Transactions Costs in Efficiency and Emissions Reductions Projects in the Industrial Sector

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ABSTRACT

Even when cost-effective, energy efficiency investments face a number of well-documented obstacles to their implementation, including lack of information, financing, and risk aversion. Analysts have described these obstacles as contributing to high effective discount rates and "hurdle rates." While often overlooked analytically, "transactions costs," can also be important obstacles to energy efficiency projects. There are several significant types of transactions costs, which are the deal-making costs and fees encountered by project proponents. Fortunately, when transactions costs are recognized, there are policy measures that can be taken to reduce them.

Transactions costs are particularly important in the context of "offsets programs," which are policies to reduce air pollution by allowing affected sources to earn emission reduction credits by investing in projects in other sectors. Senators of all political stripes are considering offsets programs for legislation affecting power plants, and some states have offsets programs in various stages of development. Under an offsets program, affected sources, such as utilities or their industrial customers, would have an incentive to search for emission reduction projects that would allow them to meet their reduction targets at least cost. While such an approach would likely be characterized by significant transactions costs, it could represent a source of increased investment in energy efficiency. Measures to lower the transactions costs would very likely increase the economic feasibility of offsets projects. Moreover, as economic actors in an offsets program gain experience with the transactions, it is very likely that learning will take place, and that transactions costs will fall.

Introduction

In virtually any investment, there are a variety of "deal making costs" that one or more parties are required to absorb. These include, for example, the fees paid to arrange financing and the costs of insuring the investment. The staff time involved in researching investments and choosing between options is also a cost that must be considered. An often overlooked cost is the "opportunity cost" of the scarce commodity of management resources. All of these costs contribute to the price paid for the investment, but don't actually result in the acquisition of additional assets. Generally speaking, these deal making costs are called transactions costs.

Even when cost-effective, energy efficiency projects face a significant level of transactions costs, and these costs do discourage investment. Analysts typically describe these costs as contributing to some high implicit discount rate or "hurdle rate." In other words, some of the impediment represented by the hurdle rate are the transactions costs associated with the investment.

It is possible to identify specific types of transactions costs. Importantly, certain kinds of these costs can be reduced, and identifying the types of transactions costs associated with any given investment can be the first step to increasing the likelihood of implementation.

Types of Transactions Costs

Table 1 provides a list of typical transactions costs. Dudek and Wiener (1996) draw on the general theory of transactions costs and provide a framework by categorizing transactions costs as *search costs, negotiation costs, approval costs, monitoring costs, enforcement costs, and insurance costs.* The types of costs identified below could be classified into these six categories, but it is useful to be specific about types of transactions costs that might apply to energy efficiency projects.

Table 1. Typical Transactions Costs for Project Level Investments

Transactions Cost	Description
Identifying the Project	This could include choosing among possible investments, selecting the appropriate technology, efforts to keep current with technological and policy developments etc.
Identifying Project Partners	Partners could include consultants, or in the case of demonstration projects, the technology suppliers could be partners as well.
Feasibility Studies	While some engineering/technical and financial feasibility studies in some degree of rigor will likely have been completed in the actual selection of the project, it is possible that the "top choice" would be subjected to additional, more formal study.
Environmental Impact Assessment	May be required for some types of projects
Permits and Relicensing	May be required for some types of projects
Arranging Financing	This is not only the cost of financing (interest on loans, etc) but also the time and effort spent choosing among potential financing sources.
Negotiations	This is a broad category that reflects the costs of making arrangements and contracts with contractors and other partners
Insurance	The specific investment may require insurance, or it may require re-negotiation of the overall insurance coverage of the firm.
Project Approval	Management resources required to study, choose between competing priorities, and authorize the investment.
Organizational Change	Costs of implementing organizational, staff, and equipment changes to accommodate an improved use of a new technology. This is difficult to quantify, but must be considered.
Training	Costs associated with the need to upgrade labor skills to more productively use a new technology or process.
Monitoring	There is time and effort involved with ensuring that equipment is installed correctly and on time, and that project partners are conforming with agreements, etc.
Attorney Fees	Attorneys may be involved in the initial negotiations, but may also be required over the life of the project to enforce contracts.

Note: This list is illustrative, and not exhaustive. While this listing is approximately sequential, any specific project may avoid certain types of costs, or face them in a different sequence.

Transactions Costs in Greenhouse Gas Offsets Projects

Greenhouse gas (GHG) offsets projects continue to be discussed as a potential mechanism to address the risks of increasing emissions of carbon dioxide and other heat trapping gases. At the time of this writing, there are two separate bills before the U.S. Congress proposing at least some form of tradable credit for projects which reduce emissions of GHGs. These proposals raise the possibility of generating an extra stream of income for industrial energy efficiency projects, and, could create the incentive for undertaking some projects that would otherwise have been difficult to implement.

Table 2. Additional Transactions Costs Offsets Projects

Transactions Cost	Description
Identifying Offsets Buyers	This falls into the category of "Identify Project Partners," with the specific requirement of finding someone to pay for emission reductions.
Demonstrating "Additionality"	This refers to proposition that offsets should not be awarded for activities that would have happened with or without the "offsets policy" (i.e. if every one of Firm A's competitors has installed a specific high efficiency technology, there is an argument to be made that Firm A would likely have had to install it as well, and should not be able to earn revenue producing offsets for such a project). Demonstrating additionality is typically described as determining an "emissions baseline" of what future emissions would be if the project were not completed, and comparing it to projected emissions with the project. In some cases, this can be quite complicated.
GHG Offsets Negotiations	There are additional negotiations costs involved in a GHG offsets project, as the offsets represent a separate financial transaction. This includes contracting, possibly marketing the offsets, and possibly, registering the credits for trading.
GHG Offsets Insurance	The revenue stream and the value of the offsets may need to be insured. Assuming that the buyer is acquiring the offsets because he or she faces some penalty for not securing emissions reductions credits, the risk of equipment failure, etc. that results in a loss of emissions offsets could be expensive.
Emissions Monitoring	This is necessary to ensure that the expected reductions are actually occurring, though it may be possible to measure some proxy for emissions, like electricity use. In addition to any staff time and monitoring equipment, it likely includes the costs of developing a protocol for monitoring.
Third Party Validation and Verification	It is possible that an offsets policy may require third party verification of emissions reductions for some kinds of projects.
Offsets Approval	It is likely that an offsets policy would require emission offsets to be approved by some official body before they can be accepted as credit against an emissions reductions requirement. It is likely that the approval body is a government agency. It is possible that the offsets policy may require government approval of the project in advance of implementation, though that would be likely to raise costs significantly.

As suggested in Table 2, above, there may be additional transaction costs for the case in which an energy efficiency investment is undertaken for the purpose of securing GHG reduction credits. Included are the costs of establishing the emissions reductions as a

commodity and facilitating the transfer of ownership when the "offsets," (or "credits") are sold. For example, before the offsets can be sold, the emissions reductions must be verified in some way, and approved by some official body. The sale itself could involve costs of effort and time in finding a buyer, possible attorney fees in contracting for the purchase, and insuring the value of the offsets against loss. As noted earlier, in many cases they may be in addition to other project costs described in Table 1.

Measures to Reduce Transactions Costs

The market itself can be effective at reducing transactions costs. Institutional structures tend to evolve that facilitate transfers, purchases, and investments. The classic example is the evolution of money as a medium of exchange – one cow may be worth three pigs, but if you wanted to trade your cow, you had to expend significant time and effort to find an owner of three pigs willing to exchange them for your cow. Banking institutions are also examples of market developments that facilitate exchange. Individuals who have money can deposit in a bank and earn interest, while individuals seeking loans can borrow that money, while paying interest. The bank makes a profit by charging higher rates than it pays, but it is much more efficient than the alternative, in which individuals hoping to borrow would have to find individuals hoping to lend. There are limits to the extent to which the market can reduce transactions costs, however. Even with the development of money as a medium of exchange and the institution of banking, homeowners still wait for significant mortgage rate reductions before refinancing, reflecting the importance of the transactions costs in time, money and effort involved in securing the lower rate.

The market is likely to have a more pronounced effect on transactions costs if the actual transaction becomes more common. Institutions – in particular, rent seeking private firms such as brokers and banks, energy service companies, and third party vendors – are more likely to evolve when there is a greater demand. At the moment, for example, while there is a market for GHG offsets, and there are brokers to facilitate those types of trades, such activity is likely to increase if other nations ratify the Kyoto Protocol.

Government programs can also help to limit transactions costs. For example the Federal Deposit Insurance Program, which help reduce the costs of insuring consumer saving – and arguably has increased the national savings rate. Governments can also reduce transactions costs by creating information services, such as the Securities and Exchange Commission, which assist investors. Here are ways in which the market and government can contribute to reductions in specific types of transactions costs:

- *Identifying Project Partners and Offsets Buyers*. For energy efficiency projects, there are already registries of consultants and technology suppliers to assist project developers. In a functioning GHG market, one might expect registries to develop matching buyers and sellers of offsets. It is also possible that GHG "banks" would become common, negating the need for buyers and sellers to find each other – they would simply buy and sell offsets at a fixed price from an institution.
- *Arranging Financing.* It can be difficult to arrange financing for new technology – as new approaches become more common, lenders' comfort levels can increase, and financing can become easier. The government can also play a role, by helping to

finance demonstration projects and providing information that lenders can use to value the risk of the loans.

- *Negotiations Costs.* As individual technologies become more common, or if offsets projects become more frequent, negotiations can become more routine, and standard contracts can evolve. Brokers and "banking" institutions with extensive experience with offsets projects can be expected to facilitate transactions, just as real estate brokers and banks assist home buyers and sellers.
- *Insurance Costs.* Governments can help to underwrite project or GHG offset risks, but private insurance costs are also likely to fall as insurers gain more experience with specific technologies, or with a GHG offset market. The development of GHG offset "banks" would automatically reduce insurance costs, through the simple method of diversification of investments – by holding offsets from many projects, they self insure.
- *Project Approval.* As specific technologies, or GHG offsets projects become more common in the marketplace, managers are likely to have more information available and quickly make decisions about individual projects. The government can also provide information that can assist in this process. Voluntary greenhouse gas reduction programs such as the Coal Bed Methane Outreach Program, the Voluntary Aluminum Industrial Partnership, ENERGY STAR®, and Climate Leaders all provide information which can reduce the transactions costs of researching and approving projects.
- *Attorney Fees.* These are also likely to fall as contracts become routine.
- *Demonstrating Additionality.* This cost can be greatly reduced by the development of standard baselines, or "benchmarks," for specific types of technologies. For some technologies, the market is likely to develop these very quickly, though the government would likely review any industry-developed benchmarks before using them to approve offsets from specific projects. It is possible that the government could facilitate the process by developing benchmarks of its own, which would reduce costs for the private sector. Note that a given offset project developer may face unique circumstances and may not wish to use a benchmark for his or her project, and would likely be free to develop a "project-specific" baseline for the purpose of demonstrating additionality.
- *Emissions Monitoring.* In a functioning GHG offsets market, standardized monitoring protocols for many types of projects are likely to be developed by the private sector, but could be developed by the government for specific types of projects,
- *Third Party Validation and Verification.* These types of services are likely to become more common, and more competitively priced, in a mature GHG offsets market.
- *Offsets Approval.* The government can develop streamlined procedures for approval of offsets.

A Theoretical Construct for Understanding the Effects of Transactions Costs

In many of the standard approaches that evaluate new investment opportunities, businesses are presumed to maximize a well-defined profit function that arises from a highly stylized set of market and technological conditions. It is assumed that resources are utilized

in an entirely efficient manner. Moreover, they are assumed to have perfect information without the complications of decision-making costs. Or, the analysis assumes that industrial firms face high implicit discount rates that are invariant over time, regardless of the market conditions confronting them. In fact, both theory and empirical evidence provide compelling grounds for believing that energy or environmentally related decision making processes may differ in significant aspects from the way these activities are represented in standard economic models. As a result, the standard numerical simulations do not allow policy makers to assess the full range of options for effective and efficient energy efficient policies (Laitner et al. 2000).

A usual formulation for project evaluations is that if the discounted value of savings exceeds the investment cost of a project, then it is assumed that a project will be adopted. For example, if an industrial firm requires an internal rate of return of 33 percent before it chooses to adopt a new technology, then capital costs are usually compared with net energy savings to determine whether that threshold is met. A $750,000 project, for example, would need to save a minimum $250,000 per year to meet that level of return (assuming a 15-year project life with no change in operating and maintenance costs or other expenses). But if transaction costs are significant, pushing total costs from $750,000 to one million dollars, the 33 percent return (or roughly a 3-year payback) now becomes a 25 percent return (or a 4-year payback). Even though the project would certainly be considered cost-effective at a 25 percent return, under the customary analytical treatment it would be assumed that the project is not implemented since the return is less than the desired hurdle rate of a 33 percent return.

In a hypothetical project such as this, the transaction costs might consist of several parts: (a)$50,000 in choosing and scoping a project; (b)$80,000 in financing costs (c) $50,000 in the form of insurance, (d) $60,000 in negotiating costs; and (e) $10,000 in licensing costs. These total to $250,000. As institutions and government programs evolve, however, the costs in this example might decline to $150,000. Under these combined circumstances, the total costs might fall to $900,000 with an implied 28 percent return (or roughly a 3.6 year payback).

The same factors that reduce specific transaction costs (market experience with technology, development of brokerage entities, public information etc) can also effectively reduce perception of risk. In addition to transaction costs, projects involving new technologies are also subject to an effective barrier if investors perceive them to be risky. There is an extensive literature on risk and the effect of “risk premium” on investments as shown in Hassett, et al (1993), and many others. As the market gains more experience with these investments, the magnitude of the risk premium might also drop. This is especially the case if government programs help reduce the perception of risk by providing information or funding demonstration projects. If a project is perceived to be risky, and has high transactions costs, it is significantly less likely to be implemented. Reductions in both of these factors, especially as they can be accomplished with similar policies and programs, would benefit the market for industrial energy efficiency. To take the case of this hypothetical project, in which the total costs might fall to $900,000, there is an implied 28 percent return. At this point, the firm might decide that with a greater likelihood of success, and with lower than expected transaction costs, a 28 percent return would be acceptable. Consistent with the findings of Ross (1986), this change in behavior would be seen as consistent with the idea that a firm might now view a project as a strategic rather than purely

discretionary investment. As a strategic investment, it would be satisfied with a lower return on investment.

In this example, then, we've seen three different elements of investment decisions all affected by so-called transaction costs. The first is that such costs might otherwise lower the expected return when compared to an evaluation based only on equipment or technology decisions. The second opens up the possibility that changing or evolving institutions, as well as government supported programs, may lower such costs in ways that encourage or accelerate such investments. Finally, actively managing transaction costs, either internally or through sound programs and policies, might alter firm behavior in ways that reduce the expectations or need for higher returns that also encourage new investments.

A Specific Example

To illustrate and attempt to quantify the impacts of transactions costs, Trexler and Associates (2002a, 2002b, and 2002c) has compiled a number of reports on hypothetical GHG offset projects in specific sectors, and estimated the associated transactions costs. These reported transactions costs were based on published literature, and Trexler's own experience as a project developer. The report on a biomass co-firing project provides estimates for a hypothetical 100 MW coal burning power plant which will install the capacity to substitute biomass for ten percent of typical coal consumption. For this example, the project lifetime is ten years, and there is a prevailing carbon price of three dollars per metric ton of CO_2. This is actually a complicated project, in that the benefits of installing a biomass co-firing capacity are not only related to net emissions of GHGs, but also reduced emissions of conventional pollutants. Consequently, not all of the transactions costs of the project are attributable to the GHG offsets, but it is also more difficult to prove that the emissions reductions are "additional," and that they should be credited by an official body.

This project reduces net emissions by 60,000 tons per year[1], and discounted at eight percent per year, the present value of GHG offset revenue total is $1.2 million. The costs listed below are the costs specifically required to secure the GHG offset revenue, and are assumed to apply to a project implemented in an early stage of a GHG reduction requirement. Table 3, on the following page, lists the identified costs. Note that some costs, such as an environmental impact statement, permit and licensing fees, and arranging financing are transactions costs that would be incurred in order to secure the benefits of reducing conventional emissions, and are not attributed to the GHG offsets in this example. There is no reliable information available on the costs of GHG offsets insurance and, though these costs are non-zero, they are not reported here. Similarly, organizational change costs and training costs are firm specific, and difficult to estimate. These costs are also positive, and potentially significant, but they are not included in Table 3.

The table below assumes that the firm attempts to market the GHG offsets to other companies. If, instead, the firm faced it's own GHG reduction requirement and intended to use the credits to meet its own obligations, then certain costs, such as GHG marketing, GHG offsets negotiations, and attorney fees for enforcing contracts drop to zero.

Transactions costs for GHG reduction investments, are, of course, sensitive to the expected market price of GHG offsets. If the prevailing price were higher than three dollars,

[1] The project description explicitly assumes that the biomass used as fuel is grown specifically for that purpose, and implicitly, assumes that land is replanted and that the new biomass sequesters carbon as it grows.

then GHG offset marketing costs would climb, as these are typically brokerage fees paid on the value of the transaction. GHG insurance could also be more expensive.

Finally, as the market gained more familiarity with GHG offset projects and valuing the risks associated with them, many of these costs would be expected to fall.

Table 3. GHG Related Transactions Costs for Hypothetical Project

Category	Estimated Expense
Identifying the Project	$3,000
Identifying Project Partners	$2,000
Feasibility Studies	$8,000
Demonstrating "Additionality"	$25,000
GHG Offsets Negotiations	$50,000
GHG Offsets Insurance	not estimated
Organizational Change	not estimated
Training	not estimated
GHG Offsets Marketing	$126,000
Emissions Monitoring	$54,000
Third Party Validation and Verification	$43,000
Attorney Fees	$75,000
GHG Offsets Approval	$4,000
Total	$390,000

Discussion

The estimated costs of $390,000 represent about thirty three percent of the expected net present value of the sale of GHG offsets.[2] Including estimates of insurance, organizational change and training would certainly raise this total. If GHG offsets are trading at relatively low prices, transactions costs can constitute a significant fraction of the costs of a GHG offset, and, obviously, if these costs can be reduced, more transactions would be facilitated. As some transactions costs are effectively fixed, smaller projects would likely face large relative transactions costs. It is possible that an offsets policy could exempt small projects from certain requirements, but it is also possible that the market could facilitate the implementation of these projects through the development of brokerage services.

Conclusion

Even when found to be cost-effective on a purely hardware or equipment basis, a large number of projects may not be implemented. The reason is that transactions costs are also an important consideration in the project analysis — not only to investors who have to

[2] Note that this is consistent with the findings of Delmas and Mazurek (2001) of average transactions costs associated with EPA's Project XL of $325,000. While not particularly comparable in that the goal of XL was not explicitly the registration of tradable carbon offsets, these were changes in approach at large facilities which involved financing, negotiations, outside review and organizational change.

pay them, but also to policy makers interested in promoting greater levels of investment in energy efficient technologies or clean energy projects. The costs can be significant, but when they are identified, there are a number of approaches to reducing them. From the perspective of increasing investments in industrial energy efficiency projects, it is helpful, of course, to reduce the costs of the technologies, but it is also helpful to streamline institutions and encourage the development of market structures that minimize the transactions costs as well. Clearly, understanding transactions costs is an important first step in reducing them. Despite preliminary efforts to evaluate their potential impact (see, for example, de Bruijn and Norberg-Bohm 2001), to date, there is very little specific data available on specific projects in a wide range of sectors. Additional research on the subject is needed to understand the potential for greater market penetration of both industrial and emission offsets projects, and for designing flexible, market-based public policy instruments that reduce transactions costs. Hence, the collection and review of credible and well-defined project data is a crucial need.

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