Considering Risk and Investor Value in Energy Efficiency Business Models

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ABSTRACT

Utility management often views energy efficiency (EE) programs with somewhat limited enthusiasm because EE programs limit future investment opportunities and can negatively impact utility profitability. Most regulatory and ratemaking mechanisms designed to mitigate negative financial impacts focus primarily on restoring profitability, but that singular focus on the utility's earnings ignores the other key value drivers of the utility's stock price—namely, risk and investment scale. We discuss the drivers of investor value creation and value destruction as they relate to EE and quantify changes in utility stock prices based on investment options that vary in terms of risk and scale. The analysis shows that many utility incentives and disincentives for promoting EE, in isolation, are not likely to provide an attractive value proposition for utility managers and investors. We also find that the specific utility's financial characteristics determine the magnitude of financial impacts. Such a comprehensive analysis and understanding of investor value can drive progress toward new business models for utilities, ones aligned with clean energy public policy goals. Regulators can use the framework to incent utilities to adopt more sustainable resource portfolios.

Introduction

Energy efficiency is widely recognized as a highly cost-effective resource in terms of meeting customers' energy service needs. As the saying goes the least expensive kWh is often times the one that is never produced.

Yet, from the utility's perspective, energy efficiency has negative impacts on revenues and profitability (Cappers et al., 2009). Because a utility's collected revenues are largely driven by retail sales and demand, any reduction in sales and peak demand resulting from energy efficiency program impacts reduce utility revenues. Utilities have a financial incentive to manage costs between rate cases and will see achieved profits and rates of return on equity increase over that time if the reduction in operating expenses is greater than the loss in revenue between rate cases. However, if the reverse is true and the reduction in revenues is greater than costs, utility profitability and rates of return are eroded. Likewise, by reducing sales and peak demand, energy efficiency may limit the financial growth of the utility, as it may need to defer future capital investments in generation, distribution or transmission assets. Because rate-of-return regulation provides an authorized return on capital investments, shareholders then miss out on the earnings opportunities such investments would otherwise create.

As such, aggressive pursuit of energy efficiency cuts against the financial motivation of utility management, especially for investor-owned utilities (IOU). This has led to relatively low levels of interest on the part of some electric IOUs to vigorously pursue all cost-effective energy efficiency opportunities. To counter this disinterest, Moskovitz (1989) identified over 25 years ago how to change regulatory approaches and procedures to: a) insulate utilities from the reduction in earnings that results from revenue erosion of energy efficiency programs (e.g., implementing revenue decoupling or lost revenue adjustment mechanisms); and b) to provide sufficient financial incentives for utilities to willingly promote efficiency improvements to offset the foregone earnings effect of deferred capital investment (e.g., allowing utilities to earn returns on efficiency expenditures).

Regulators consider and approve such regulatory mechanisms as a way to deliver the benefits of energy efficiency programs to ratepayers while attempting to make the utility financially indifferent towards energy efficiency and possibly financially driven to seek opportunities for increased energy savings. But many approaches often rest on the tacit assumption that utilities unambiguously benefit when profits or earned rates of return increase, regardless of the circumstances. While utilities would consider themselves responsive to their regulators and customer, investor-owned utilities, like any corporation, legally have a fiduciary duty to their shareholders to act in their best interests.[1] Although utility managers may be rewarded financially for meeting or exceeding annual earnings goals, giving them an unambiguous incentive to grow profits or earned rates of return, conditions can and do exist where such actions may still be ill advised as they can adversely affect the utilities' investors.

To comprehensively assess the financial impact of policy changes that support the expansion of utility energy efficiency efforts, one must have a thorough understanding of the conditions under which value is created or destroyed by utility investment decisions. Herein, we develop a rigorous framework for capturing investor value creation based on well-vetted corporate finance principles that quantifies the stock price formation process. Our goal is to use this framework to ultimately gain a better understanding of how investor value and the resulting utility stock price are affected by energy efficiency activities. We also use it to estimate the investor value associated with viable alternative utility investments based on their respective changes to risk, return and investment scale, paying particular attention to risk.

Modeling Investor Value Creation

We can start by turning to a simple and well vetted financial model (Brealey, Myers and Allen, 2006) that estimates a stock's price and is regularly applied in utility regulatory settings – Gordon's (1974) constant-growth dividend discount model.[2] This model derives the stock price based in part on the underlying value from all existing assets, which are subsumed in the book value of, in this case, the utility.

$$(1) \qquad P = \frac{BVPS(r)(1-b)}{k-b(r)}$$

In the model *P* is the stock price, *BVPS* is book value per share, *r* is the return on equity, *b* is the earnings retention rate (the portion of earnings not paid out as dividends), and *k* is the cost of equity. However, the value to shareholders of owning a piece of equity in an investor-owned utility comes, in part, from all previously invested assets, but also from those incrementally made in any single year. Thus, we must expand the stock price formation process depicted in Equation

[1] See for example, *Dodge v. Ford Motor Company* (1919) in which the Michigan Supreme Court found that a firm could withhold a dividend only if that action was based on a clear plan to benefit shareholders (Henderson 2007).
[2] This model assumes the utility's asset base grows at a constant rate in perpetuity. As such, Equation (1) represents the sum of an infinite series of discounted returns from those investments in assets.

(1) to allow for greater insight. In qualitative terms we can think of the stock price as a function of two separable items:

(2) stock price = f(value from existing assets, value from new assets)

The two elements of the stock price formation process depicted in Equation (2) differs. Thus, we extended a more-advanced model developed by Gordon (1974) to arrive at Equation (1).

(3) $$P = \frac{(BVPS)(r)(1-b)}{k-b(r)} + \frac{(r-k)I}{N(k-b(r))}$$

N is the number of shares of common stock outstanding; *I* is the equity capital (in dollars) used to finance a new project. The other variables are as defined earlier.

Unlike in the first term in Equation (3) where so long as $r > 0$ there is always some positive contribution to stakeholder value, the second term illustrates it is the difference between *r* and *k* that dictates incremental value. Shareholder value is created from new utility investment when $r > k$, resulting in the stock price rising, while shareholder value is destroyed when $r < k$ which depresses the stock price.[3]

Enter Risk

With the stock price formation framework in place, the role of return (*r*) and scale (*I*) should be clear, but not so with risk. Risk is a critical variable to consider when discussing a utility's motivation to pursue energy efficiency, as higher return and larger scale investments may create less value for utility shareholders if they have sufficiently higher risk, and vice-versa. In essence, there are two types of risks that affect investors: macroeconomic and firm-specific. Macroeconomic risks (e.g., recession, interest rates, inflation) represent changes in system-wide economic conditions that will positively or negatively affect the value of all firms, albeit not necessarily to the same degree. Firm-specific risks, however, reflect unique changes in a particular firm's economic conditions that will affect that firm's value.

In addition, we must further distinguish between risk as viewed by diversified equity investors and as viewed by utility management. Equity investors see as relevant only the risks that they cannot diversify away. If the investor diversifies broadly, firm-specific (and by extension sector-specific) risks will tend to cancel out as one firm's loss is another's gain. The only risks that are not eliminated in this fashion are those that affect all companies in the economy to one degree or another, risk impacts that portfolio diversification does not eliminate.These macroeconomic risks are the only risks investors demand compensation for in terms of a required return on a stock (i.e., the cost of equity).

In contrast, utility management see all risks, macroeconomic and firm-specific, that affect their company's stock prices as worthy of consideration. Their stocks stand alone in this context - they don't benefit if factors negatively impacting their cash flows which result in losses at their firm are offset by gains at other firms. While utility management see the impacts of risk on the utility's return on equity differently than investors do, that does not mean that they should see the cost of equity any differently. There is only one cost of equity for a firm and it reflects only the

[3] The model can be refined to allow for different *r*'s and *k*'s for existing assets and new assets. In fact we show that the expected returns on the two asset types are likely to be different later on in this paper. However, to show that the *k*'s can also be different is beyond the scope of this paper.

firm's sensitivity to macroeconomic risks from an investor's standpoint. Figure 1 provides a summary of the different types of risks and what metrics they can affect.

	Cost of Equity	Return on Equity
Macroeconomic Risk	●	●
Firm-specific Risk		●

Figure 1. Effects of different risks on financial metrics of interest. *Source*: Authors' creation.

Unlike investors, utility management and regulators can take actions to reduce the firm's sensitivity to macroeconomic risk to some extent. For example, utility revenue decoupling makes a utility less sensitive to recessionary impacts. The more a firm can insulate itself from macroeconomic risks, the lower the return investors will require (i.e., the lower the cost of equity).

To better understand the relative size of macroeconomic and firm-specific risks that investors see as well as to validate our claims concerning where those risks manifest themselves in a firm's stock price formation process, one can analyze actual stock prices and their returns (i.e., appreciation in price plus any dividends paid).

A simple approach to quantifying risk is to construct a measure of volatility over time by calculating the standard deviation of stock returns. Focusing on stocks from different sectors over the past three years, we see that utility stocks have generally exhibited more volatility than stocks from other sectors, including the technology companies and financial firms.[4] See Table 1.

But diversified investors who control the equity markets are not concerned with this sort of volatility per se, but rather with volatility that they can't insulate themselves from via portfolio diversification. A stock's beta coefficient derived from the Capital Asset Pricing Model (CAPM) is a better measure of the degree to which a firm or fund is affected by broad (i.e., macroeconomic) changes in financial conditions.[5]

[4] Utility stock volatility varies over time, but is generally not low relative to other sectors, but rather is close to market averages. For example, from 1950-2015, the standard deviation of annual returns for the Dow Jones Utility Index was 15.9%; the standard deviation for the S&P 500 Index was 16.7% over the same period.

[5] A beta of 1.00 means that the stock price tends to move in tandem with the general market. If the market rises or falls by 10 percent, the stock tends to rise or fall (in the same direction of the market) by 10 percent, on average over time. A beta greater than 1.00 means that the stock price accentuates general market movements. If the market rises or falls by 10 percent, a stock with a beta of 1.25 would tend to rise or fall (in the same direction as the market) by 12.5 percent, on average over time. Conversely, a stock with a beta below 1.00 mutes the impact of broad market movements. A stock with a beta of 0.50 would rise or fall (in the same direction as the market) by about 5 percent in response to a market movement of 10 percent. For a full discussion of the capital asset pricing model, see Brealey, Myers and Allen 2006.

Table 1
Economic sector funds ranked by fund price volatility (standard deviation of annual stock returns)

1.	Energy	17.1%
2.	Materials	16.7%
3.	**Utilities**	**13.6%**
4.	Consumer Discretionary	13.4%
5.	Financials	13.0%
6.	Industrials	12.3%
7.	Health Care	12.3%
8.	Technology	12.0%
9.	Consumer Staples	10.9%

Source: AltaVista Research

Investors will demand higher returns (higher costs of equity) for higher-beta stocks and demand lower returns (lower costs of equity) for firms with low betas because high beta stocks magnify impacts when broad market conditions (the ones investors can't diversify away) change while low beta stocks mute them. All investors feel the impact when the general market crashes, but low beta stocks experience smaller impacts. Looking at the beta metric over the same time horizon for the same set of sectors as is shown in Table 1, we obtain a markedly different, but ultimately more relevant, picture of risk.[6] See Table 2.

In terms of non-diversifiable risk—the risk that determines the cost of equity—utilities are by far the least risky sector to invest in. As such, investors will require the lowest return (i.e., utility stocks have the lowest cost of equity). Since the overall volatility of utility stock prices is not low, however, we must conclude that there is noticeable risk that cash flows can be adversely affected by macroeconomic as well as firm-specific conditions. Those risks affect the utilities' ability to earn returns on equity and therefore affect the price of their stocks through that variable, not through the cost of equity, as shown in Table 1.

Table 2
Economic sector funds ranked by fund beta (raw betas)

1.	Materials	1.24
2.	Consumer Discretionary	1.13
3.	Financials	1.07
4.	Technology	1.03
5.	Industrials	1.02
6.	Energy	0.99
7.	Health Care	0.94
8.	Consumer Staples	0.76
9.	**Utilities**	**0.19**

Source: AltaVista Research

[6] Over the 1950-2015 period the raw beta for the Dow Jones Utility Average was 0.60, noticeably below the market average of 1.00.

The Impact of Investment Risk, Scale and Return on a Utility Stock Price

With a validated assessment of risk and how it affects different metrics in our stock price formation model, we can now turn to an application of that model, by way of an example. Such an approach should enlighten our understanding, through a value lens, of different utility asset investment choices, including energy efficiency, and any associated changes to the regulatory and/or utility business model.

We assume that an electric utility has 1 million shares of stock outstanding, a book value of $30.00 per share, a return on equity of 10.0 percent, a cost of equity of 7.5 percent and it choses to retain 35 percent of its earnings. We assume initially that the firm has no plans to add any new assets. Using Equation (3), its stock price will then be:

$$P = \frac{\$30.00(0.100)(1-0.350)}{0.075-(0.350*0.100)} + \frac{(0.100-0.075)(\$0)}{1{,}000{,}000(0.075-(0.350*0.100))} = \$48.75 \tag{4}$$

Now assume that the utility has the opportunity to add a $15 million asset to its rate base to meet emission reduction requirements. In particular, we'll assume that the utility is investing in carbon capture and sequestration (CCS) technology. If we assume that the plant will earn the same return as the existing book value of utility invested assets the stock price should, upon announcement, rise to:

$$P = \frac{\$30.00(0.100)(1-0.350)}{0.075-(0.350*0.100)} + \frac{(0.100-0.075)(\$15{,}000{,}000)}{1{,}000{,}000(0.075-(0.350*0.100))} = \$58.13 \tag{5}$$

Under these conditions, the new plant will add value for investors because r (10.0 percent) is greater than k (7.5 percent).

However, we haven't yet considered risk. Assume that investors are highly skeptical about the cost estimates for the CCS technology being considered. They assume that there's a 50 percent chance that the investment will cost twice as much as the utility expects, and the regulator will not allow any recovery of the extra costs. If such comes to pass, it will affect future cash flows and hence its achieved return on equity.

Investors assume that the utility will be allowed to earn 10.0 percent on a $15 million investment ($1.5 million of income per year), regardless of whether the utility brings the plant in on budget or at twice the budget (but is ineligible to recover the additional $15 million cost overrun). For this simple example we assume only two discrete possibilities. So in a probabilistic sense, the expected achieved return is not 10.0 percent, but rather:

$$E(r) = \frac{\$1{,}500{,}000}{(0.50)\$15{,}000{,}000+(0.50)\$30{,}000{,}000} = 0.067 \tag{6}$$

As such, impacts on cash flow will reduce the expected achieved return to only 6.7 percent. This will turn the project from value creating to value destroying, because now the expected r is less than k. In addition, the expected investment of capital is no longer $15 million, but rather due to the potential for a cost overrun that is just as likely as no cost overrun, in a probabilistic sense it is:

$$E(I) = (0.50 * \$15{,}000{,}000) + (0.50 * \$30{,}000{,}000) = \$22{,}500{,}000 \tag{7}$$

If the expected investment cost is now \$22.5 million, then using Equation (3) the stock value is:

$$(8) \qquad P = \frac{\$30.00(0.100)(1-0.350)}{0.075-(0.350*0.100)} + \frac{(0.067-0.075)(\$22{,}500{,}000)}{1{,}000{,}000(0.075-(0.350*0.067))} = \$45.12$$

Note that this price decline has nothing to do with the cost of equity, which is the same regardless of the investment. The culprit here is the substantial expected impact on the utility's cash flow associated with the scale of the carbon capture and sequestration technology (\$22.5 million) which manifests itself in risk associated with changes to the return of equity (6.7 percent). Because of this outcome, utility management could look for alternative means of meeting its customers' energy services' needs.

An Energy Efficiency Alternative

Assume that the utility can eliminate the need for the new CCS investment by implementing an aggressive energy efficiency portfolio of programs. This energy efficiency portfolio will reduce the total electricity demanded such that the utility no longer needs this generation facility with CCS technology.[7] The utility management predicts that the regulator will allow full cost recovery for the energy efficiency programs but will refuse to offer the utility a decoupling mechanism or any lost revenue adjustment mechanisms to compensate for the reduction in sales revenue that exceeds the utility's operating cost savings. Therefore, the utility management predicts that the aggressive efficiency effort will reduce the utility's collected revenues resulting in a reduction of its achieved return on equity from the authorized level of 10.0 percent to 9.0 percent. Since this is clearly not due to a macroeconomic event, the utility's cost of equity will again stay the same. The expected earned return on equity for existing assets declines, but the \$15 million CCS investment is avoided. The new stock price would be:

$$(9) \qquad P = \frac{\$30.00(0.09)(1-0.350)}{0.075-(0.350*0.090)} + \frac{(0.09-0.075)(\$0)}{1{,}000{,}000(0.075-(0.350*0.090))} = \$40.34$$

The utility management now has a thorough assessment of its options and their implications for its stock price:

- Invest in the carbon capture and sequestration technology: stock price declines to \$45.12
- Implement an aggressive energy efficiency program: stock price declines to \$40.34

Both cause a loss of investor value (the stock price absent pursuing either option is \$48.75), but the CCS option destroys less investor value than the energy efficiency option despite the fact that the CCS option seems far more risky. The sheer scale of the expected CCS investment and the associated return on that investment is larger than the cost overrun risks, when compared to the risk of revenue loss that affects only existing assets under the EE case. If these are the only options available, the utility management would choose to invest in the former.

Suppose that a utility regulatory affairs manager comes forward at the last minute with a third option. She is convinced she can get stakeholders to support an energy efficiency package that includes the implementation of a revenue-per-customer decoupling mechanism that would be designed to allow the utility to achieve its authorized return on equity of 10.0 percent. The fact that decoupling restores revenues lost to energy efficiency will reduce firm specific risk

[7] We further assume there are no decommissioning costs associated with this plant and that it is fully depreciated, thus leaving the utility with no stranded asset.

affecting the earned rate of return. The energy efficiency program allows the utility to avoid the CCS investment and the decoupling mechanism allows the utility to earn its 10.0 percent authorized rate of return.

In addition, though most utility risk impacts manifest through expectation regarding the return on equity, the decoupling mechanism is likely to have an impact on the cost of equity as well. Since it will further insulate the utility from recessionary impacts (i.e., a macroeconomic event) that would reduce sales, utility investors would demand an even lower cost of equity, say 7.3 percent (a 20 basis point reduction). Under this set of circumstances, the stock would now be worth:

$$(10) \qquad P = \frac{\$30.00(0.100)(1-0.35)}{0.073-(0.350*0.100)} + \frac{(0.100-0.073)(\$0)}{1{,}000{,}000(0.073-(0.350*0.100))} = \$51.32$$

Based on these assumptions and the stock valuation model described in Equation (3), this third option is the clear winner (assuming that the regulator will approve the decoupling mechanism).

An Alternative Generation Technology

Using CCS technology as the supply-side alternative to an aggressive portfolio of energy efficiency programs is an extreme scenario. If we instead use a combined cycle plant fired by natural gas the analysis reveals a different result. Switching technologies will not affect the cost of equity, as a CCGT will be just as affected by macroeconomic forces as the CCS investment would be. It will, however, substantially lower the firm-specific risk that will affect cash flows and subsequently the utility's achieved return on equity. Utilities and their vendors know how to build combined cycle units. Unlike the CCS technology, it is quite likely that the utility can bring the plant in or near budget.

We'll assume that the combined cycle unit costs only $10 million, not $15 million we assumed for the CCS investment, but there is a 50% chance that the cost could be $11 million instead. Investors assume again that the regulator will allow only the original estimate of $10 million to earn the 10.0 percent return, which creates a cash flow of $1,000,000. The effective return under these conditions is then:

$$(11) \qquad E(r) = \frac{\$1{,}000{,}000}{(0.50)\$10{,}000{,}000+(0.50)\$11{,}000{,}000} = 0.095$$

In addition, we must account for the fact that the expected investment cost of the plant is not $10,000,000, but:

$$(12) \qquad E(I) = (0.50 * \$10{,}000{,}000) + (0.50 * \$11{,}000{,}000) = \$10{,}500{,}000$$

Using Equation (3), we can reprice the stock using this expected return on equity of 9.5 percent and an expected capital investment of $10.5 million. The new stock price is:

$$(13) \qquad P = \frac{\$30.00(0.100)(1-0.350)}{0.075-(0.350*0.100)} + \frac{(0.095-0.075)(\$10{,}500{,}000)}{1{,}000{,}000(0.075-(0.350*0.095))} = \$53.85$$

This plant is now the best choice of the four to meet both customers' electricity needs and environmental regulations - the scale of the CCGT investment is lower than the CCS technology but it is also much less risky from a cash flow perspective. The choices are, ranked by stock price.

Table 3
Utility resource choice and stock price

1.	**Combined cycle plant**	**$53.85**
2.	Aggressive energy efficiency portfolio with decoupling	$51.32
3.	Carbon capture and sequestration plant	$45.12
4.	Aggressive energy efficiency program without decoupling	$40.34

The point here is not that building supply-side assets are always more attractive to the utility than pursuing energy efficiency resources even with a decoupling mechanism in place. Instead, **the point is that we cannot tell which option is best without considering all three value drivers—risk, return and scale**.

As our example shows, from the stock valuation standpoint, the winner here has neither the highest expected return on equity, the lowest risk, nor the largest scale. But building the combined cycle plant is nevertheless the option that maximizes the stock price. Knowing which resources the utility has an incentive to pursue is not about generalizations—it's the details that matter.

In this example decoupling elevates the aggressive energy efficiency portfolio from last place to second, but does not make the utility indifferent between all supply-side resources and energy efficiency. In other cases, under different assumptions about risk, return and scale, energy efficiency might be the preferred choice (e.g., adding a shareholder incentive mechanism which would boost achieved returns), perhaps even without decoupling. To know which conclusion might hold the specifics would need to be analyzed.

Conclusion

In this paper we illustrated how analysis resting on sound financial principles can help predict what a stock price will do when a utility is faced with alternative investment opportunities that differ by scale, scope and risk. We were able to create a model that comports with observed utility stock price data and use it to illustrate how different utility investments and changes to the utility business model can differentially affect the stock price.

Clearly, maintaining and, especially, increasing stock prices and shareholder returns is not the objective of state and federal regulators and policymakers. However, we believe the valuation framework presented here matters because it illustrates an alternative perspective concerning what motivates decision makers within a utility regarding the firm's investment choices – namely utility management. If these decision makers indeed focus on the value proposition various investment options present and how each will affect their utility's investors, then it is possible to create an attractive value proposition for utilities to undertake energy efficiency programs which are aligned with regulatory and policy goals, like grid modernization and deployment of clean energy technologies.

Our framework identifies the risk factors that impact both the return on equity and cost of equity, and ultimately the approaches regulators and policymakers may take that lead to a more attractive and sustainable value proposition for utilities. The framework laid out herein should help regulators and policymakers better understand the sometimes opaque set of incentives that drive utility investment decisions, and can serve as a tool in the tool box to help better align utility and policymakers goals and objectives.

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