answer to whom should pay for avoided pollution (Coase 1960). It depends on a politically and culturally determined assignment of property rights to the environmental service and must be worked out to be both equitable and practical.

Here is a description of incentives banks and governments can deploy to encourage environmental performance:

Carbon deposits: The main environmental impact of roads in South America is the deforestation they induce. Deforestation can cause hundreds of tons of carbon emissions

per hectare. Typical road-induced deforestation can be predicted ex ante and easily measured ex post, presenting an opportunity for a carbon-based incentive. Typical deforestation would be estimated based on spatial models that take into account historical forest loss patterns along other road corridors and the soils, climate, topography and human factors of the road in question. Emission reduction credits in that amount would be added to the construction budget and purchased by the road agency before construction. At five-year intervals after the road is inaugurated, the agency could sell on the open market any credits in excess of those needed to cover deforestation induced by the road project.

For example, suppose that 100,000 hectares of forest would usually be cleared over a 20-year period as the result of a project, with net carbon emissions of 10 million tons of carbon dioxide. The road agency would initially have to hold 10 million one-ton credits. At the end of each five year period, the agency could sell the quantity of credits corresponding to avoided deforestation in that period, at prevailing market prices. At the end of the period the agency would have to continue holding enough credits to cover the total deforestation covered by the project, six million in our example.

Table 3 – Carbon emission deposit for road projects

Years	1-5	6-10	11-15	16-20	Total
Expected deforestation (ha)	40,000	30,000	20,000	10,000	100,000
Actual deforestation (ha)	25,000	15,000	10,000	10,000	60,000
Avoided deforestation (ha)	15,000	15,000	10,000	0	40,000
Avoided emissions (tons C)	1.5 million	1.5 million	1 million	0	4 million
Credits held at end of period	8.5 million	7 million	6 million	6 million	

Source: Author

There are many possible variations on this idea, and obviously a need to consider the peculiarities of current regulatory and voluntary markets and those that may obtain under a successor to the Kyoto Protocol. One key feature in any such mechanism is the initial deposit by the road developer against projected emissions. If credits were awarded for avoided deforestation without the up-front payment, carbon credits would provide a perverse incentive for more road building. Likewise, there must be an ongoing incentive to reduce emissions. Because road builders and concession-holders have little authority over land use, a government agency is the logical depositor and holder of credits. One possibly controversial aspect of this proposal is that it places the cost of carbon emissions squarely on the government causing them through road building. While this may make

some sense, it implies that a developing country pay for something that has always been free and raises the thorny issue of who is responsible for curbing global warming. Some cost-sharing (through a discounted certified emission reduction price, for example) among rich countries and the country in question would attenuate this problem.

Carbon payments are less applicable to hydroelectric dams. Dams cause greenhouse gas emissions by flooding and/or removing vegetation and may avoid emissions from other energy sources. Whatever the net effect, the dam builder and operator's ability is very limited to change the level of emissions based on management decisions.

Variable interest rates: One way to internalize environmental costs into the project is through the borrowing cost. Interest rates on debt-financed projects are traditionally a function of the level of risk involved in the business, the creditworthiness of the borrower and lending policies of the bank in question. Environmental (or social) performance does not come into the equation. Because interest is paid over the lifetime of the project loan, it represents a mechanism to induce sustained environmental performance by the borrower.

Here's how it could work: An interest rate band of, say, 5-8% could be established in the loan agreement. The midpoint would correspond to basic compliance with provisions of an environmental assessment and environmental regulations. Performance above and beyond those regulations during a certain period would cause an interest rate drop for the following period, while violations would result in an increased rate.

There are some practical considerations. First, the lender and borrower have exactly opposite interests, so adjustments in the rate represent a zero-sum game. An outside arbiter of environmental performance would have to be selected at random from a qualified pool, and paid from an escrow account set up for the project. Second, as the outstanding principal declines, so does the interest portion of loan payments. For interest payments to continue to influence behavior, the band around the central rate would have to be widened. Further, the application of this mechanism is obviously limited where debt represents a small fraction of project financing. Dams and toll roads may be funded with private capital. Projects in general may be funded straight from government budgets. Finally, rates have to vary enough to influence behavior, but not so much as to introduce intolerable uncertainty.

Interest rates based on environmental performance could be feasible for all sorts of infrastructure, but care should be taken to establish performance criteria over which the borrower can exert control. This mechanism likely would need to be combined with others in view of the limitations noted.

Extended grace and payment periods: Long grace periods and extended payment periods are common features of public lending in developing countries, where governments wish to encourage investments in sectors such as agriculture that are risky and have long payback periods. In the United States, federal education loans provide a grace period lasting until the borrower has completed his or her degree. Low-income students receive

an interest subsidy during this period. The same principle could be applied to environmental performance. Grace and payment periods could be extended where environmental standards have been met or exceeded during construction. Continued performance during operation could be a condition of maintaining the long payment period. As with variable interest rates, changes in the payment period would have to strike a balance between providing a significant incentive and keeping uncertainty within bounds.

Interest during construction rebates: Interest during construction (IDC) can be a significant cost of large projects with long construction periods. Large dams are often built with construction loans and then refinanced for operation. A $2 billion project with an annual IDC rate of 10% and a five-year construction schedule can accumulate $244 million in interest due at refinancing. In the dam example, a major impact during construction is that on the people who must be resettled to make way for the project. Resettlement and compensation have seldom been adequate in any country (World Commission on Dams 2000). If resettlement was done according to a consensual process with affected people, the dam developer could be provided an IDC rebate. Clearly there is a cost involved for the bank, but there are also benefits in the form of reduced risk of negative publicity and of project delays that keep the construction loan on the bank's books.

Accelerated depreciation: Governments can get into the act by permitting accelerated depreciation for long-lasting assets such as roads, bridges, power lines, pipelines and dams – as long as environmental conditions are met during construction and operation. In countries with corporate income taxes, depreciating assets quicker reduces a company's tax liability in the short run, deferring some taxes until later and thus reducing the present value of the overall payments.

Contractor bonuses: Another way of accomplishing the same end as IDC rebates and accelerated depreciation is to simply provide the contractor with a fixed bonus for environmental performance during construction, in the same way that bonuses are given for early delivery.

Mitigation/compensation fee paid into trust fund: An entirely different approach can be taken where the environmental impacts are largely outside the control of the project developer or the agency responsible (a public works agency, for example). In Brazil, developers pay a fixed 0.5% of their project investment into the Environmental Compensation Fund, which supports protected areas. The environmental investment has no necessary relationship to the environmental damage caused by the industrial activity. The advantage of this arrangement is that companies and agencies are not saddled with environmental management tasks outside their expertise and their own financial interests. Funds flow to an agency with an interest and capacity aligned with environmental conservation, and the financial commitment is made up front.

Calculating the amount of the fee in such a system involves a tradeoff. A fee based on a fixed percentage of capital investment is simple, keeps transaction costs low and avoids

disputes over the appropriate level of payments. However, the relationship between capital investment and environmental damage is anything but linear. Certain dams may have huge up-front costs and do relatively little damage, compared to roads, where maintenance costs are more significant and damage can be enormous. In the same way, a six-lane highway in a developed area may have far smaller impacts and a much bigger capital investment than a two-lane road in the Amazon. At the other extreme, a precise and complete estimate of environmental costs can be a very costly research undertaking.

A transparent schedule of fees is probably the best compromise in such a system. The index would generally make higher impact projects more expensive, but would not purport to actually estimate environmental costs. Criteria could include Table 4's first two in the simplest system, and those shaded in a more detailed index:

Table 4 – Index for flat compensation fees	
Type of project	Urban road, rural road, storage dam, run-of-river dam, navigation locks, powerline, pipeline, airport, etc.
Capacity	Lanes, MW installed, area flooded, tons cargo/day, Kv, volume of oil, gas or water, flights, etc.
Population displaced	Number of people
Type of ecosystem affected	Already altered, intact natural forest, intact grassland, intact wetland, etc.

Source: Author

Fines: There are also negative incentives traditionally applied for violations of environmental agreements. The simplest financial incentive is the fine. And while fines are culturally accepted as a general idea, they often fail to deliver results. Sometimes that's because they are lower than the cost of environmental compliance. In other instances, the "expected value" of the fine is much lower than the stated value because violators do not expect the government to collect the fines in full or in every case (Akella and Cannon 2004). Collection is obviously easier where the government is the violator, or has a payment stream to the violator that can be interrupted (payments from a public utility to a power station, for example). Fines will likely remain as a standard management tool for governments to encourage environmental performance, but they have not proved effective on their own, especially where private parties have recourse to a weak judicial system.

Performance bonds: A widely used mechanism to ensure compliance with environmental or other agreements is a performance bond. The bond is posted by the project developer and forfeited if the developer fails to perform. The bond is returned with interest if the developer fulfills his obligations. This mechanism is best-suited to address direct impacts within the short- to medium-term. Developers would be reluctant to risk a bond for impact over which they have limited control, or to have the bond indefinitely committed. The performance bond is a generic tool of which the carbon deposit proposal is a special case. Another variation on the bond is performance

insurance. An insurer could write a policy against the risk that the developer would fail to comply with environmental agreements. While the developer's short-term loss in the case of non-compliance would be limited to the premium, rather than a presumably much larger bond, access to future insurance would be compromised, or made more expensive, by causing the insurer to pay a claim.

Financial assurance such as performance bonds and insurance are used in the United States in a variety of cases, including landfills, transportation and treatment of hazardous materials, offshore oil and gas operations, underground fuel tanks, nuclear facilities and mines. Boyd (2001) stresses the importance of up-front financial commitments, pointing to the hundreds of millions of dollars in publicly-funded cleanups needed annually because private companies declare bankruptcy to avoid cleanup obligations.

Suspension of construction/operation: Another sort of financial penalty that can be easier to enforce is a suspension in construction or operation of a project until environmental compliance is achieved. Lost revenue, disruption in supply chains, problems with vendors, mounting interest payments and continued payment of fixed costs are at least as compelling to a project developer as a simple fine. This is more politically feasible during construction than during operation, particularly if a vital service such as energy, water or transportation is at stake (which it usually is).

Conditionality of future borrowing: Leading development banks like CAF can have a large positive impact on compliance by making future loan eligibility contingent on environmental performance during the entire period of a current loan. This is perhaps the simplest and most powerful incentive banks have to encourage environmental excellence. To exploit this tool, the first step is to include environmental conditions in all infrastructure loans. Then the link between current performance and future access to credit must become bank policy, rather than a matter of discretion. The story of Bahia's Ilhéus-Itacaré road shows how IDB was unwilling to use this leverage, even when confronted by a stark case of non-compliance. The policy would not be confined to borrowing governments; contractors supplying services to governments would also have to have environmental credentials in order.

Environmental rating of borrower: A more nuanced approach, for borrowers that meet minimal standards of performance, is an environmental rating system, akin to bond ratings, that would determine the interest rate at which a borrower has access to development bank funding. This solution has advantages over the mid-project adjustment of interest rates in that there is more predictability for the borrower. Also the borrowing cost takes in a longer track record of performance. Issues of subjective judgment remain. And, changes in corporate or governmental culture and standards are slower to show benefits, as "past sins" will slow a borrower's access to cheaper debt. In the case of governments, one administration has limited incentive to preserve a good rating for the next.

Making incentives work

This section concludes by exploring what banks and governments can do to bring these tools into play, and by noting some practical considerations. It is worth mentioning that most of the incentives suggested above are perfectly feasibly and several (performance bonds, preferential access to capital and trust funds, for example) have been suggested before in high profile settings (World Commission on Dams 2000).

The role of development banks

Referring back at Table 2, we are reminded that there are numerous actors who bring divergent, overlapping interests to issues of infrastructure development. They include contractors, private operators, regulators, planning agencies, implementing agencies, groups of affected people, NGOs and development banks. Each group also holds a different kind of influence on decisions and their implementation.

Currently, a bank's leverage is based on withholding money until a borrower agrees to and/or complies with certain terms, including environmental ones. This indirect influence over environmental outcomes evaporates entirely if a bank is unwilling to impose consequences for non-compliance, or extend additional rewards for compliance. As a first step, therefore, banks should institutionalize a blend of the incentives listed above at least during the life of a given loan. Beyond the period of a loan, the most powerful tool at a bank's disposal is conditioning future access to credit on past environmental performance. This policy can be absolute, extending credit only to borrowers with no outstanding environmental obligations, or incremental, basing the cost of credit on an environmental rating.

It must be recognized that development banks' leverage is based on their ability to provide capital on terms more attractive than competitors'. Competitors include private banks, private equity investors, national and sub-national development banks, export credit agencies and construction companies. In the past, development banks' tolerance for the risk of default gave them a large role in public investments in developing countries. That advantage has dissipated due to the advances in economic development and fiscal discipline in many developing countries.

Development banks will continue to play a large role in many countries, especially those with smaller economies. They can remain competitive due to the large added value they bring as research and grant making institutions and through low interest rates. And, by combining both positive and negative environmental incentives, banks can minimize or eliminate the need to further subsidize credit to interest borrowers in environmentally exigent loans.

The role of government

Governments control more of the decisions on the planning and implementation of infrastructure and therefore need to play the biggest role in providing green incentives. All the credit-related proposals in this paper can be deployed by national development banks. In addition, governments have the ability to reward environmental excellence

with preferential scoring in public bidding on government projects and resource concessions, and with expedited environmental licensing procedures.

Most of all, governments must integrate environmental responsibility fully into the sector agency promoting a given development project, as well as into planning and development agencies that may influence decisions across a range of sectors. Risks and duties for the various involved agencies need to be clearly delineated and reasonably allocated given each agency's powers and competencies. That means, for example, that a roads agency assumes a financial exposure to the deforestation so often induced by better transportation, rather than leaving a poorly funded environmental agency with the task. While the expert work may have to be done by people outside the roads department, the funding must be guaranteed through a deposit, bond, insurance or contribution to a trust fund.

Practical considerations

Implementing such reforms presents certain practical challenges. First, many performance-based measures require judgment. These judgments must be made by a third party selected at random from a pool of qualified consultants and paid from an escrow account funded by the project. This arrangement at least eliminates incentives to act as a biased agent for one of the parties. To make the system more robust, the scope for subjective judgment must be minimized. For example, in the case of a hydroelectric dam, one appropriate criterion for assessing performance would be maintenance of an agreed upon level ecologically acceptable minimum flows downstream. It is easily measurable, requiring no qualitative judgment.

A second point to keep in mind in choosing performance criteria is the project developer's degree of control. A road agency, for instance, has a high level of control over keeping cut material out of streams. It has a moderate degree of control – through cooperation with other agencies – over induced deforestation. It has very little control over the extent of fires in an El Niño year. Criteria shouldn't necessarily be limited to those over which the developer has a high degree of control. In fact, one of the greatest advances governments need to achieve, as noted elsewhere in this paper, is the integration of infrastructure operation and ecosystem protection. Reasonable limits, however, need to be placed on the developers' liability, just as they are in many other kinds of contracts. For instance, a government might commit to mitigate a road's damage by setting up a protected area. They should decree the area, resolve land-tenure issue, compensate affected people, install park infrastructure, hire staff and deposit funds in the country's environmental trust fund to cover recurrent costs. Doing all that would constitute good environmental performance, even if the park were adversely affected by storms, fires or other factors beyond their control.

There's nothing new about environmental licensing agreements that entail some level of subjective judgment on performance. The difference in this case is that there would be real money at stake.

The final practical consideration worth noting is that some of the incentive tools proposed apply only to debt-financed projects. Equity investors' have a more direct stake in the financial performance of the project. Only those explicitly differentiating themselves as environmentally conscious are likely to "self-regulate" or add costs not integral to financial results. Table 5 shows which incentives could be applied in primarily debt-funded projects and which would work for both.

Table 5 – applicability of incentives according to project finance		
	Debt	Equity
Carbon deposit	X	X
Variable interest rate	X	
Extended grace, payment period	X	
Interest during construction rebate	X	
Accelerated depreciation	X	X
Contractor bonus	X	X
Mitigation/compensation fee (up front)	X	X
Fine	X	X
Performance bond/insurance	X	X
Suspension of construction/operation	X	X
Future access to credit	X	
Price of future borrowing based on environmental rating	X	
Preference in bidding/licensing based on environmental rating	X	X

Source: Author

Table 6 – Priorities for implementation (1=higher; 2=lower)			
	Priority	Comments	Who pays?
Carbon deposit	1	Carbon is quantifiable and representative of many forest values. Anticipates possible national forest carbon targets. Incentive active for every ton.	Developer/public works agency pays deposit and receives refund for all reductions in deforestation below expected amount. Cost of deposit and deforestation avoidance measures ultimately fall on taxpayers.
Variable interest rate	2	Wide rate band required for low-leverage projects, projects nearing payoff; unpredictable cash flows.	Developer pays or benefits depending on level of performance. No cost to lender if average rate is equal to current average rate.
Extended grace, payment period	2	Applies to high-leverage projects.	Lender pays.
Interest during	1	Simple, discrete	Lender pays.

construction rebate		incentive for reducing construction impacts. Uncertainty limited in time.	
Accelerated depreciation	1	Tested, financial exposure small relative to overall government revenues.	Government (taxpayers)
Contractor bonus	2	Discrete, foreseeable incentive for construction phase	Lender or government pays
Mitigation/compensation fee (up front)	1	Assures resources for mitigation or compensation; implementation done by experts; downside: no ongoing incentive for performance	Developer pays flat fee for anticipated damage.
Fines	2	Probably part of any incentive toolbox but ineffective as stand-alone because evasion too easy	Developer pays for actual infractions.
Performance bond/insurance	1	Assures resources available for mitigating damage and provides ongoing incentive for performance; downside: as stand-alone doesn't provide money to offset inevitable impacts (as flat fee does)	No one pays for bonds if developer performs. Developer pays for insurance.
Suspension of construction/operation	2	Suspension of construction more practical than of operation because infrastructure provides essential services; police power may be required; backlash against putting people out of work. Upside: a cost is imposed without the trouble of a financial transaction (as	Developer pays in the case of noncompliance.

		in the case of a fine).	
Future access to credit	1	Continual incentive provided both for builders and operators of infrastructure; applicable to public and private borrowers; no complex loan terms required; no transaction cost.	Developer pays in the case of noncompliance.
Price of future borrowing based on environmental rating	1	Advantages of previous incentive apply here; in contrast to cutting off credit, variable pricing more easily allows past failures to be rectified by good performance.	Developer pays/benefits. No cost to lender if the average rate is equal to current average lending rate.
Preference in bidding/licensing based on environmental rating	2	Advantages of previous two incentives apply; could be used in conjunction with the second, doubling the value of environmental achievement for firms.	Developer pays/benefits.

Source: Author

4. Conclusion

This paper proposes that better planning and public disclosure, combined with lasting financial incentives can improve the environmental performance of infrastructure investments. To improve environmental performance, banks and governments need not devise yet another generation of better environmental assessments. The one that are done just need to be taken seriously – backed by concrete financial incentives over the life of a project.

Will it cost more to develop infrastructure as recommended in this paper? The overall economic result will very likely be better. First, there is the matter of fewer delays related to controversy. Second, low environmental cost sites are more likely to be chosen. Third a more efficient overall level of environmental damage to public goods is likely to result. And finally, those extra costs that are incurred in environmental mitigation and compensation will effectively convert public economic costs into private financial ones, which, in most cases can (and should) be paid for by users of the infrastructure.

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