

# Efficiency valuation – concepts and practice

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## Abstract

Energy efficiency projects can be modelled 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. The primary difference is the difficulty 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 Measurement and Verification (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. Both the engineers and the bankers shall agree upon the accepted level of risk and M&V requirements.

This paper discusses a framework for performing efficiency investment valuation and making decisions based on the

combined physical and financial uncertainty, and the value of information resulting from the M&V plan. The authors hope that wider discussion on this topic will lead to a growing body of expertise on efficiency valuation techniques and thereby enhance investment in efficiency.

## Context – Efficiency Investments – Assets, Behaviour and Externalities

Global energy consumption 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. Global electric power capacity is forecast to add 3 000 GW of capacity over the next 25 years (EIA, 2004). 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 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. (Barnett, 2004). The question facing policy makers, regulatory bodies, private corporations and average citizens around the planet is how much to invest to mitigate the impact of our growing thirst for reliable energy.

The most obvious way to mitigate energy impacts is to assure that the 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 efficiency is not difficult, deciding how much to invest in efficiency, whether at the level of nations, regions or households, can be very difficult. Furthermore, having made investments in efficiency programs and projects, it is often very 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 (Bertoldi, 2005). In fact, regulatory uncertainty resulting from some deregulation experiments has increased the overall uncertainty of the value of energy efficiency.

In response to this need for better tools to predict and measure the results of energy efficiency projects, the US Department of Energy, in 1994, initiated a program to assist the efficiency industry to account for efficiency projects. The result was the International Performance Measurement and Verification Protocol (IPMVP, 1997). The IPMVP has been revised twice and is undergoing its third revision in 2005. The IPMVP is currently the only international standard for assessing efficiency impacts (often mislabelled "savings"), but it is hardly the only tool available. Nor is it complete in its approach. As noted by Jim Waltz, the IPMVP is a good beginning, but it has failed to answer the question of how to attribute financial value to physical impacts (Waltz, 2004). In fact, the IPMVP misses on another score. While it is useful for getting parties to create the right measurement strategy (M&V plan) for their particular project, it does not provide guidance on reporting the uncertainty in this process. The lack of risk metrics to go along with expected results greatly reduces the attractiveness of energy efficiency as an investment (Mills et al. 2004).

Recognizing that the current IPMVP was of limited use in assessing the financial viability of energy efficiency investments, the IPMVP organization has adopted a new mission and a new name – the Efficiency Valuation Organization (EVO). The new mission is "to develop and promote the use of standardized protocols, methods and tools (EVO Protocols) to quantify and manage the performance risks and benefits associated with end-use energy efficiency, renewable energy, and water efficiency business transactions." The goal is to create a globally recognized center of excellence on quantifying the physical and financial benefits of efficiency projects. Regions and nations may vary in the policies they choose to address energy impacts, but the underlying economic principals of energy efficiency projects are shared around the globe. Regulators, policy makers and practitioners will benefit from a common terminology and framework for assessing and assigning efficiency value.

EVO will provide guidance on identifying and quantifying all of the value that result from energy efficiency investments. In the simplest case, the only term in the value equation will be the quantity of energy saved times a flat rate for that amount. In more complicated cases the value equation will incorporate MBIs and advanced economic valuations such as hedge value.

## 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 (Decisioneering). 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 to dampen, but not eliminate volatility of demand side estimate for the value of "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 (Mathew *et al.* 2004).

Public programs have had to adapt to meet the changing regulatory structures of energy markets. In the past, regulators would allow or dis-allow certain expenditure of the regulated entity. As efficiency became a higher priority in the 1970's, regulators adopted new methods to unbundle supply and demand investments and incentives, allowing utilities to earn money from it. More recently, deregulation (an 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. In California, while the governor, legislature and regulatory officials all agree that efficiency will be a priority in future resource planning, there is no clear picture on how tariffs and incentives will be designed to implement this policy. It is perhaps ironic that 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 a 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 or program, Baselines are problematic.

(Borenstein, S., Rosenfeld, A, "Demand Response and Real Time Pricing")

In the case where the public interest in an absolute reduction in energy consumption (or associated emissions) the efficiency valuation procedures are simpler, but less forgiving (needs work)

- **Project Intrinsic Volatilities**—those energy consumption elements directly affected by changes within the facility, and are thus measurable, verifiable, and controllable. This includes the energy volume risk, asset performance risk, and energy baseline uncertainty risk.
- **Project Extrinsic Volatilities**—those energy consumption risks which are outside the facility, and hedge-able. These include energy price risk, labor cost risk, interest rate risk, and currency risk.

In order to allow risk metrics to be incorporated into efficiency investments, the authors advocated for public and private efforts to identify and compile data on both the aforementioned intrinsic and extrinsic volatilities and on energy audits, measurement, and verification.

### Risk Terms – Time, Cost and Value

Earlier we mentioned that the IPMVP has become the international standard for quantifying the results of energy project. We added that 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. It is perhaps ironic that the 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 (Bonbright, 1961) (<http://www.terry.uga.edu/bonbright/about/center/>).

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

#### Externalities – emissions credits, NO<sub>x</sub>, SO<sub>x</sub>, CO<sub>2</sub>, 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<sub>2</sub> 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 (Bertoldi, 2005).

#### 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 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 previously 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 to 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.

As mentioned above, 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". The design parameters are

the expected uncertainty in the measured system and the measurement uncertainty of the instrumentation. The optimizing equation requires the designer to place a value on the marginal reduction in uncertainty from the last increment spent on the M&V system.

We now get to the final problem of efficiency valuation. We have outlined above how energy efficiency projects are similar to other investments in that there is a unique risk and reward relationship for each project. Some of the project risk results from regulatory and market uncertainty that affect the underlying value of the savings. Other terms in the value equation add uncertainty to project value as a result of related market values such as Carbon mitigation, volatility of energy markets and productivity of the plant. 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. It is in this context that the authors see the opportunity for a new approach to energy efficiency investments that focuses equally on risk and reward. The mantra of the 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.

This provides a context to answer the question "how much should I spend on M&V"? Where a value can be placed on identifying and potentially reducing the uncertainty in the investment, the proper expenditure on M&V occurs when the last increment (marginal cost of M&V) equals the marginal value from risk reduction. While easier said than done, this approach informed the M&V planning of a large (\$300M) DSM program that sought to optimize M&V expenditures (Mathew, *et al.* 2004).

The goal of the M&V activity was to mitigate, not eliminate, the uncertainty in a large portfolio of energy efficiency investments. The approach to cost-effective valuation included the creation of a data-base of results of energy projects. The database was designed as an actuarial tool. It included reported results from a range of programs and projects. Where possible, uncertainties were included with expected value of project results.

The authors recommend further research in and support of large-scale databases to document energy efficiency results and promote investment.

## Conclusion

Energy efficiency will always be a preferred mechanism for managing our energy future. 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, modelling, 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.

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