Submetering Business Case: How to calculate cost-effective solutions in the building context

INTRODUCTION

This document discusses the financial implications of using submetering as a means of energy cost management and reduction in federal facilities or commercial leased buildings. It introduces the concept of submetering and its "value added" applications, and provides key metrics needed for making a business case for submetering efforts as part of new construction or retrofit projects, focusing at the building and system levels.

SUBMETERING & ITS UTILITY

Submetering Defined

Metering is an important approach for improving the energy performance of federal buildings.[1] In its common use, the term metering refers to consumption recording for purposes of billing by a utility company at an installation, campus or building level, which conforms with established accuracy standards and uses utility-grade meters. *Submetering*, however, is the application of metering technology below the level necessary for utility billing. That may mean capturing data for different buildings in a multi-building campus, different floors of the same building, different tenants in a multi-tenant office facility, individual building systems (e.g. heating and cooling, lighting, plug loads), electrical circuits, or even down to specific devices.

While not yet common practice, submetering is a potentially valuable approach for improving the energy performance of federal buildings. *Submetering by itself does not reduce energy use, greenhouse gases, or costs - in fact installing and monitoring the technology will require resources. However, thoughtfully designed submetering programs generate data that can guide management strategies, operational and investment*

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[1] Recent commercial managed and leased buildings with tenant submetering and effectively designed monitoring portals, such as Vornado's "Energy Information Portal (EIP)," are demonstrating the potential extent of energy savings by providing building managers with monitoring and tracking access. More on several New York City cases studies can be found at:
http://www.baruch.cuny.edu/realestate/pdf/Unprecedented-Visibility-Vornado-White-Paper.pdf

decisions, and tenant interaction that ultimately results in significant energy-reduction benefits, whether in federal facilities or commercial leased buildings.[2,3] In the following section, we further discuss the potential benefits of a submetering program.

Utility of a Submetering Program

Applying submetering to the building, system, tenant, circuit, or device levels can provide building utility bill, operations & maintenance, and problem solving value-add at various levels and costs. The value and effectiveness of any submetering effort will depend on its purpose, goals, design, and implementation. Table 4 provides a summary of where submetering can add value, at what level, and to what end and purpose.

Table 1. Submetering Value Add, Application Level(s) and Primary Use

Value Add	Application Level(s)	Primary Use
Energy procurement and billing	Building;	Management
Baselining and optimizing building performance	Building; System;	Management; Diagnostic;
Project measurement and verification (M&V)	System; Circuit;	Management; Diagnostic;
Equipment and Plug-load diagnostic	Tenant; Circuit; Device;	Diagnostic; Research;
Occupant awareness and behavior change	Tenant; Circuit; Device;	Diagnostic; Research;

Submetering programs can offer significant opportunities but likewise need to be keenly focused, purposeful, and sensitive to the return on investment (ROI) of the project. To analyze the estimated return on investment of a submetering program, the estimated savings potential of the project will need to be determined. Below, we discuss the estimated savings potential of a submetering program applied at the building level.

Estimated Submetering Savings Potential

As submetering is not common practice within the federal government, there is a lack of metering data below the building level. This makes it challenging for building and energy managers to estimate the potential energy cost savings of a submetering program or build a convincing business case. However, recent industry research has found that an effective submetering program can generate energy savings of as much as 21 percent in a leased

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[2] FEMP, 2001

[3] Paciorek et al., 2010

building space.[4] Table 2 provides a range of estimated metering savings at the building level.

Table 2. Table of Estimated Metering Savings (DOE 2006)

Action	Observed Savings
Installation of meters	*0 – 2%* Initial impact, but savings will not persist
Bill allocation only	*2.5 – 5%* Improved occupant awareness
Building tune-up and load management	*5 – 15%* Improved awareness, identification of simple operations and maintenance improvements, and managing demand loads per electric rate schedules
Ongoing commissioning	*15 – 45%* Improved awareness, ongoing identification of simple operations and maintenance improvements, and continuing management attention

It is important to reiterate that metering *by itself* does not reduce energy use, GHG's or costs – installing and monitoring this technology will require resources. However, purposeful and carefully planned submetering programs generate data that can guide management strategies, investment, and operational decisions that ultimately bring about energy reduction benefits.

Until more meters are installed in federal buildings and experience can provide agencies with better business case examples of the real-world energy savings, energy managers should be conservative in their energy savings expectations and ROI estimations.

MAKING THE CASE FOR SUBMETERING INVESTMENT

In making the business case for a submetering effort, energy managers must first estimate its cost effectiveness. To assist in doing so, below we discuss three common methods for determining cost-effectiveness: simple payback period, net present

Macy's "Race to Erase Waste" initiative, a competitive effort to reinvigorate associates to conserve energy, used submetering data to track the energy consumption of their 500,000-square foot tenant space in New York City. Macy's estimates that the efforts from this initiative resulted in an actual electrical expense $70,000 less than their aggregated monthly estimate, which was recognized as a credit to Macy's account from the landlord (Vornado) on their 2009 utility reconciliation (Paciorek 2010).

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[4] Bernstein, *et al,* 2011

value, and internal rate of return. The *Guide to Energy Management* states that "the primary criterion mandated for assessing the effectiveness of energy conservation investments in federal buildings is the minimization of life cycle costs." To that end, the latter two of the three methodologies account for the lifecycle cost (LCC) of submetering (i.e. total cost of purchasing and operating over entire lifespan of submetering system) and the time value of money.

Simple Payback Period (SPP)

Simple Payback Period (SPP) is one of the most commonly used cost analysis methodologies. It should be an energy manager's first step in considering the cost-effectiveness of a potential submetering program. The SPP determines the number of years required to recover an initial investment through project returns. The formula is:

$$SPP = (Initial\ Cost)/ (Annual\ Savings)$$

For example, assume an electrical metering system has an initial (installed)[5] cost of $5,000, an estimated energy savings of $1,250 per year, and a maintenance cost of $250 per year. The system's net annual savings is $1,000 (= $1,250 – 250). Therefore, its SPP would be 5 years (= $5,000/ $1,000 per year).

Another application utilizing SPP would be to ***target a desired payback period and use that information to determine the minimum annual utility bill for a cost-effective meter installation***. For example, consider the following assumptions for an electrical metering system being installed at the building level:

1. An electrical metering system has installed costs of $5,000 per meter (assume one meter)
2. Monthly cost per meter is $25, which includes metering operations, maintenance, data collection, storage and analysis.
3. Building-level electrical meter data analysis will save 2% of current annual electricity consumption.
4. Desired SPP is 10 years or less.

With these assumptions in mind, the minimum annual electric bill for this meter installation to be considered cost-effective can be calculated as:

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[5] Installed costs of a submetering program will include hardware (e.g. meter purchase costs, ancillary devices, communications module, etc) and labor (e.g. crew, planning and prep time, operational testing, etc).

$$\frac{\left(\dfrac{\text{Installed Cost}}{\text{Desired Simple Payback Period}}\right) + \text{Annual Cost}}{\%\ \text{Annual Savings}} = \text{Minimum Annual Electric Bill}$$

= [($5000 / 10 yrs) + ($25 per month * 12 months per yr)]/ (0.02) = $40,000

Given the stated assumptions, it would be economically feasible to meter a building with an annual electric bill over $40,000 to achieve a 10 year simple payback period. It meets the SPP criteria identified by EPAct 1992 §152 for energy conservation investments.

The advantage of the SPP cost-effective analysis is the fact that it is simple and easily understood. It will provide a rough measure for evaluating a project's risk and financial viability. *However, this calculation does not consider the time value of money, nor does it consider any costs or benefits beyond the given payback period.* The following two cost analysis methodologies account for these considerations and can offer deeper insight into the financial implications of a submetering investment. After performing SPP, these two methodologies are best practices currently used to vet energy conservation investments and used when making the business case for capital investment.

Net Present Value (NPV)

Net Present Value (NPV) is the difference between the present value of an investment's future net cash flows and the initial investment. This calculation offers a present-day look at the value of the expected future net cash flows (e.g. operating and maintenance costs, savings) of a project. A project may be considered cost-effective if its NPV is greater than zero. The formula for NPV is:

$$NPV = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$$

Where:

N	=	total number of periods
t	=	time period of the cash flow
i	=	discount rate
R_t	=	net cashflow at time t

Drawing on the first example we used of a SPP calculation, assume an electrical submetering system had an initial cost of $5,000 and a net annual savings of $1,000 per year for 10 years. In this example, we make an additional assumption that the organization's discount rate[6] is 10%. Given these assumptions, the NPV of this same submetering project may be calculated as follows:

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[6] Discount rates are often organization-specific and may be supplied by the accounting department. They serve as a standard value for the organization to evaluate investments. The discount rate may also be known as the Minimum Attractive Rate of Return (MARR). Since 1992, the Office of Management and Budget (OMB) has recommended rates for two basic types of discount rates: (1) a real discount rate of 7 percent for public investment and regulatory analyses; and (2) a discount rate for cost-effectiveness, lease-purchase, and related analyses, which are updated annually based on interest rates on Treasury Notes and Bonds with maturities ranging from 3 to 30

1) $$NPV = R_0 + \sum_{t=1}^{10} \frac{R_t}{(1+0.10)^{\wedge t}}$$ R_0 = initial investment	2) $$NPV = -\$5{,}000 + \sum_{t=1}^{10} \frac{\$1{,}000t}{(1.10)^{\wedge t}}$$
3) $$NPV = -\$5000 + \$6{,}145$$ $$= \mathbf{\$1{,}145}$$	

In the SPP calculation, it was determined that this project would pay for itself in 5 years. *The NPV calculation reveals that this submetering system would not only be cost-effective but that it would ultimately add monetary value to the organization* (i.e. its NPV is greater than zero). A project with a NPV less than zero should not be considered cost-effective because it would represent a financial loss to the organization (i.e. its initial investment exceeds the present value of its future cash flows). If a project's NPV is equal to zero, further analysis will be required to determine its viability because it is financially indifferent.

Finally, it can be worthwhile to conduct a subsequent *sensitivity analysis* on NPV calculation results. A sensitivity analysis will offer insight into how the project's NPV will change based on marginal changes in assumptions (e.g. discount rate, estimated annual savings, periods of cash flow, etc). For instance, using the above example, if the project's net annual savings were expected to be $750 instead of $1,000, its NPV would be -$392 (= -$5,000 + $4,608). This relatively small change in the net annual savings assumption would render the project uneconomical. This change demonstrates the necessity for sensitivity analyses as part of determining a metering project's cost-effectiveness, particularly where uncertainty exists in the assumptions. As energy managers' calculations will be based on estimated costs and savings, these estimates should be analyzed to determine if their uncertainty will have a pronounced effect on the project's anticipated economic viability.

Internal Rate of Return (IRR)

Internal Rate of Return (IRR) is the discount rate at which the present value of a project's costs equal the present value of the project's savings (i.e. NPV = 0). If the computed IRR for a project is greater than the established discount rate for an organization, the project may be considered cost effective. Mathematically, IRR can be calculated as:

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years. The rate used may be either nominal or real, depending on how benefits and costs are measured. Rates in 2012 ranged from 0 to 3.8 percent.

$$NPV = \sum_{n=0}^{N} \frac{C_n}{(1+r)^{\wedge}n} = 0$$

Where:		
N	=	total number of periods
n	=	time period of the cash flow
r	=	internal rate of return
C_n	=	net cashflow at period n

Given the complexity of solving for the internal rate of return (r) in this equation, using an economic analysis program, financial calculator, or the MS Excel® formula *IRR(values, [guess])* to help determine the IRR is a recommended timesaver. Using our previous example of an electrical submetering system project, we assume an initial cost of $5,000 and a net annual savings of $1,000 per year for 10 years. Given this, the IRR would be determined in MS Excel® as:

=IRR(-5000, 1000, 1000…1000) = 15%

As the project's IRR is 15%, which is higher than the organization's 10% discount rate (as stated earlier), it represents a strong business case for funding the investment. Just as in the NPV example, it is recommended that building or energy managers conduct a sensitivity analysis on the results of their IRR calculations as well.

Analyzing the SPP, NPV, and IRR of potential submetering program investments can help provide building and energy managers with a clear understanding of and business case for investing in the program. While each of these methodologies provide a glimpse into the project's cost-effectiveness in their own right, when used together, they can provide ever more insight into the project's financial viability and can make a strong business case for (or against) a particular metering program.

> Limited Brands occupies over 350,000 square feet of office space in a Vornado-owned property. The real-time energy data provided by the EIP allowed them to make immediate changes to their energy use, including adjusting temperature settings and reducing the number of active HVAC units in the main server room. Limited Brands was able to reduce energy consumption by over 2,000 kWh per day during the weekdays and slightly more during weekends, representing an annual energy avoidance of 730,000 kWh.

MOVING BEYOND THE FULLY SERVICED LEASE

Tenant agencies in privately owned, fully serviced lease facilities may not have access to energy consumption data or cost incentives to reduce consumption – in such instances, tenant submetering may be worthwhile. For example, Vornado Realty Trust has successfully utilized tenant submeters and its Energy Information Portal (EIP) to engage its commercial tenants and building managers to realize significant energy and cost savings in some of its New York City properties.[7] While data on federal landlords and tenants is

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[7] Paciorek et al., 2010

limited, cost effective submetering alternatives may provide new energy and cost saving opportunities moving forward.

CONCLUSION

Submetering can be a financially viable component of energy cost management and reduction in federal facilities and commercial leased buildings. Methodologies that account for the lifecycle cost of submetering are critical to developing cost effective solutions designed to generate actionable data that guide management strategies, operational and investment decisions, and tenant interaction.

For more information about submetering programs, making a business case, and its application in various lease types (e.g. single-net, triple net, private fully serviced, etc), refer to the supplemental resources below.

SUPPLEMENTAL RESOURCES

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