Efficiency Valuation: How to "Plan, Play and Settle" Energy Efficiency Projects

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ABSTRACT

The return on investment from energy efficiency is termed "savings" or avoided cost. ESCOs, equipment vendors, project developers, facility owners, and financial institutions all desire accurate assessment of the achievement of savings from their energy efficiency projects. The best way to ensure the long-term achievement and persistence of energy savings is to establish, up-front, a cost-effective measurement and verification (M&V) plan that is followed throughout the useful life of the energy assets installed. Energy efficiency projects can be modeled as investment decisions under uncertainty. Efficiency projects occur in the physical world, but are justified through financial determinants. In the simplest sense, an efficiency project is no different from any other investment. However, such projects present unique difficulties in quantifying the value and risk resulting from the investment. While it may seem obvious that efficiency is a good idea in general, it is far from obvious how to conduct the valuation of projects in a manner that is efficient both in terms of quantification of energy (physical settlement) and financial appropriation of the resulting value (financial settlement). A major barrier to the development of efficiency projects is the cost associated with establishing a baseline and measuring the results. One leading document in the M&V arena is the International Performance Measurement and Verification Protocol (IPMVP). The IPMVP addresses issues and provides a framework to make decisions, but stops short of providing a financial decision framework. Lacking a means to arrive at the proper amount of metering for a particular project, many people opt to stipulate the results, thereby introducing a large amount of uncertainty in the project valuation. Engineers and project financiers must agree on the accepted level

of risk and M&V requirements. This article discusses a framework for performing efficiency investment valuation and making decisions based on the combined physical and financial uncertainty—or how to "plan, play, and settle" energy efficiency projects.

INTRODUCTION

Energy and environmental issues continue to be front page stories around the world. From Rome to Beijing, the kind of power shortages that became headlines in California several years ago are spreading around the globe. In addition to the strains on the energy infrastructure created by fast growth—in both established and developing economies—the connection of energy development to climate change is now being considered at the highest levels of government. The UN's Kyoto protocol was adopted, and at the 2005 G8 Summit climate change and the related need for further action to control emissions topped the agenda.

Global energy consumption of all types continues to grow. Less developed nations are still building infrastructure to serve their populations. More developed nations continue to increase their per capita consumption of energy. Globally, electric power capacity is forecast to grow by 3,000 GW over the next 25 years. [EIA04] Much of this capacity will be generated with fossil fuels. All of this energy growth will occur in the context of increasing concern about the impacts that energy systems have on the global environment and the security of energy supplies.

A reliable supply of electric power is considered a necessity for development in an increasingly competitive economic world. Forcing people to "make do with less" is not a strategy that will work in the modern economy. The question facing policymakers, regulatory bodies, private corporations, financiers, and average citizens around the planet is how to balance investments in necessary supply, while mitigating the impact of our growing demand for reliable energy.

EFFICIENCY INVESTMENTS— ASSETS, BEHAVIOR, AND EXTERNALITIES

Clearly, the costs of our growing thirst for energy are beginning to shift the focus from supply-only solutions towards demand-side solutions. Increasingly, the demand side of energy development is seen as a preferred sector for investments that can address the problems of strained capacity and environmental impacts. The most obvious way to mitigate energy impacts is to assure that energy productivity is maximized. Whether by reducing negligent waste of energy, optimizing existing physical systems, or retrofitting with newly available technology, energy efficiency is a common sense part of the long-term solution. And given that efficiency can eliminate the need for some of the expected investment on the energy supply side, it can make good economic sense at every level. Deciding to be efficient is simple; deciding how much to invest in efficiency, whether at the level of nations, regions, or households, can be difficult. Furthermore, having made investments in efficiency programs and projects, it is often difficult to evaluate the financial benefit of those investments.

Energy supply and demand issues did not begin recently. In most countries the energy sector has been regulated, and decisions regarding the optimal mix of supply and demand investments took place within a legislative and regulatory environment. In the past 20 years, natural gas and electricity markets worldwide have been converting to more market-based approaches. "Deregulation" has added a number of new opportunities for valuing energy efficiency. For the most part, however, the energy efficiency market is still experimenting with mechanisms to internalize energy externalities in retail energy prices. Market-based instruments (MBIs) hold the promise of efficiently apportioning the risk and value of energy efficiency investments, but they are still in their infancy. [Bertoldi05] In fact, regulatory uncertainty resulting from some deregulation experiments has increased the overall uncertainty of the value of energy efficiency.

What are the rules that will guide the massive new investments in efficiency? Who will assist in setting the standards for "measuring" the results of energy demand-side investments? Who, in more colloquial terms, will help the industry "plan, play, and settle" its energy efficiency projects?

The efficiency valuation organization (EVO) provides tools to evaluate these investment decisions and manage the risks in efficiency development. In fact, EVO is the only organization in the world solely dedicated to creating measurement and verification (M&V) tools to allow efficiency to flourish.

THE INTERNATIONAL PERFORMANCE MEASUREMENT AND VERIFICATION PROTOCOL

EVO, through its flagship product the International Performance Measurement and Verification Protocol (IPMVP), has been assisting public and private decision-makers on this issue for over ten years. Starting in the 1990s, standardized approaches to energy efficiency M&V were prepared to assist developers, owners, and financiers of projects. Today, the EVO-owned IPMVP is the leading international standard in M&V protocols. IPMVP has been translated into ten languages and is used in more than 40 countries. Five thousand copies are ordered or downloaded annually. IPMVP's flexible framework has proven successful in all types of programs and projects, and its use has grown as a consequence. (The present article explores the founding concepts of the IPMVP. For specific real-world examples of its use, readers are encouraged to visit *www.evo-world.org* to view IPMVP training presentations and learn of upcoming training workshops.) EVO protocols allow financiers and project implementers to make decisions informed by the real risks that exist. Hence, energy-efficiency investments can be evaluated against other options.

CONTRACTING EFFICIENCY

Efficiency is delivered in many ways, but most of us are familiar with two predominant mechanisms—public programs and private contracts (including internal company decisions). In both of these cases, the relevant decision-makers seek to calculate the cost and benefit of the efficiency investment. Investment decisions under uncertainty are a common problem that is well addressed in the economic and financial literature (see *www.decisioneering.com*). On the energy supply side, there are a number of tools available that collectively comprise the energy risk management industry. Despite some setbacks to the industry in the U.S., the use of financial risk management tools such as forward contracts, long-term contracts, options, and swaps is growing worldwide and is an accepted form of risk sharing. Tools for managing risk on the supply side help dampen, but not eliminate, volatility of the value of demand side savings, or "negawatts." The simple fact is that when one makes an energy efficiency investment, there is often very little chance of knowing what the actual value of savings will be more than a year or two hence. Ignoring this uncertainty, as most energy efficiency planners do now, does not make it disappear. In fact, when energy efficiency is allowed to compete directly with other sources of supply in terms of value *and* risk, it can often provide a more attractive investment. [Mathew04]

Public programs have had to adapt to meet the changing regulatory structures of energy markets. In the past, regulators would allow or disallow certain expenditures of the regulated entity. As efficiency became a higher priority in the 1970s, regulators adopted new methods to unbundle supply and demand investments and incentives, allowing utilities to earn money from it. More recently, deregulation (and partial re-regulation) of energy markets has advanced at different speeds around the planet, creating a wide range of regulatory environments. Efficiency valuation in each case is a function of market structure and incentives. And often the greatest risk facing many efficiency investments is the lack of a stable regulatory process.

In private contracts for energy services, the parties must allocate the responsibility for energy asset purchase, maintenance, and long-term energy use. A common form of energy service contracting involves a host facility and an energy services company (ESCO) under an agreement called an energy savings performance contract (ESPC). The ESPC contract outlines the responsibilities of the host and the ESCO. The goal is to optimize the productivity of the host facility. These site-specific contracts allow the parties to allocate all of the risks associated with the project. However, finding the optimal mix of efficiency investments for any plant requires knowledge of future incentives. As energy efficiency investments can have terms of well over 10 years, the valuation uncertainty can be significant.

When contracting for efficiency, whether at the level of project of program, baselines are problematic. [Borenstein02] To allow risk metrics to be incorporated into efficiency investments, public and private efforts must identify and compile data on project intrinsic volatilities (those energy consumption elements directly affected by changes within the facility and thus measurable, verifiable, and controllable, including the energy volume risk, asset performance risk, and energy baseline uncertainty risk) and project extrinsic volatilities (those energy consumption risks which are outside the facility and hedgeable, including energy price risk, labor cost risk, interest rate risk, and currency risk), as well as on energy audits, measurement, and verification.

RISK TERMS—TIME, COST AND VALUE

As noted above, the IPMVP has become the international standard for quantifying the results of energy projects. Also as noted, this only applies to the physical quantities of energy saved. There remains in every case the challenge of translating the physical impact into financial rewards. As discussed in the previous section, energy markets worldwide have attempted to deregulate with varying degrees of success. Even within fully regulated energy markets, the number and complexity of rate structures precludes a simple solution to this problem of translating physical results to financial value. Indeed, a classic 1961 text on rate structure design, "Principals of Public Utility Rates," identified the need for price certainty to allow energy consumers to make informed purchasing decisions. [Bonbright61]

Nothing of substance has changed. The uncertainty to potential investments in energy efficiency is first and foremost in the hands of the regulators who set the tariff and other incentives. The following are the most important terms in the efficiency valuation equation:

- Tariff: Regulated utilities perform a host of calculations to come up with equitable tariff structures. The impact of tariff design on efficiency incentives is obvious. Recently, there has been an increased interest, and increasing debate, on the role of retail tariffs that include time of use (TOU), real-time pricing (RTP), and demand-response programs (DR). Each of these tools is forced to make a compromise between complexity of implementation and equity among market participants.

- Externalities: Emissions credits, NO_x, SO_x, CO_2, security. While still in its infancy, there is a growing interest for instruments that efficiently allocate the external costs of energy use. Indications from early trading of CO_2 credits has not yet risen to the level that will significantly impact project valuations, but with increased use there is a growing chance that these policy instruments will benefit energy efficiency investments. [Bertoldi05]

- Hedge Value: Energy consuming assets represent a "short" position in the energy markets. A "short" position is risk terminology that implies a relationship between future energy prices and price risk.

Modern energy supply markets allow energy producers and end-users to protect against the negative impacts of volatility by using financial instruments known as hedges. Hedges are effectively insurance instruments where a market participant can pay a relatively small amount to reduce the uncertainty in future prices. Energy efficiency projects provide exactly the same risk reduction function, and hence represent an equivalent value to the implementer.

- Productivity: Easy to qualify, difficult to measure. The purpose of any energy-using device is to create some value for the end-user. In the case of commercial and industrial end-users, the economic productivity of energy assets can be measured precisely. Technological innovation in energy efficiency often includes innovations that improve the productivity of the system as a whole. One example is the improved lighting quality provided with electronic ballasts. Energy calculations alone may not capture the increased value from improved technology.

- Associated Maintenance Cost Reductions: Owning and operating an energy asset entails costs beyond just the raw fuel. Efficiency valuation must include all of the life-cycle costs of asset ownership.

THE RESPONSE—PUTTING A VALUE ON UNCERTAINTY

Assuming that we can assign expected values and uncertainties to the above-mentioned terms in the efficiency valuation equation, what is the role of verification and how much should be spent on it? The IPMVP was designed to help parties develop an M&V plan for their specific project. Because the universe of possible projects/investments is effectively infinite, the IPMVP recommends that the parties involved in the contract take three steps.

First, identify all of the values and risks resulting from the energy project. Second, assign responsibility for each of the risks and values. Third, create a cost-effective M&V plan that takes into account the specific risks for that project.

It is critical to match the physical results to the potential financial value. And it is equally critical that M&V costs be kept reasonable. The goal is to design the optimal "negawatt meter."

BUILDING A NEGAWATT METER: HOW TO MEASURE THE ABSENCE OF ENERGY USE

The concept and much of the economics of energy efficiency as a resource are not new (Franklin's stove revolutionized wood burning and was a hit in the 1750s), but relying on large-scale efficiency investments to meet future loads is a relatively recent phenomenon. The concept of relying on "negawatts" was put forth by Amory Lovins 20 years ago [LovinsX89], and is continuing to influence energy supply procurement decisions.

Investing in negawatts is a powerful idea. However, there remains the question of how to accurately measure and value them and assess the return on investments in efficiency, both large and small. The supply side has its metering industry for quantifying consumption and billing the user. The demand side needs to continue to improve negawatt consumption and billing meters.

The metering and billing industry is aware of the complex needs of the supply side of the energy marketplace. From simple to smart, meters are used to quantify, value, and settle the usage of energy commodities. The complexity on the demand side is doubled. The IPMVP design for quantifying savings requires two "meters." One is used to record the baseline and post-retrofit consumption. This meter looks like, and often is, the standard billing (watt, Btu, gpm) meter. But M&V requires a second meter, one that we call the "what would have happened" meter. This virtual meter is the output of a model that indicates what energy consumption would have been in the absence of the energy-efficiency investment.

As we can see, savings are a bit more complicated to "measure" than commodity supplied. In fact, IPMVP supports the idea that savings, since they don't exist, cannot be measured directly. Consumption, performance, and operational parameters can be measured. Savings are calculated using the two "meters" mentioned above, and this calculation introduces some uncertainty into the quantification of savings.

And it's not just the quantification that induces uncertainty. Other market-related terms in the energy efficiency value equation induce uncertainty as well—values such as carbon mitigation and volatility of energy markets. Investment capital will flow to energy efficiency projects and be priced to the degree that these risks and rewards are "better" or "worse" than other investments. This context provides the opportunity for a new approach to energy efficiency investments that focuses equally on risk and reward. The mantra of this new approach is "identify, quantify, manage… risk." The expected return from most energy efficiency investments is often well above other investments with equal risk profiles. The leap required to clear the investment hurdle is an effective risk evaluation to accompany the expected value of the investment. The goal of EVO and IPMVP is to identify, quantify, and manage these risks, not ignore them.

CONCLUSION

Energy supply, and the consequences of energy use, will continue to be a dominant environmental and security issue for our life and times. Energy demand-side solutions will increasingly be looked upon to address these challenges, and demand-side investments will be a source of solid value to those who know how to manage the risks. Whether as a common sense decision or a smart financial investment, energy efficiency will benefit from better tools for calculating the value and uncertainty of planned efficiency activities. Efficiency valuation goes beyond the quantification of physical results by addressing the financial uncertainties associated with the avoided costs. Efficiency valuation acknowledges risks and seeks to quantify and manage them—not ignore them. The goal of EV is to identify the optimal mix of planning, modeling, measurement, and analysis to accompany energy efficiency investment projects. Enhanced efficiency valuation will lead to increased investment in energy efficiency projects. The Efficiency Valuation Organization will build on the international success of the IPMVP to advance the application of cost-effective M&V around the globe.

References

[Bertoldi05] P. Bertoldi, S. Rezessy, O. Langniss, M. Vogt, "White, Green & Brown Certificates: How to make the most of them?," ECEEE Summer Study on Energy Efficiency, June 2005.

[Bonbright61] J.C. Bonbright, A. Danielsen, D. R. Kamerschen, "Principals of Public Utility Rates," 1961.

[Borenstein02] S. Borenstein, M. Jaske, A. Rosenfeld, "Dynamic Pricing, Advanced Metering, and Demand Response in Electricity Markets," Hewlett Foundation Energy Series, October 2002. Found at http://www.ef.org/documents/DynamicPricing.pdf.

[Dreessen05] T. Dreessen, P. Langlois, "Practical Experiences in Applying Savings M&V," 2005.

[EIA04] Energy Information Administration, "Annual Energy Outlook 2004," 2004.
[Lovins89] A. Lovins, "The Negawatt Revolution: Solving the CO2 Problem," CCNR Green Energy Conference, Montreal, 1989. (found at http://www.ccnr.org/amory.html).
[Mathew04] P. Mathew, S. Kromer, O. Sezgen, S. Meyers, S., "Actuarial Pricing of energy efficiency projects: lessons foul and fair," Energy Policy, 2004.

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