

## Output-based aid and carbon finance

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**O**utput-based aid (OBA) involves the use of explicit, performance-based subsidies to deliver public services such as water and sanitation. It is used to fund the gap between people's willingness or ability to pay for a service whose delivery is deemed worth subsidizing and the cost of providing that service. It can also be used to finance public goods or to mitigate externalities such as environmental costs.

One such application is carbon finance, an output-based approach to mitigating climate change. Under the Kyoto Protocol's project-based mechanisms—the Clean Development Mechanism and Joint Implementation—projects in developing and transition economies that reduce greenhouse gas emissions can receive “carbon credits.”

Carbon revenues can help project sponsors close the financing gap between climate-friendly projects and conventional projects, and can help industrial countries reduce their cost of compliance with the Kyoto Protocol.

### What are the advantages?

#### Greater value for money

Carbon finance generates incremental revenues for climate-friendly projects, rendering more such projects financially viable (box 1). Carbon credits provide an incentive for investing in projects that reduce emissions at low cost, helping to ensure efficient use of scarce funds.

#### More transparency

To obtain carbon credits under the Kyoto Protocol, a project must demonstrate that it is “additional,” through an analysis showing that the project reduces emissions relative to a baseline scenario. The baseline must be validated by an independent third party, the project registered, and the emission reductions verified in accordance with an approved methodology and monitoring plan. These activities enhance transparency and improve the targeting of funds.

#### Greater efficiency

Like other output-based approaches, carbon finance is performance-based. The seller of carbon credits gener-

ally bears the operational risks of the project. Payment is typically made after emission reductions have been delivered. Some forward contracts contain delivery guarantees or penalties for shortfalls attributable to company misconduct. These provisions offer an incentive for the seller to operate efficiently.

#### Reduced economic distortions

Carbon finance assigns a value to the global externality of greenhouse gas emissions, which are widely held to cause climate change. Internalizing the climate externality brings the financial internal rate of return of climate-friendly projects closer to their economic rate of return and increases their competitiveness relative to conventional projects.

### Catalyzing investment in renewable energy

Despite the declining economic cost of renewable energy technologies,<sup>1</sup> emerging markets have received scant private investment in renewables. In the private power boom of the early 1990s, for example, hydro-power projects represented only 2.5 percent of the generation capacity developed in emerging markets. Only about 20 percent of the economically feasible hydropower potential of developing countries has been developed, compared with more than 70 percent in OECD countries.<sup>2</sup>

<sup>1</sup> A decline in economic costs of hydro, onshore wind, geothermal and biomass cogen to 204 US\$/kWh by 2010 is projected. International Energy Agency, *Renewables for Power Generation: Status and Prospects*, 2003 Edition (Paris, 2003; [http://www.iea.org/textbase/nppdf/free/2000/renewpower\\_2003.pdf](http://www.iea.org/textbase/nppdf/free/2000/renewpower_2003.pdf)).

<sup>2</sup> Jamal Saghir, “Energy and Water, Business Action, Working for a Sustainable Solution,” presentation at side event of United Nations Commission on Sustainable Development, 13th session, New York, April 20, 2005 (<http://www.wbcsd.org/web/projects/climate/bae/JS-water-and-energy.pdf>).

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**Box 1. How carbon finance boosts profitability and reduces risk**

Carbon finance can improve the viability and profitability of clean infrastructure projects by providing incremental revenues and improving access to capital. The sale of carbon credits can increase internal rates of return (IRRs) by 40 percentage points or more for projects that mitigate methane including landfill methane collection, biogas digestion, and coal mine methane. For renewable energy technologies, carbon finance can increase IRRs by 1–3 percentage points, depending on the cost of the technology and the fossil fuel(s) displaced.

Increase in internal rate of return of selected carbon finance projects

Sector	Project	Increased IRR (percentage points)	
		Seven-year crediting period	Ten-year crediting period
Landfill	South Africa: Durban	56.2	57.9
Landfill	Brazil: Nova Gerar	47.9	51.0
Landfill	Argentina: Olavarria	10.1	18.2
Coal mine methane	China: Jincheng	9.0	11.5
Energy efficiency	Indonesia: Indocement	7.6	13.6
Biomass	Bulgaria: Svilosa	4.2	6.0
Biomass	Hungary: Pannonpower	2.2	2.6
Biomass/forestry	Brazil: Plantar	5.4	6.7
Forestry	Romania: Afforestation	0.5	1.1
Hydro	Peru: Poechos	0.8	0.9
Wind	Colombia: Jepirachi	0.5	0.6
Wind	Philippines: Northwind	0.3	0.4
Energy efficiency	Bulgaria: District Heating	0.6	0.7

*Note:* Assumes an emission reduction price of \$7.50 per ton of carbon dioxide equivalent, sale of 100 percent of expected emission reductions, and transaction costs of \$100,000 up front and \$20,000 annually. Crediting period is the time a project is eligible for carbon finance payments.

**Financial barriers to renewables**

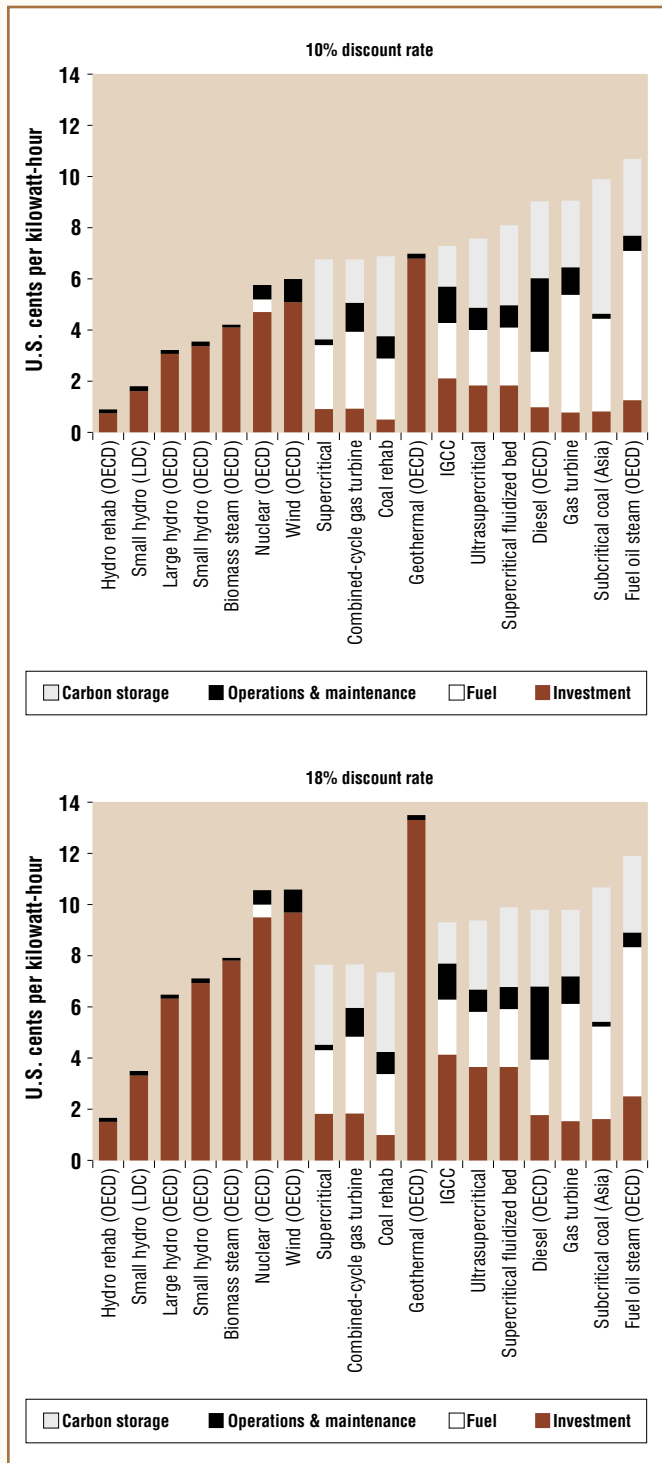
This investment gap can be explained largely by financing barriers, illustrated by the difference between economic and financial rates of return. While renewables appear to be competitive in *economic* terms, they are generally not *financially* viable in emerging markets because such projects require large up-front investments relative to overall project costs. In high-risk environments they are therefore at a disadvantage relative to conventional power sources. To illustrate, figure 1 shows generic levelized costs (discounted cost per kilowatt-hour) at two different discount rates for a range of generation alternatives.

At a 10 percent discount rate (typically used for economic analysis), hydro and biomass appear cheaper than commercial coal technologies even with the cost of carbon capture excluded. At a more realistic 18 percent discount rate (which more closely reflects

the risk-adjusted financial cost of capital in emerging markets), the levelized cost of renewables nearly doubles. Indeed, using this risk-adjusted rate suggests that renewables are substantially more expensive than the commercial coal- and gas-fired generation in use today in developing countries, and puts them about on par with “cleaner coal” technologies when the estimated cost of carbon capture and storage is included.

Given two alternatives with approximately equal cost, investment will flow to projects with lower risk. Coal generation offers lower up-front costs than renewables, with easier financing, less resource risk, and a greater ability to scale generation (and variable operating costs) up or down. Encouraging investment in lower-carbon energy sources will therefore require not only increasing their profitability to levels comparable to that of conventional sources but also reducing their inherent risk.

**Figure 1. Levelized cost of low-carbon power generation alternatives**



Source: Authors' calculations using data from World Bank and International Monetary Fund Development Committee, "Clean Energy and Development: Toward an Investment Framework" (Washington, D.C., 2006; [http://sitere-sources.worldbank.org/DEVCOMMINT/Documentation/20890696/DC2006-0002\(E\)-CleanEnergy.pdf](http://sitere-sources.worldbank.org/DEVCOMMINT/Documentation/20890696/DC2006-0002(E)-CleanEnergy.pdf)).

### The power of carbon finance

Carbon finance boosts the profitability and reduces the risk of clean technology investments by providing a high-quality, hard currency revenue streams from highly creditworthy sources that project sponsors can use to mobilize financing. In Ecuador, for example, carbon revenues were critical to mobilizing financing for the country's first privately financed hydropower project (box 2).

### Combining carbon finance with other OBA approaches

Despite these advantages, carbon finance has not been sufficient to mobilize funding on a large scale. For renewables, carbon revenues are generally insufficient to compensate for the difference between their risk-adjusted cost and that of conventional projects. Combining other output-based approaches with carbon finance can help close the funding gap.

### Addressing local externalities in renewable energy projects

While carbon trading internalizes (at least in part) the global environmental externalities of fossil-fuel-based power generation, it does not address local externalities. Conventional energy sources in emerging markets typically generate substantial local health problems. Substituting low-emission technologies reduces these externalities.

OBA approaches addressing local externalities can make a project financially viable where carbon finance alone is not sufficient.

### Addressing affordability and access to energy

Combining carbon finance with other OBA approaches in projects providing basic energy services can address both affordability and externalities.

The World Bank has used OBA to provide affordable basic energy services in ways that are also climate-friendly—such as through solar home systems in Bolivia, village hydro grids in Nicaragua, and other decentralized energy services and through grid extensions. By substituting modern energy services for traditional and fossil-fuel-based energy, these projects have helped reduce indoor air pollution linked to respiratory disease and infant mortality.

To the extent that these projects reduce fossil fuel consumption, these projects have the potential

**Box 2. Catalyzing financing for Ecuador’s first private hydro investment**

Despite Ecuador’s substantial hydro potential, it had attracted no private investment in grid-based hydropower until 2006, when carbon finance helped mobilize financing for the Abanico project.

Abanico is a run-of-river project consisting of two 15-megawatt systems. It is expected to generate over 220 MWh of power annually, displacing diesel-fueled power generation. The project sponsor, Hidrobanico S.A., obtained private equity financing for 65% of the \$33m project costs, and sought financing from the Inter-American Investment Corporation (IIC) for the remainder. Despite strong fundamentals, the project did not meet IIC’s requirements that at least 50 percent of sales be under firm power purchase agreements and that the proceeds be escrowed for debt service.

Hidrobanico contracted to sell the project’s first 806,000 tonnes of carbon credits to the Netherlands Clean Development Mechanism Facility under a long-term contract arranged by the World Bank. The contract was structured so that the proceeds accrue directly to a debt reserve account in favor of IIC, eliminating sovereign risk to the extent of the carbon payments.

IIC agree

loan to Hidrobanico, but also to reduce the interest rate by 100 bps relative to other Ecuadorian debt. Thus carbon finance facilitated financial closure for Ecuador’s first privately-financed hydroelectric project, and will save the company \$300,000 in interest payments over the life of the loan.

Source: Inter-American Investment Corporation, “Investment Summary: Hidrobanico S.A.” (Washington, D.C., 2005; <http://www.iic.int/projects/view.asp?id=255>).

to generate carbon revenues. A project in Nepal, for example, replaces kerosene and other energy sources with biogas digesters. GPOBA is considering to provide OBA grants to partly cover the cost of the biodigesters, thereby improving affordability, while the World Bank’s Community Development Carbon Fund is purchasing emission reductions generated by substituting biogas for fossil fuels.

Working with carbon buyers could help identify additional projects that offer potential for combining the two funding sources—thus addressing global and local environmental concerns as well as providing pro-poor solutions in meeting basic energy needs.

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