RECOGNITION OF ENERGY COSTS AND ENERGY PERFORMANCE IN COMMERCIAL PROPERTY VALUATION

Recommendations and Guidelines for Appraisers

December 2000

Prepared by:

Mark Chao and Gretchen Parker
Institute for Market Transformation

For the New York State Energy Research and Development Authority
New York Energy $mart[SM] Program

About the Institute for Market Transformation

The Institute for Market Transformation (IMT) is a nonprofit organization whose mission is to promote energy efficiency in the United States and abroad. The organization's activities include technical and market research, policy analysis, public education, and creation and coordination of program initiatives. Founded in 1996, IMT is headquartered in downtown San Francisco.

The term "market transformation" encompasses various strategies for the creation of permanent, self-sustaining success of energy-efficient technologies in the marketplace. In contrast to traditional energy-efficiency programs, which have tended to focus on piecemeal procurement and installation of efficient technologies, market transformation offers a strategic approach to shift entire market sectors toward a more efficient overall product mix. Market-transformation programs may focus on stimulation of consumer demand as well as supplier innovation. In the United States, market transformation has a growing track record of successful synergy with codes and standards for energy efficiency.

Acknowledgments

The Project on Energy Efficiency and Property Valuation is conducted through the generous support of New York State Energy Research and Development Authority (NYSERDA). NYSERDA is the third-party administrator of **New York Energy $mart^{SM}** programs, which are funded by a System Benefits Charge on users of the electric transmission and distribution systems in New York State.

IMT would also like to thank those the appraisers and energy specialists who contributed their time and expertise to reviewing drafts of this document. They include: Justin Casson, Albert Valuation Group, Inc.; Linda Yancey, Yancey Associates; Robert Gallaher; Raymond Redner; David Scribner, Scribner & Partners, Inc.; John Bentkowski, J. Bentkowski Appraisal Associates; Frank Donato, Roefaro, Dickinson, Donato, & Prumo Appraisal; James Murrett, Fleet Bank of New York; Michael Nevin, Con Edison; Laurie Kokkinides, NYSERDA; Bob Sauchelli, Environmental Protection Agency; Robert Rose, U.S. Environmental Protection Agency; James Park, Appraisal Foundation; Drury Crawley, U.S. Department of Energy; and Ted Baker, American Society of Appraisers.

TABLE OF CONTENTS

I. Introduction

In many types of commercial buildings, energy costs are a significant component of operating costs and overall net operating income (NOI). In New York, such costs typically represent between nine and 27 percent of NOI. Energy costs are also highly variable, depending on the efficiency of the building and its equipment, as well as building type, location, vintage, and other important factors.

Thus, insofar as NOI is a foundation of building value, accurate assessment of energy costs is an important element of accurate valuation. Yet many professional property appraisers tend to use cursory or inaccurate methods for assessing energy costs, and ignore the presence or absence of energy-efficient features or equipment in buildings. Many appraisers commonly use regional-average energy-cost figures as default estimates in NOI calculations. Appraised values therefore often fail to reflect differences between high-energy and low-energy properties.

Accurate assessment of energy costs is an important element of accurate valuation. But actual appraised values often fail to reflect differences between high-energy and low-energy properties.

The Institute for Market Transformation (IMT) has developed this document to offer guidance to appraisers and other real-estate stakeholders on enhanced methods for energy reporting. We discuss various approaches for assessing energy performance in buildings, including identification of equipment and components, examination and normalization of energy bills, and engineering simulations. We also present advanced methods for benchmarking a building's energy performance — that is, generating energy-related "comps." All the technical methods described here are all well established in the fields of building science and energy engineering, and are being broadly implemented already in the commercial building sector in New York and throughout the United States.

Different Methods for Different Cases and Needs

We recognize that appraisers' needs and priorities vary widely from practice to practice and from case to case. We have therefore made an effort to present options spanning a range of complexity, cost, and accuracy.

Many of the methods we discuss are quite simple. They should place minimal incremental burdens of time and money on the appraiser. (Indeed, some important and user-friendly tools are accessible free of charge in seconds via the Internet.) We also present more advanced information, including an appendix discussing basics on energy-efficient materials and equipment, for appraisers who wish to take a more proactive role in assessing energy performance in their subject buildings.

Moreover, even for methods involving more complex energy-related record-keeping and analysis, we envision that the bulk of time and expense would most often fall to the owner, developer, or prospective buyer of the building. Having compiled and analyzed necessary data, the owner, developer, or buyer would provide data from the energy assessment in a summary form for the appraiser. The appraiser's role would be to provide critical review and to assess accuracy and credibility, not to generate the technical analysis from scratch.

Finally, we wish to make it clear that we are offering these recommendations and guidelines for use on a voluntary basis. Insofar as the accuracy of appraisals may be improved without much added effort, we hope that appraisers would consider our recommendations seriously.

Summary of Contents

This document is divided into five sections. Section II offers an overview of energy use in commercial buildings, with a focus on the relative effects of energy costs on NOI. Section III presents methods and procedures by which enhanced energy-related documentation can be used in property valuation. This section describes the methods themselves in some detail, characterizes their relative accuracy and uncertainty, and refers the reader to commercially-available or public-domain tools that apply these methods.

Section IV presents recommendations on benchmarking — that is, locating and using energy-related data for similar properties for comparison with the subject building. Section V discusses technical qualifications, certification, and other assurances of the competence and professional responsibility of preparers of energy-performance documentation.

The Appendix provides a brief overview of common energy-efficient measures, including sections on insulation, windows, lighting, and heating, ventilation, and air-conditioning systems.

Foundations of This Document

The Institute for Market Transformation (IMT) has developed this document on the basis of extensive input from commercial property appraisers. IMT surveyed 141 certified general appraisers in October 1999 in New York State. Surveys focused on their energy-related valuation practices and methods for reporting energy costs. IMT also held two half-day discussion meetings and phone interviews in New York with commercial appraisers, exploring energy-reporting issues in more detail. The conclusions and recommendations in this document reflect the collective insights culled from these contacts.

This document also draws significantly from IMT's previous research into the energy-related practices of certified general appraisers in California. This work was conducted in 1998 and 1999 through the generous support of the Third Party Proposal Program of the Pacific Gas & Electric Company.

In assessing the merits of various building-performance assessment methods, databases, and other technical matters, IMT has also consulted technical specialists in building energy modeling and engineering, developers of analytic software, and architects specializing in energy efficiency. These specialists represent a wide range of sectors, including utilities, private companies, government agencies, environmental groups, industry associations, university programs, and national laboratories.

Limitations

Energy performance assessment for buildings, like all aspects of appraisal, is subject to some uncertainty. While IMT's proposed approaches are expected in most cases to offer lower uncertainty and significantly improved overall accuracy relative to common current methods, the reader should understand that in specific cases, the energy-reporting methods proposed here may yield incorrect results. Wherever possible, the authors have attempted to discuss the conditions and cases under which significant inaccuracies are likely to emerge. Still, it is possible that unforeseen or unidentifiable factors may lead to inaccuracies in estimates of energy cost and energy performance — inaccuracies which could in turn have an impact on real NOI and value. Therefore appraisers and other readers are advised to exercise their discretion and judgment in making use of energy-related information and energy-reporting approaches recommended by IMT.

There exist myriad tools and approaches for tracking and modeling energy performance in commercial buildings. While it would have been impractical for us to address all methods in detail, we have endeavored to include those which represent or have the immediate potential to represent widely-used industry standards. The chosen methods cover a broad range. Still, in certain cases, appraisers may receive energy-related information based on methods not addressed here. In these cases, the appraiser should attempt to assess independently whether it meets criteria of credibility and technical rigor.

The recommendations contained in this document represent the best judgment of the IMT project team, based on currently available information. The emergence of additional information and new technical advances may warrant revision of IMT's recommendations. It is IMT's intent to offer periodic revisions of this document in the future to bring appraisers and other interested parties up to date on relevant changes.

II. ENERGY, OPERATING COSTS, AND MARKET VALUE

Energy and Net Operating Income in Buildings

Energy is often a significant component of a building's overall operating costs. Therefore, to the extent that appraised value is calculated at least in part as a function of NOI, the accuracy of energy cost estimates is an important element of the accuracy of the appraisal on the whole.

Energy is among the largest operating expense items for New York buildings, constituting between 9 and 27 percent of NOI, and is among the largest operating expense items for many building types.

Table 1 presents median energy costs and NOI for office buildings in the major cities of New York. Note that in 1998, energy constituted between nine percent and 27 percent of NOI, and was among the largest operating expense items for buildings sampled. Figure 1 presents the average breakdown of operating costs for office buildings in downtown New York. Other building types and other areas of New York show similar breakdowns, in which energy is the predominant cost item.

High energy prices amplify the importance of energy as a factor affecting NOI.

High energy prices amplify the importance of energy as a factor affecting NOI. In 2000, the prices of natural gas and heating oil have risen precipitously across New York — generally, by 15 to 30 percent relative to 1999. For most New York ratepayers, electricity prices also have risen by a similarly dramatic percentage over the past year. Though the recent price increases have arisen in part from isolated or temporary supply problems, the increases also stem largely from steadily rising demand. Therefore, it seems unlikely at present that energy prices will return to their former price levels any time soon.

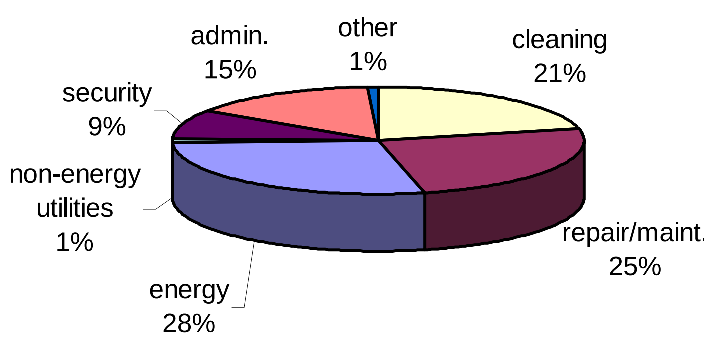
Energy-cost variations from energy-efficiency retrofits can influence overall NOI by two to ten percent.

The importance of energy arises not only from the relative *magnitude* of energy costs as a portion of NOI, but also in energy's *variability*. Differences of at least 20 to 30 percent in energy costs can typically be achieved via energy-efficiency retrofits to existing buildings; energy-cost differences across actual buildings may well be considerably higher. Given energy's proportional share of NOI, energy-cost variations from such retrofits can influence overall NOI by two to ten percent.

Table 1. Median Energy Costs and Net Operating Income in New York Office Buildings

Location	Income	Op. Costs	NOI	Electri-city	Gas	Fuel Oil	Purch Steam	Total En. Costs	Energy Share of Op. Costs	Energy Share of NOI
	$ per ft² year			*$ per ft² year*						
Downtown New York	40.89	8.57	32.32	2.01	.27	.02	.48	**2.78**	**32%**	**9%**
Downtown Albany	13.42	5.24	8.18	1.44	.16	.00	.00	**1.60**	**31%**	**20%**
Downtown Buffalo	14.35	6.03	8.32	1.98	.26	.02	.00	**2.26**	**37%**	**27%**
Downtown Syracuse	17.18	4.39	12.79	1.32	.10	.00	.00	**1.42**	**32%**	**11%**
Suburban New York	16.50	5.50	11.00	2.22	.38	.33	.00	**2.93**	**53%**	**27%**
Suburban Syracuse	17.55	4.34	13.21	1.82	.06	.00	.00	**1.88**	**43%**	**14%**

Figure 1. Average Operating Costs by Category Downtown New York



Source: Building Owners and Managers Association (BOMA). 1998 Experience Exchange Report.

Importance of Energy Costs by Building Type

The relative significance of energy costs is different for different building types. Obviously, a building which uses very little energy, such as an unconditioned warehouse, will have very low and insignificant energy costs. Conversely, energy costs can be quite significant in a building with large energy consumption. It is therefore useful to have a general understanding of the building types and characteristics for which energy strongly influences operating costs.

Buildings which have significant equipment or process energy costs will usually top the list. For manufacturing or special process buildings with energy intensive equipment, energy costs can be of primary importance. Examples would include refrigerated warehouses, hothouses, and other specialized structures. In the more typical buildings, energy use from equipment and processes can also be significant. Grocery stores have large refrigeration loads, and commercial kitchens have large cooking and refrigeration loads, as well as large ventilation loads from exhaust hoods.

Ordinary building energy uses – lighting, heating, cooling and ventilation – can be more significant in some building types than others. Buildings with large numbers of people, such as theaters or gymnasiums, require large quantities of ventilation air that must be provided through fans and duct systems, and which must be heated and cooled. Buildings with specialized lighting requirements, such as theaters, museums or jewelry stores, will require unusually high lighting energy use. Buildings with unusually large window areas, such as glass façade office buildings or automobile dealerships, will experience unusually large heating and cooling loads.

Buildings with unusually long operating hours or extreme environmental influences will have significantly higher energy usage. For example, hospitals operate 24 hours a day all year long. Some types of businesses, such as grocery stores, also have nearly full time operating hours. Finally, buildings exposed to constant wind or extreme temperatures, such as seaside locations or mountaintops, will have unusually high energy consumption.

Some or all of these factors may be present in a building and should be recognized in the appraisal process, especially when they might cause the subject building to stand out from other similar buildings in the same market.

The Significance of Bottom-Line Effects: An Actual Example

Table 2 shows an actual appraisal calculation for a motel in Southern California, as conducted by a certified general appraiser. The table shows estimates of income, expenses, and net operating income both before and after a major energy-efficiency upgrade. The costs shown include both budgeted figures and actual incurred expenses (including energy expenses).

Note that in this case, energy upgrade measures led to a reduction in gas and electricity costs by nearly $10,000 per year. Simple capitalization implies that these annual savings lead to a bottom-line increase of $124,720 in present asset value, or an increment of about 8.5 percent above the estimated pre-retrofit value.

Table 2. Sleepy Time Inn[1]
Property Appraisal, November 1998

		1997 Pre-retrofit		1998 After energy upgrade	
Income					
		$503,029.00		$503,029.00	
Other		$3,595.00		$3,595.00	
Gross Scheduled Income		$506,624.00		$506,624.00	
Vacancy Rate	35%	$177,318.40		$177,318.40	
Net Scheduled Income (NSI)		$329,305.60		$329,305.60	
			% of NSI		**% of NSI**
Operating Expenses					
Electric		**$18,766.00**	**5.70%**	**$10,450.00**	**3.17%**
Natural Gas		**$5,447.00**	**1.65%**	**$2,850.00**	**0.87%**
Water		$2,886.00	0.88%	$2,886.00	0.88%
Janitor		$5,475.00	1.66%	$5,475.00	1.66%
Landscape		$3,900.00	1.18%	$3,900.00	1.18%
Taxes Real & EMP		$31,059.00	9.43%	$31,059.00	9.43%
Tele & Sat TV		$4,897.00	1.49%	$4,897.00	1.49%
Insurance		$2,450.00	0.74%	$2,450.00	0.74%
Pest		$275.00	0.08%	$275.00	0.08%
Maid		$10,950.00	3.33%	$10,950.00	3.33%
Laundry		$23,500.00	7.14%	$23,500.00	7.14%
Repairs		$7,566.00	2.30%	$7,566.00	2.30%
Management		$38,500.00	11.69%	$38,500.00	11.69%
Advertising		$2,550.00	0.77%	$2,550.00	0.77%
Legal & Acct		$1,500.00	0.46%	$1,500.00	0.46%
License		$500.00	0.15%	$500.00	0.15%
Bed Tax	10.0%	$32,930.56	10.00%	$32,930.56	10.00%
Reserve	2.5%	$8,232.64	2.50%	$8,232.64	2.50%
Subtotal Expenses		$201,384.20	61.15%	$190,471.20	57.84%
Net Operating Income		**$127,921.40**	**38.85%**	**$138,834.40**	**42.16%**
Cap Rate	8.75%				
	Formula Employed	Net Operating Income / Cap Rate			
Opinion of Value		$1,461,958.86		$1,586,678.88	
Energy Retrofit Effect				**$ 124,720.00**	
		Based on 50 rooms at $27.50 per night GSI			
City Tax is 10% of collections, all sources					

[1] The name has been changed to protect client confidentiality.

Assessing Uncertainty in Energy-Reporting Methods

Energy-reporting methods, as with other elements of appraisal, involve a degree of uncertainty — a natural consequence of making estimates with imperfect data, and projecting future income streams and market preferences based on present information. Appraisers therefore tolerate some uncertainty in all aspects of the appraisal, while seeking to keep it to a minimum.

High levels of uncertainty in estimation of revenue and cost items raises an important question: are actual meaningful variations "lost in the noise"? In the specific case of energy, if estimates of energy costs are highly uncertain relative to the magnitude of the costs themselves, then what is the difference if the appraiser uses convenient default figures instead of more technical, building-specific estimation methods?

Uncertainty is no worse a problem with energy than with other factors affecting value.

Sources of uncertainty fall into two general categories — the inherent spread of data points (statistical variation) and the imperfection of data collection and analysis (measurement and modeling error). True, energy cost estimates are subject to uncertainty in both of these areas. But it is also apparent that uncertainty is likely no worse a problem with energy than with other factors affecting value.

In statistical indices of building revenues and costs — for example, the Experience Exchange Reports of the Building Owners and Managers Association (BOMA)— energy costs are typically the largest single itemized expense for New York office buildings (up to a third of total operating costs), while the variability of energy costs is about the same as for the other revenue and expense categories. In other words, the problem of statistical variation is probably comparable between energy costs and other elements of NOI. It follows further that the degree of care and precision that appraisers apply to estimates of non-energy components of NOI should also apply to estimates of energy costs.

Since energy use patterns are complex and sometimes difficult to track, modeling and measurement error can be a problem with estimations of energy cost — enough so that appraisers may, in their distrust of other more technical methods, use tabular regional averages or basic rules of thumb to choose figures for the NOI calculation. This strategy, in effect, seeks to avoid uncertainty problems by ignoring the complexity that underlies them. But ignoring complexity does not eliminate it — and one should note that regional averages and rules of thumb themselves carry latent "modeling" uncertainty, embedded in the assumption that the chosen averages and rules apply to the subject building.

Therefore, even when measurement and modeling error is unavoidable, an appraiser should not assume that it doesn't matter; instead, the appraiser should seek to minimize error by using reliable, building-specific data grounded in well-substantiated technical methods, as elaborated in Section IV of this document.

Energy-Related Value and Market Preferences

Most appraisers would say that the truest measure of value is the market's willingness to pay, not net income. As with other elements of value, actual market preferences regarding energy efficiency are not well understood; it is not clear to what extent building purchasers would pay more for buildings with energy-efficient features, or would demand discounts on energy wasters.

In the absence of market information, many appraisers consider energy costs along with other expenses and revenue streams in calculating net operating income of the building. Net income calculations, when well substantiated by convincing documentation of net-income figures, can often be the best practical substitute for information on market preferences. Furthermore, it is arguable that as real-estate investment becomes an increasingly corporate activity driven heavily by creation and capture of real value, with would-be purchasers themselves basing their investment decisions on pro-forma NOI calculations; under these conditions, NOI capitalization may indeed be a close proxy for empirical market information.

Net income calculations can often be the best practical substitute for information on market preferences.

III. Assessment of Building Energy Performance

Once the appraiser decides that NOI calculations will be the basis for considering energy costs, the objective should be to make as accurate and well-substantiated an energy-cost estimate as possible. But the most common current methods for energy-cost assessment often suffer from questionable credibility and poor accuracy. The following section describes key deficiencies in common existing methods of energy assessment and reporting, then outlines alternative techniques to obtain more technically accurate, building-specific estimates of energy costs that appraisers can confidently use in the NOI calculation.

In assessing building energy costs, appraisers often rely on financial statements, tax returns, or other historical records submitted by the building owner. The problem with this approach is that owners' disclosures on past energy costs may be shaped by the owner's incentive to suppress the real magnitude of costs in order to obtain a higher valuation. Owners' records may also mask anomalous conditions such as deviant weather patterns, unusual building use or occupancy patterns, or temporarily broken or idle equipment. Under these conditions, appraisers are often rightly skeptical about owners' claims on energy performance.

Energy Cost References

Where owners' disclosures are suspect or absent altogether, appraisers may seek energy-cost information from standard references such as the *Experience Exchange Reports* of BOMA and *Income/Expense Analysis* publications of IREM. These sources collect survey data from owners on income and expenses, and present results as average figures for given locations and building types.

Use of regional-average default figures for energy costs poses serious concerns about accuracy.

Appraisers sometimes use these averages as default energy-cost figures for NOI calculations. This approach, while certainly convenient, poses serious concerns about accuracy. Given the range of building types, vintages, features, and equipment, treating all buildings as average will only rarely be accurate, and indeed, will often be egregiously inaccurate. Such inaccuracy will propagate from the energy line-item through to the estimate of overall NOI, and can adversely affect the accuracy of the appraisal on the whole.

Equipment Reference Guides

With new construction, in employing the cost approach to valuation, appraisers may try to obtain cost figures for the individual energy-related equipment in buildings. Many refer to *Marshall & Swift* statistics[2], the subscription-based database for building maintenance and repair costs, or one of the *RS Means Guides,*[3] the set of lookup guides which include figures on the prices of various lighting, heating, ventilation, and air conditioning (HVAC) equipment. For some equipment, the *RS Means Guides* also present comparisons between the annual cost of conventional versus energy-saving equipment in terms of their annual energy consumption, cost, expected lifetime, as well as various lighting quality indices.

For the cost approach, these references are essential — but when appraisers also want to take into account future cash flows, these sources have their limitations. Many energy-efficiency measures pay their incremental costs back rapidly — lighting measures in less than a year, commonly, and HVAC measures in three to five. Therefore, a cost-based estimate of the incremental value of energy efficiency will tend to fall below an estimate based on income capitalization or discounted cash flow. And even when the equipment reference guides do present estimated operating costs as well as initial costs, their data are based on manufacturing and engineering specifications, as opposed to tested performance of the measures in actual buildings.

Recommended Methods for Energy Performance Assessment

Though no method is fail-safe, and anomalies will occur even with the most reliable among them, the following methods should generally provide acceptably accurate estimates of energy costs, and should be used in place of owners' statements and standard references as described above.

[2] The publication *Marshall Valuation Service Commercial Cost Explorer* is updated monthly.

[3] For commercial applications, some of the guides include the *Means Building Construction Cost Data 2000*, the *Means Electrical Cost Data 2000* (including lighting), and the *Means Mechanical Cost Data 2000* (including HVAC equipment).

IMT envisions that the recommended methods will not necessarily require additional workloads or technical responsibilities from the appraiser, because the bulk of analysis and record-keeping will be conducted by the building owner, developer, buyer, or a hired contractor. In most cases it would be the responsibility of the current owner or developer to conduct the analyses described here, and to deliver a summary statement of results to the appraiser, along with supplemental information on methodology and on the technical qualifications of the preparer. The appraiser's responsibility would ideally be limited to reviewing and assessing the summary document, and making adjustments or requesting additional information as he or she judges necessary.

All of the performance-assessment approaches described here are well known in the field of building performance assessment and energy engineering, and most are already being broadly applied for various purposes in the commercial buildings sector.

Billing Histories

One of the most direct methods of assessing building energy costs is to examine the building's utility bills. Examination of bills themselves, particularly multiple years' worth, is more time-consuming than reviewing summary financial statements, but also removes the potential that the owner is fudging or obscuring the numbers. Bills are also preferable to standard reference sources in the sense that billing records are specific to the building itself, and at some level, will reflect the presence of efficient built features or operations.

The problem with billing histories is that they reveal little about *why* bills show the numbers they do. A building may have low energy use (relative to the levels that appraisers might normally encounter) because it has advanced, well-maintained energy-efficient features; on the other hand, it may have broken equipment or an owner who is willing to sacrifice occupant comfort for energy-cost savings by running the HVAC system in a miserly way. Bills may also be anomalously low or high because of abnormal weather conditions, partial vacancies, unusually long operating hours, or the presence of unusual energy-using equipment. Furthermore, in older buildings, there may be more than one utility meter; also, the metered floor area may not correspond to the floor area used in the NOI calculation.

In assessing billing histories, an appraiser should ask for evidence that the energy cost levels result from working features, not erratic external conditions like weather, or anomalies like broken equipment.

Given the number of confounding factors, it is less than optimal to use energy bills alone—even multiple years' worth—in estimating energy costs for a calculation of NOI. In addition to the bills, an appraiser should ask for evidence that the building's energy costs result from the presence of desired features, not undesired anomalous factors or erratic external conditions.

There are two ways to show that low energy bills result from efficiency rather than other conditions. The first way is to verify the presence of efficient features, either visually or through a record of installation and performance verification, or ideally, both. The second way is to normalize the bills by correcting for the effects of building space use, weather, occupancy, and other factors.

Energy bills plus verification of efficient features

The simplest approach to using energy bills for appraisal purposes is to supplement the bills with a procedure to verify the presence of working energy-efficient measures. The purpose of this verification is to document the energy efficiency measures which help to determine the magnitude of the utility bills. Under this approach, an appraiser could verify the presence of efficient building features through a visual inspection, using a checklist. (See Appendix for a discussion of energy-efficient technologies and materials commonly found in commercial buildings). Any appraiser could complete a checklist of simpler building features; for more complex measures, special training or qualifications would be needed to identify measures and to assess their working condition. To supplement the identification of measures, the appraiser could ask the owner for a written record of installation and performance histories for special efficiency measures.

While appealing in its simplicity, this verification approach would not provide complete answers to explain high or low energy bills. For example, if a building had consistently average energy bills, they could be the result of reliable energy efficiency measures which were offset by a history of unusually long hours of operation, or by a stretch of extreme weather patterns. This building, then, under normal operation and weather, would be expected to have lower than average utility bills because of its efficiency features. Despite these difficulties, however, this verification approach is surely an improvement over the practice of simply taking average or historical energy bills as the estimate of future energy costs.

Measure-by-measure performance verification is a common element of energy performance contracts, in which an outside contractor provides an energy-efficient upgrade, for which the building owner pays over time as savings are gradually achieved. Since savings levels are the basis for repayment terms, protocols for measurement and verification of savings under these contracts tend to be rigorously specified.

The International Performance Measurement and Verification Protocol (IPMVP) is the standard for verification of energy-efficiency measures in the performance-contracting field. While the Protocol provides for varying degrees of precision (and level of effort) in verifying energy efficiency savings, all are based to some degree on careful engineering analysis.

Energy bills normalized for weather, occupancy, operating hours, and other factors

Normalization controls for extraneous variables and isolates the effects of high-performance features.

Energy bills may be corrected for various confounding variables through a process called normalization, which essentially breaks down a series of energy bills into their component parts so that the extraneous variables can be controlled for, leaving the efficiency performance variables to predict future energy savings. In this process, bills over an extended period are analyzed and correlated to the variables in question, which may typically include outdoor air temperature, occupant density, and operating hours. The billing patterns are then expressed as a multivariate linear function of the variables. This equation can then be used to predict the building's energy performance based on specified "normal" conditions.

The big advantage of normalization is that it provides a much more rigorous treatment of the energy bills than the simple validation method. In some ways normalization is simpler, because it does not require a detailed survey of all the building energy features (although listing them would be an informative complement to the analysis). Normalization does, however, require reliable historical data on a number of independent variables, such as heating and cooling degree day data, hours of occupancy, numbers of occupants, internal and equipment loads, etc. It may also require data on physical parameters that have a direct relationship to energy usage, such as floor area, glazing area, or ventilation rates. The more complicated the building, the more independent variables will need to be analyzed. Moreover, while normalization techniques are well understood, their application to a particular building can require a certain amount of trial and error to develop the most descriptive regression equation that makes the best use of the available information about the building.

Use of normalized billing is relatively common among building managers and building energy consultants, covering a range of applications. Owners and managers may use normalized billing to simply track energy use and trends, to forecast operational cash flow, and to help identify opportunities for energy cost savings via retrofits, maintenance, or improved operations. Normalized billing is also used as a basis for energy-efficiency performance contracts. In this case, normalized bills can be used to project a baseline level of energy consumption against which the post-retrofit actual energy use can be compared. For these and other applications, the most common billing-normalization tools include *Utility Manager*™ (from Illinova Energy Partners), *Metrix*™ (from SRC Systems), and *Faser 2000*™ (by OmniComp). A normalized billing projection from any of these tools should generally be a reliable source of energy-cost information for use in appraisal.

The ENERGY STAR® Building Label

Normalized billing now has another important application through the ENERGY STAR® Building Label program of the U.S. Environmental Protection Agency (EPA). Under this program, the ENERGY STAR® label, which is a well-known mark of energy-efficient performance in appliances, copiers, computers, and homes, may be assigned to energy-efficient office buildings.

The EPA system for assessing buildings and assigning the label is based on normalized billing. An applicant collects 12 consecutive months of utility billing information, along with information on a number of normalization factors — occupant density, space use, floor area, numbers of personal computers per person, hours of operation, and outdoor temperature. The collected data is submitted via the Internet to the program Web site,[4] where a calculation engine then normalizes the bills for the given factors.

The ENERGY STAR® system compares the results of the normalization analysis with statistical information from a major building-energy database, the Commercial Buildings Energy Consumption Survey. This comparison yields a rating for the subject building, on a scale of one to 100. Buildings rating 75 or higher represent the top 25 percent of buildings on EPA's ranking scale, and receive an ENERGY STAR®. In addition to the rating, the ENERGY STAR® calculation tool also generates a Statement of Energy Performance summarizing normalized energy use, energy costs, atmospheric emissions, and other factors associated with the building. (See http://www.epa.gov/buildings/label/html/statement1.html.)

Normalization does have its limitations. With the EPA normalization and benchmarking tool, as with other normalization software, it should be understood that results may vary depending on the normalization factors chosen. In certain cases, normalization may not recognize important anomalous factors that strongly affect energy use. For example, a building may have stuck dampers or incorrect setpoints in the HVAC system, leading to high energy use that weather, occupancy, and other normalization corrections will not catch. Normalization will also likely be unable to reveal cases where low energy use results from underheating and undercooling of occupied areas, though the EPA Building Label program requires that any buildings qualifying for an ENERGY STAR® Label must have an engineer's certification that minimal comfort conditions are met.

[4] http://www.epa.gov/buildings/label/

Design Simulation

For some buildings (including, most obviously, new buildings) energy billing data may be absent. For other buildings, the magnitude of energy costs may warrant a more detailed assessment of the energy performance and how it is influenced by the equipment and operation of the facility. In these cases, an owner may be able to provide the appraiser with the results of a computer simulation of the building's energy performance, based on the building's built features, its location, and other factors. In other cases, it may be worth the time and expense to develop such a simulation model of the facility specifically for the appraisal.

A computer simulation model is essentially a sophisticated engineering calculation of the energy flows in a building and their cost. Much as NASA scientists use simulations to study the effects of space flight, building engineers use simulations to study the energy performance of buildings and their equipment. As with any simulation model, the results can only be as good as the input data, so there must be a reasonable amount of effort expended to adequately describe the building and its operation. The energy analyst must necessarily make simplifying assumptions about the building, so it is also necessary that the simulation be performed by a person with the training and experience to make these simplifications in a way that does not compromise the accuracy of the simulation. Done properly, however, energy simulations provide the ultimate tool for predicting energy costs for a building in a way that recognizes the performance of the specific energy features of the building.

DOE-2

The widely-recognized standard for building energy performance simulation is a computer program called DOE-2, which was developed by the U.S. Department of Energy (DOE) and has been undergoing periodic improvements and revisions over the last two decades. DOE-2 requires voluminous input data on the geometry, materials, equipment, and controls of the building. It also considers internal heat gains within the building, the effects of solar radiation incident on the building, the relevant utility rate schedule, the daily and weekly variations in operating and occupancy schedules, and other factors. DOE-2 calculates hourly expected energy consumption for the building, taking into account historical hourly weather files for the building location. Summed over the entire year, hourly consumption estimates can yield an estimate of whole-building consumption.

DOE-2 is the industry standard energy simulation tool for buildings, with results generally falling in the range of +/- 5% accuracy.

The DOE-2 simulation procedures are available in a range of software packages (user interfaces), ranging from simple text-based programs such as EZDOE, to interactive graphics-intensive tools like VisualDOE, for desktop as well as mainframe computers. Most users currently use the programs on standard personal computers. A list of commercial, PC-compatible versions of DOE-2 may be found via the Internet[5].

DOE-2 is a rather specialized computer program, and one must possess a college engineering level of understanding of building energy and analysis principles to use it with confidence. In particular, it is necessary to ensure that input information on building parameters is accurate and reasonable; some DOE-2 versions automatically reject unreasonable input data, but in many cases, verification of inputs can only be conducted through third-party review.

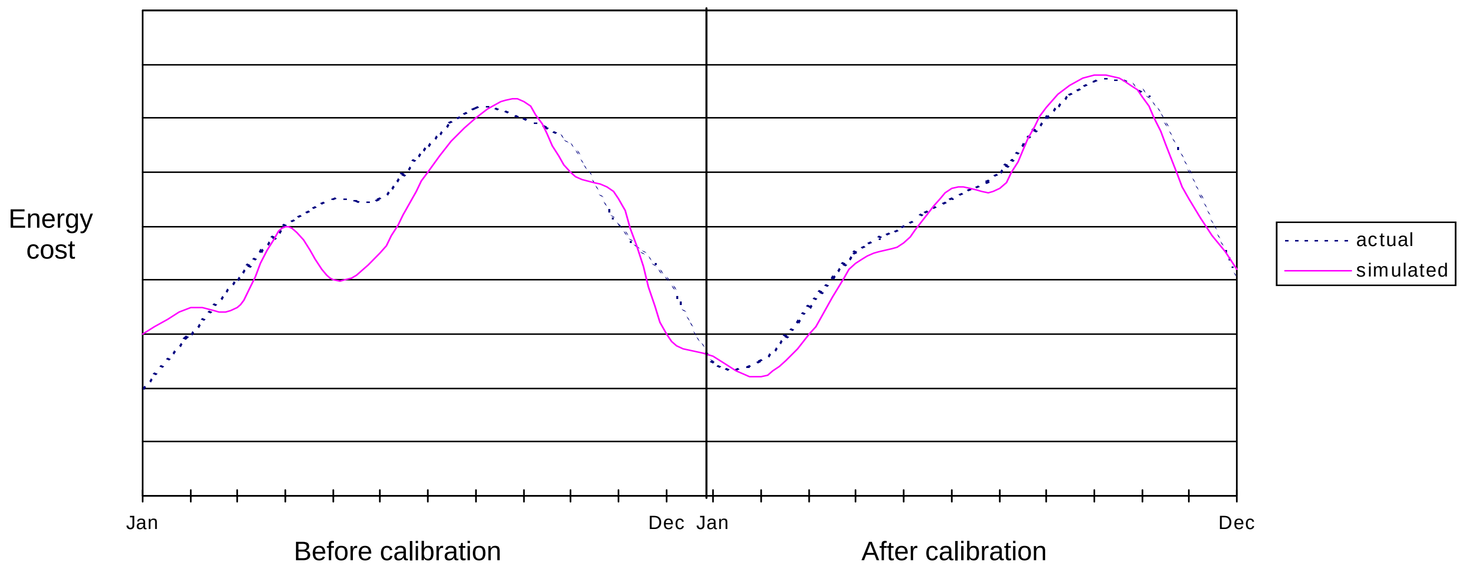
Yet despite these caveats, DOE-2 is among the most widely used energy analysis tools, and is accepted as rigorous and accurate for building simulation purposes; results generally fall in the range of plus or minus five percent accuracy.

DOE-2 may be especially accurate in predicting energy use when the simulation model is "calibrated" to past energy bills. In the calibration process, the user actually adjusts the calculational engine of the simulation model so that it accurately "backcasts" (as opposed to "forecasts") past bills.[6] The modified simulation model is then used to forecast future energy consumption and costs. Figure 2 depicts actual energy costs for an average large commercial customer in Con Edison's service territory (10,800 kilowatt hour and 31 kilowatts per month), compared to a fictitious simulation of energy costs, before and after simulated calibration.

[5] http://www.eren.doe.gov/buildings/tools_directory/software/doe-_pc.htm

[6] The accuracy of a calibration (that is, the closeness of fit between the simulation and the past bills) is commonly quantified by means of two statistical indices: mean bias error, or MBE, and coefficient of variation of the root mean square error, or CV(RMSE). The lower these indices are, the closer the fit. Generally, a simulation model is considered calibrated if its MBE falls within ±10%, and if CV(RMSE) is within ±30%. (Stein, J., 1997.)

Figure 2. Calibration of Building Energy Simulation



The advantage of calibrated simulation is that by tuning the model to past bills, one should, in theory, generate a model that is more accurately representative of the energy-use behavior of the specific subject building. The problem, however, is that tuning the model is a highly sensitive and ultimately subjective endeavor; the model may inevitably be tuned in any of a number of ways, which will likely yield different patterns of forecasted energy use. Therefore it is imperative that the specialist performing the calibration be a real expert not only with the software, but also with technical aspects of building science, in order to assure that calibration adjustments represent reasonable engineering assumptions, not random guesswork.

Notably, DOE-2 modeling is also a common approach to compliance with New York's non-residential building energy code,. Building designers may show compliance by submitting to code officials the results of a DOE-2 simulation. While these compliance results show consumption rather than costs, it is a relatively simple analytical step for the owner or appraiser to turn the consumption estimate into a cost estimate. This points to a promising possibility for using DOE-2 in conjunction with the appraisal of new commercial buildings. Because many of these building owners have already paid to develop a DOE-2 model for compliance purposes, it is relatively inexpensive to fine-tune these models to the as-built conditions in the building and use the result to produce a reasonable estimate of the future average energy costs for the facility.

Other simulation tools

Other energy-simulation tools, which target various building types and cover a range of cost and complexity, may also yield information for use in appraisal. Here we discuss only a few tools, which exhibit such desirable qualities as technical sophistication, accuracy, and widespread availability. A more comprehensive and regularly updated list of commercial and residential energy-simulation tools, with useful discussion of the features, uses, strengths, and weaknesses of each, is available via the Internet[7].

BLAST

BLAST (Building Loads Analysis and System Thermodynamics), like DOE-2, performs hourly simulations of building dynamics and energy use, using input data on building geometry and materials, operating schedules, equipment types, and weather for the given location. It can also be customized by highly sophisticated users for specific types of building systems and physical plant types. Less widely used than DOE-2, BLAST nevertheless ranks with DOE-2 as one of the more technically advanced building simulation tools in the United States.

The U.S. Department of Energy is beta testing a new sophisticated simulation tool called *EnergyPlus* which to builds on the capabilities of both BLAST and DOE-2. It promises a much simpler information input structure than either DOE-2 or BLAST. More information is available at Lawrence Berkeley National Laboratory, a co-funder of EnergyPlus with the U.S. DOE, and at the DOE Web site.[8]

Energy-10

Energy-10 is a design tool that performs annual energy-use estimates based on simulated hourly consumption summed over the year. Vastly simpler than DOE-2, Energy-10 requires a minimum of only four building-specific inputs, with flexibility to add more information to the simulation as it becomes available during the design process. As a design aid, it offers building designers a variety of possible cases for comparison and rank-ordering, based on variations in design features. Its use is limited to residential and small commercial buildings.

---

[7] http://www.eren.doe.gov/buildings/tools_directory/
[8] http://gundog.lbl.gov/ or http://www.eren.doe.gov/buildings/energy_tools/energyplus.htm

EZ Sim

EZ Sim, developed by Stellar Processes, Inc., models building energy performance based on monthly, instead of hourly, input data. Intended primarily for diagnosis of energy-use patterns and identification of potential conservation savings, EZ Sim offers a relatively simple way to estimate future energy use. Most significantly, EZ Sim is designed to be conveniently calibrated to actual monthly utility bills — much more simply than with DOE-2, whose calibration requires extreme sophistication and care in selecting input data and adjusting the model.

Billing Histories and Design Simulation: Which to Prefer?

In gathering comments from appraisers and energy-analysis specialists on these proposed tools, IMT has observed a rather distinct disparity in each professional sector's preferences. Appraisers widely consider billing histories to be acceptable for use in the valuation process, and simulation tools somewhat less so. Energy specialists tend to hold the opposite position; they are skeptical about billing-based assessment, and more confident in simulation methods, particularly those that involve calibration to measured performance.

Both enhanced billing histories and design simulation are preferable to straight non-normalized bills and lookup of regional averages — and both can enhance accuracy without significant incremental burdens for the appraiser.

There are various possible reasons for this divergence. Appraisers' preference for billing histories may be based on a sense that bills represent information that is more tangible than the results of an engineering calculation. Appraisers may be able to apply their own judgment more constructively to billing histories, which require relatively little technical background, than to simulation, which is a "black box" to all but the most highly trained programmers and engineers. Enhanced billing methods may also be more popular among appraisers in that they resemble currently-applied methods more closely than simulations do; changing practice by enhancing billing assessment would be a manageable incremental step, whereas assessing and trusting a simulation would be more of a leap in practice.

Energy specialists, on the other hand, prefer simulation methods because they are able to take into account the detailed dynamics of building performance, including the effects of various specific technologies in the building. They are familiar with these tools, work with them regularly, and not surprisingly, generally view the more advanced tools such as DOE-2 and BLAST as the leading edge in their work. To them billing methods are, technically speaking, much blunter instruments, subject to confounding factors and gaming as described above.

In presenting both billing-based and simulation-based approaches, we are not suggesting that one should be preferred over the other. We do believe that the listed simulation methods are worth recognizing in the valuation process, and indeed, one purpose of this section is to provide some background and unbiased third-party assurances to allay appraisers' skepticism in this area. At the same time, we recognize billing histories (when enhanced with normalization or verification of features) as useful tools as well. The key point is that both approaches are preferable to common existing methods — straight non-normalized bills and lookup of regional averages — and both can enhance overall accuracy in the appraisal without significant incremental burdens of time, effort, or training for the appraiser.

IV. Benchmarking and Comparisons of Energy Performance

Appraisers often seek information on buildings with comparable characteristics when estimating property value as a whole, and for confirming or arriving at ranges for particular expenses, such as energy costs. The purpose of this section is to propose procedures and guidelines for evaluating currently-available data sources on comparable properties ("comps") for use against subject buildings, including government building survey results and data from private agencies and companies.

We emphasize that comp data should be used only as *checkpoints* for estimates of energy costs, but *not* as default figures for the energy costs of the subject building. For estimating energy costs for the subject building itself, the appraiser should refer to Section III.

Ideally, energy-related comps should fulfill the following criteria:

- The comp building set should represent the **same specific building type** as the subject building.
- The **same energy cost calculation method** should be employed for both the subject building and the comp data set.
- A **sufficiently representative or large data set** should be sampled.

The appraiser may conclude that, after applying these criteria, none of the available databases can offer a rigorous enough energy cost for comparison to the subject building. In this case, the appraiser will have to make a subjective judgment as to what level of credibility to assign given energy cost figures, or may request corroborating information from other analytic methods applied to the subject building.

Existing Baseline Databases

The building databases enumerated below are widely accessible and convenient, but have relatively small sample sizes and informal collection methodologies. These databases examine costs only; they lack information on the specific built features of buildings. Therefore, these sources only weakly satisfy the above criteria.

Building Owners and Managers Association (BOMA)

The BOMA Experience Exchange Report is compiled from the results of 30,000 surveys of BOMA members and building managers listed in real estate publications, and is published yearly by the BOMA Research Committee. The dataset covers office buildings only; energy consumption is broken down by utility, and is represented as total dollars per square foot per year. Data are presented for downtown and suburban sectors of metropolitan areas, in aggregate and broken down by floor-area ranges. Sample sizes vary widely according to location and floor-area category.

COMPS InfoSystems, Inc.

COMPS, Inc. offers a subscription-based on-line accessible database targeted to the commercial real estate industry, called E-Comps, of over 500,000 commercial real estate transactions in 42 major U.S. cities. The database obtains its information from Metroscan and Experian (First American Real Estate Solutions), examination of sales figures and deeds at county recorders' offices, and physical inspections of buildings. It provides appraisers with an estimate of operating revenue and operating costs based on the area, type, and age of building, and the type of lease, but it does not publish specific line items for utility costs. Instead, operating cost estimates are based on informed rule-of-thumb figures — for example, $0.15 per square foot per month for all utilities. COMPS, Inc., therefore, offers very little in terms of useful energy performance information at this time, and is recommended for use only when a range of average operating expenses is needed and other baseline sources are inadequate for the subject property.

Institute of Real Estate Management (IREM)

IREM publishes results, in book form only, of its annual survey of 2,400 property managers and other real estate professionals across the country. Income and expense analysis is conducted for over 3,300 private-sector office buildings in major metropolitan areas and regions, and is presented by building type, building size, region, rental range, and age group. Expenses are reported for each major utility, and a subtotal calculated. Relative to BOMA, IREM's database has fewer data points and is therefore a less reliable basis for comps.

Databases Specifically on Building Energy Performance Data

CBECS (Commercial Building Energy Consumption Survey)

The CBECS database is the only national-level survey of commercial buildings and their energy suppliers, put together by the Energy Information Administration of the U.S. Department of Energy. The main advantage of the survey is that it collects information on the physical characteristics of buildings, building use and occupancy patterns, equipment use, conservation features and practices, and types and uses of energy in buildings. Monthly utility bills are also reviewed to corroborate energy consumption and expenditure claims. Its disadvantages are that it is only conducted quadrennially and that it does not allow searches by geographic location to levels of resolution finer than the nine US census regions. CBECS data come from multiple sources for each building: interviews with building owners, tenants or managers, documentation from energy suppliers, energy simulation model runs, and weather data.

The 1999 CBECS survey data were collected via telephone interviews for over 5,000 commercial buildings, each with over 1,000 square feet of floor space. In 1995, the sample was weighted to represent 4.6 million commercial buildings nationwide. In the Middle Atlantic Census division, which is composed of New York, New Jersey, and Pennsylvania, this accounts for over 11 percent of commercial buildings.

This building energy performance data is available in aggregated tabular form via the CBECS Web site[9]. However, the data are very difficult for people not familiar with the database to access and manipulate. For that reason, the U.S. Department of Energy has developed an interactive energy analysis tool, called the Commercial Building Energy Consumption Tool, based on a 1998 subset of CBECS data. It is also accessible via the Internet[10], allowing users to define a set of buildings by principal activity, size, vintage, region (Northeast, South, West, Midwest), climate zone (based on heating- and cooling-degree days), and fuels, and then view the energy consumption and expenditure estimates in tabular format.

[9] http://www.eia.doe.gov/emeu/cbecs/
[10] http://energydata.wdc.pnl.gov/webcbecs/cbecs.htm

Appraisers who tested the Commercial Building Energy Consumption Tool found it convenient and easy to use. A review appraiser at a major New York bank said that if he were presented with output that demonstrated significant energy efficiency in a subject building from such a tool, the result would likely be an increased comfort level in the ability of the mortgager to repay his or her loan, or in a recommendation for increased loan size or valuation of the property. Appraisers also agreed, however, that the major drawback of the tool for potential use by appraisers seeking to benchmark energy performance of subject buildings is the lack of regional specificity beyond the tool's four regions. Regretabbly, it is unlikely that finer geographic resolution of the data will be available in the near future.

Other Methods

Simulated reference buildings

Simulated reference building comparisons are useful because they employ the same tool to estimate energy performance between buildings, inherently represent the same building type, and obviate the need for a large comparison data set.

In New York and selected other states, developers have the option of demonstrating energy-code compliance by conducting an energy simulation for a subject building and comparing the results to those of a similar simulation for a hypothetical minimally code-compliant reference building made with stipulated features and materials[11]. Comparison with the reference building thus can tell the code official (and the appraiser) how the energy performance of the subject building compares to minimum code requirements.

Since codes set forth the same basic energy-efficiency requirements that apply to all new buildings within a given type, this method also provides a possible means for comparing buildings against each other. For example, one new building may be shown to have energy consumption 30 percent lower than its code-defined reference building, while another may show levels only five percent lower than its respective reference building.

Comparison to a simulated reference building is preferable to using database comparison methods because it employs the same tool to estimate energy performance between buildings, inherently represents the same building type, and avoids the issue of needing a large comparison data set.

---

[11] New York State Energy Office, Bureau of Codes and Standards. *New York State Energy Conservation Construction Code*, 1991. A new code based on the International Energy Conservation Coded 2000 is under development, however the current code will remain in effect through 2002.

Rating systems

Energy performance documentation in the form of a rating delivers energy cost information to the appraiser with a built-in baseline, in that it represents where the subject building stands in relation to other buildings. As described in Section III, the Energy Star® benchmarking tool rates the subject building relative to CBECS.

Another system is the LEED V2 Green Building Rating System™, a voluntary program of the U.S. Green Buildings Council.[12] An eligible building receives one of four ratings (bronze, silver, gold or platinum), based on the number of defined credits its owner can claim. Therefore a LEED™ Bronze rating is awarded to buildings that earn 40 to 50 percent of the available credits, and a Silver rating for those that earn between 51 and 60 percent of available credits. Energy efficiency is assessed relative to compliance with and without performing various model codes, including the 1999 version of ASHRAE 90.1.

Appraisers should note, however, that LEED ratings are not quantitative indices of energy cost or energy consumption alone, but also use of environmentally sustainable materials. The LEED system, while the authoritative measure in its chosen area, is ultimately a subjective measure of environmental quality, rather than an objective index of energy cost or consumption.

[12] http://www.usgbc.org/programs/leed.htm

V. Technical and Legal Assurances from Preparers of Energy Documentation

Commercial real estate appraisers are subject to intense scrutiny and liability. Appraisers' work is shaped by multiple laws and interests, including USPAP, the Financial Institutions Reform Recovery and Enforcement Act (FIRREA), lenders' checklists of critical appraisal data, as well as the de facto risk of potential litigation from disgruntled parties. For these reasons, it is not surprising that many appraisers are reluctant to go out on a limb in assessing energy performance, and instead resort to familiar methods and safe default figures, even at the possible expense of accuracy.

The reliability of energy assessment and comparisons, no matter how well-tested and technically robust the given methods, depends heavily on the competence of the person performing the analysis. Therefore, not only should an appraiser verify the technical basis of energy performance documentation as discussed in Section III; he or she should also seek assurances about the technical credibility and responsibility of the preparer. This section describes three types of such assurances:

1. **Assurance of technical competence** in the form of a professional license or other related training or experience;

2. **Assurance of legal responsibility for the document contents** in the form of a signed statement;

3. **Assurance of coverage by professional liability insurance.**

Technical Assurances

To some extent, the level of technical complexity of the energy assessment tool used defines the required level of expertise of the energy performance document provider. Therefore, someone preparing a building's utility bills and list of efficient features will not require the same level of qualification as someone who conducts a sophisticated whole building simulation such as DOE-2. In some cases, the tool itself may be designed for either a technical or non-technical user, as with EZ Sim, where a one-day seminar on its application is offered free with the software purchase. In this instance, the documentation provider would not require special certification at all.

Appraisers agree that appropriate licensure of documentation providers is very important as protection against future liability. For this reason, appraisers may not want to change an appraisal to reflect unusually low energy costs if the statement comes from an unlicensed expert rather than a Professional Engineer (PE). This section discusses a number of both licensed and degree course training—from professional engineer certification to utility or industry-sponsored course work in efficient building operation. Evidence of relevant training in any of the forms below should solicit confidence from the appraiser in the competence of the document preparer and its contents.

Professional Engineer/Licensed Architect certification

Energy-performance documentation may be certified by a PE or a licensed architect. PEs render services such as consultation, investigation, evaluation, planning or design of public or private utilities, structures, machines, processes, circuits, buildings, equipment, or projects. This includes evaluation and certification of buildings' energy performance. Architects, of course, are the professionals responsible for building design, and in some cases may also conduct analyses of energy performance as part of the design process.

Like other professions that are tested and licensed, engineers and architects can fulfill requirements under state licensure laws and become registered through the New York State Education Department's Division of Professional Licensing Services. The Division qualifies and licenses individuals, and establishes and enforces laws and regulations. Accountability to this oversight body is in itself one of the most powerful aspects of the assurances embodied in the two types of licenses. Appraisers told us that in general, low energy cost information verified by an architect or PE would give them the greatest confidence that the figures are attributed to energy-efficient measures in a building.

To become a PE, an individual must pass rigorous experience and exam requirements, including graduating from an engineering program accredited by the Accreditation Board for Engineering and Technology, Inc., fulfilling 12 years of education/experience credit acceptable to the Accreditation Board for Engineering and Technology, and passing the Fundamentals of Engineering and Principles and Practice of Engineering exams. Many belong the National Society of Professional Engineers.

For architects, licensing requirements include providing verification of a bachelor's or higher degree in architecture, a minimum of three years of architectural work experience (or 12 years of practical work experience satisfactory to the New York State Board for Architecture), and successful completion of the Architect Registration Examination.

The ENERGY STAR® Building Label requires that applications be certified by a PE. (Architects are not recognized under this program.) In this way, the credibility of the preparer is essentially "built in" to the tool, and does not require additional verification by the appraiser. Other billing normalization methods, as well as DOE-2 and other simulation tools, do not contain the intrinsic assurances that ENERGY STAR® does.

Although DOE-2 is more technically sophisticated than the ENERGY STAR® benchmarking method, neither DOE-2's users, nor the tool's output documentation, are required to be certified in any way. In some states, code compliance based on DOE-2 simulation must be certified by a PE stamp. However, there is no such requirement in New York.

It should be noted that both the PE and licensed architect designations only provide a limited degree of technical assurance insofar as they do not guarantee specific expertise in energy performance assessment. Ideally, the appraiser should seek additional evidence regarding the preparer's technical competence, such as their area of specialty, training or experience.

Equivalent training or background

In the absence of any of the above certifications, appraisers might consider alternative qualifications from the energy performance documentation provider of a building, such as equivalent course work or project experience. The following is an overview of certification programs, courses, and training that specifically cover energy performance in commercial buildings, and should be recognized when evaluating energy cost documentation in an appraisal.

Building Operator Certification Program
Developed by the Northwest Energy Efficiency Council (NEEC), the Building Operator Certification (BOC)[13] is an incipient program for certification of building operators and facility managers. The program offers a voluntary seven- to eight-month training and certification courses (Levels I and II) for individuals who are responsible for the energy- and resource-efficient operation of building systems. Graduates are required to take continuing-education credits to maintain their certification.

[13] http://www.neec.net/boc.htm

Courses may include training in DOE-2 simulation and other energy-performance documentation. The certification program was launched in the Northeast in April 2000 through the Northeast Energy Efficiency Partnerships, Inc. (NEEP). Typical registrants include individuals from both the public and private sector: engineers, utility company employees, energy service company representatives, electricians, general foremen, and facility operators.

Building Owners and Managers Institute

In association with the Building Owners and Managers Association International (BOMA), BOMI sponsors three certification programs: Real Property Administrator, Facility Management Administrator, and Systems Maintenance Administrator/Technicians through its international training institute, BOMI. The curriculum and number of required courses vary for each designation, but include such classes as Design, Operation and Maintenance of Building Systems, and Energy Management and Controls. Specific topics of study include energy-efficient lighting applications, energy conservation and cost reduction practices, and computerized energy management systems .

Continuing Professional Development credits are required of the various designees every three years. Both BOMA and non-BOMA members are eligible to apply.

International Facility Managers Association

The 20 year old International Facility Managers Association (IFMA) is the largest professional association for facility management with more than 14,200 members. It offers resources to assist facility professionals in developing strategies to manage the human, structural and real estate assets of organizations. Registrants to IFMA's Certified Facility Manager program receive the CFM designation if they pass the eligibility criteria for work experience, education and the ability to pass a comprehensive examination. The designation signifies that the facility manager is competent in, among other areas, efficient operation and maintenance of building systems and equipment, "development and administration of environmentally conscious programs,"[14] setting compliance and performance criteria, managing energy costs, establishing benchmarks and measuring performance, and conducting audits.

Certification lasts for three years and is renewed based on points earned through practice or continuing education. There are over 2,000 registered CFMs worldwide.

[14] From IFMA's "Complete List of Competencies, Competency Areas and Performances Covered in the CFM Exam," pers. corr. 4/18/00.

Utility-offered training

Verification of energy bills by the utility provider can provide additional assurance that low cost figures are valid and therefore worth reporting in an appraisal, as opposed to relying on rule-of-thumb references from standard sources. Preparers of such energy-performance documentation may demonstrate technical qualifications via a certificate of completion of a utility-sponsored training course in whole-building energy analysis tools. While New York state certification is not issued for any of utility-offered programs, the utility's own certificate of completion may be accepted by appraisers as evidence of sufficient technical competency to run a building simulation and deliver the results.

Degree courses

A growing number of degree courses are now available to those in the energy sciences or engineering field, and if presented by the documentation provider, should offer some assurance to appraisers in their technical competence in energy. Many courses are offered by both state and private schools.

American Society of Heating, Refrigerating and Air-Conditioning Engineers

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is an international organization of 50,000 members, organized to advance the sciences of HVAC for the public's benefit through standards writing and continuing education, among other purposes. Its continuing-education program offers courses for its members as well as interested companies, Professional Development Seminars, Self-Directed Learning Courses, and In-Company and ASHRAE Chapter-Sponsored Seminars. Energy documentation providers who show evidence of completion of one of these courses may be recognized by appraisers as being credible for the technology being evaluated.

Assurance of Professional Responsibility

Assurances

While the various certifications and assurances of technical competence described above will provide the appraiser with some degree of protection against liability, additional assurance should be sought in the form of a signed statement from the documentation provider. With the understanding that, as with all areas of appraisal, the energy cost estimates of NOI may be contested at some future time, IMT recommends that the third party energy performance documentation provider (the preparer, reviewer, building owner, or contractor) should certify in writing that the information being provided is true and correct to the best of their knowledge.

Appraiser disclaimers and limiting conditions

In addition to requesting assurance of professional responsibility from the documentation provider, appraisers should also be certain to protect themselves in the appraisal by including disclaimer and limiting conditions language. Language already used by appraisers, such as that suggested by the International Valuation Standards Committee[15], should suffice for purposes of estimations of energy cost as well. Eventual integration of energy documentation requirements into state or national appraisal standards would also protect appraisers against liability.

Appraisers should be certain to protect themselves by including additional disclaimer and limiting conditions language in the appraisal.

Other typical general assumptions and limiting conditions are listed below as they may appear in an appraisal report:

1. The information furnished by others is believed to be reliable. However, no warranty is given for its accuracy. [16]
2. The forecasts, projections, or operating estimates contained herein are based upon current market conditions, local energy prices, anticipated short-term supply and demand factors, and a continued stable economy. These forecasts are, therefore, subject to changes in future conditions. [17]

---

[15] "The statements of fact contained in the report are believed to be true and correct. The Valuer should **identify the sources of data relied upon, indicate whether there was reliance on data supplied by others**, and if data from others is relied upon, state whether there was further verification of that data by the Valuer." *Section 7.2.2. Assumptions and Limiting Conditions.*

[16] *The Appraisal of Real Estate*, p. 582 (AIREA, 9th Ed., 1987)

[17] *The Appraisal of Real Estate*, p. 582 (AIREA, 9th Ed., 1987)

3. Information contained herein is obtained from sources deemed reliable but not guaranteed by the appraiser, who is not an expert in these matters.[18]

[18] Suggested language from a CA Certified General commercial real estate appraiser, 12/1/98.

APPENDIX: FUNDAMENTALS OF ENERGY-EFFICIENT MEASURES IN BUILDINGS

This appendix has three goals:

1. **To assist the appraiser in understanding the basic categories of energy-efficiency measures** in buildings, and the specific sectors in which certain measure types are most important;

2. **To advise the appraiser about how to identify and compare energy-performance levels** of specific building materials and components;

3. **Where available, to identify specific information sources** with more information on measure types on energy consumption and energy costs.

With some measure types, especially lighting, energy savings and effects on cash flow are relatively easy to quantify. With other measures, however, it is usually quite difficult to assess how individual energy-efficiency measures will perform in terms of savings and payback. In an appraisal, therefore, use of this appendix to identify energy-efficient measures would have to be carried out *in conjunction with* examination of billing histories, operating expense statements, or engineering analyses of whole-building performance. See Section III.

Insulation

The amount of heating and cooling that a building requires usually depends very heavily on transmission of heat through the "building envelope" — its outer shell of walls, windows, doors, roof, and bottom floor. Insulation of the building envelope, especially top-floor ceilings, is therefore a very important way to reduce a building's energy bills.

Insulation can be made of various materials, including synthetic foam, cellulose fiber, mineral fiber, and fiberglass. The performance of insulation is expressed in terms of its "R-value," or thermal resistance — the higher the R-value, the better protection against heat transmission.[19] R-values are usually visibly marked on insulation products, but note that R-value will depend on the thickness of the insulation (as, for example, with double layers of fiberglass in an attic) and most importantly, on installation quality. Absence of gaps and avoidance of moisture and compression are essential for the durability and proper function of insulation.

[19] Specifically, R-value is the inverse of the amount of heat that passes through a square foot of surface area, per degree of temperature difference on either side of the surface.

Insulation is especially important in small buildings (for example, single-family residences), which have a larger ratio of surface area to volume than larger buildings. Though we usually think of insulation as a protection against heat losses during cold weather, insulation also helps buildings to stay cool in the summer. In both hot and cold weather, insulation offers benefits in occupant comfort as well.

Windows

Windows strongly affect a building's energy consumption because of their contribution to the building's heat losses in cold weather and heat gains in warm weather. Windows transmit heat, either from indoors to outdoors or vice versa, by several means: 1) transmitting heat through the window panes; 2) transmitting heat through the window frame; 3) leaking cold or warm air through small seams between pane and frame or between frame and wall; and 4) allowing sunlight to enter the building and warm the indoors. Depending on building type, weather, and other factors, windows may account for up to fifty percent of the need for heating in a well-insulated building in winter.[20]

There are various types of window frames and window glass. Frame types include aluminum (which is light and durable but transmits heat readily); aluminum with thermal breaks (in which outer and inner layers of aluminum are separated by an insulating layer); wood; insulated and regular vinyl; fiberglass; and hybrid/composite. Windows may have one, two, or three panes of glass, with or without special coatings or films to encourage or inhibit transmittance of light or heat. Some windows are made of sealed multilayer glass units filled with argon, a gas with especially good insulating properties.

In the state of New York, the most important energy-related aspect of windows is their thermal performance — that is, their ability to retain heat in the building during the colder times of year, and to keep heat out during hot weather. The figure of comparison for window thermal performance is called *U-factor*. Note that U-factor, somewhat confusingly, is the *inverse* of R-value for insulation; therefore the lower the U-factor, the better. Another potentially relevant factor is the solar heat gain coefficient (SHGC), which is an index of how well a window blocks out heat caused by sunlight; the lower the SHGC, the less heat gain through the window. (SHGC is most important in warmer climates, where cooling needs predominate.)

---

[20] From the California Energy Commission: www.energy.ca.gov/consumer/home/windows.html.

In both residential and nonresidential sectors, the National Fenestration Rating Council (NFRC)[21] rates and labels windows for their U-factor and SHGC, as well as visible light transmittance coefficient. Though NFRC certification is not currently required in New York, some window manufacturers still provide certified rating information on their products sold there.

Aside from their direct impact on a building's energy bill, the thermal properties of windows also have a major effect on the comfort of building occupants. When the indoor surfaces of an inefficient window become cold in the winter, people may sense the chill from the cold surfaces even at some distance away. Further, cold indoor surfaces can prompt the condensation of moisture or even the formation of frost, which can lead to an array of problems — including mildew and water stains, peeling of paint, and rotting and deformation of frames and sills.

Lighting

Lighting upgrades are among the most popular energy-efficiency measures in major commercial building sectors, including office buildings, retail, health care, and educational facilities. Energy-efficient lighting measures have a long and successful track record, are relatively simple to install, and provide reliable, easily quantified energy savings.

Lighting typically accounts for over 30 percent of electricity consumption in commercial buildings, and as much as 50 percent in some office buildings. Lighting upgrades can significantly reduce electricity consumption by as much as 65 percent while maintaining or even enhancing lighting quality. In addition, efficient lighting systems also generate less heat than inefficient systems, and therefore can help to reduce cooling costs.

Several elements of lighting systems present opportunities for energy savings: lamps (including bulbs and fluorescent tubes), ballasts, fixtures, controls, and daylighting.[22]

---

[21] For more information, see www.nfrc.org.

[22] The remainder of this section is drawn largely from *Lighting Fundamentals* in Lighting Upgrade Manual issued by the Green Lights Program of the U.S. Environmental Protection Agency, February 1997. See www.epa.gov/buildings/esbhome/lightingfund.pdf for more details.

Fluorescent lamps are the most commonly used commercial light source in North America. They come in various shapes and sizes. T12 lamps, which are four-foot tubes 1½ inches in diameter, are the most common. Narrower, more efficient T10 and T8 lamps often replace T12s in routine lighting upgrades.

Compact fluorescent lamps (CFLs) replace conventional incandescent bulbs in various fixtures, especially overhead lighting. They cost several times more than conventional bulbs, but consume about 65 to 75 percent less energy, and last up to ten times longer. CFLs are not usually compatible with dimmable switches and fixtures.

Ballasts are the devices that deliver and stabilize electric current in fluorescent lighting tubes of various types. *Magnetic ballasts* (which are also called electromagnetic ballasts), in turn, encompass several types. Standard core-coil magnetic ballasts are the least efficient ballasts. So-called "high-efficiency" core-coil ballasts are about ten percent more efficient than standard ones, but despite the terminology, are still much less efficient than electronic or hybrid ballasts.

Electronic ballasts can replace magnetic ballasts in most fluorescent lighting applications, and consume about 12 to 25 percent percent less electricity for equivalent amounts of light. They also offer reduced noise and flicker, and are compatible with dimming in some cases. *Hybrid ballasts* (also known as cathode cut-out ballasts) are core-coil magnetic ballasts with some electronic components. They are approximately as efficient as electronic ballasts.

Ballasts are also used for high-intensity discharge lamps (HID lamps), a broad category that includes mercury vapor, metal halide, and sodium lamps. Such lamps are most common in industrial and outdoor lighting applications, though some HID lamps, especially metal halide, are also used indoors in office or retail settings. Selection of ballasts for HID lamps can have very important effects on lamp efficiency, lamp life, and maintenance costs.[23]

Light fixtures (also called luminaires) direct and distribute light by means of their orientation, reflectors, and shielding. The primary purpose of fixtures is to enhance visual comfort; in certain cases the use of reflectors may distribute enough light to targeted areas to allow for removal of some superfluous lamps, resulting in energy savings.

---

[23]More information on HID ballast selection is available in *Lighting Fundamentals* (see footnote 4).

Lighting controls include timers that shut off lights according to scheduled hours of occupancy; motion sensors which switch lights on and off as people come and go; and manual and automatic dimmers. Such controls are especially important in office buildings, in which people leave rooms and workstations unoccupied periodically during the day and for long stretches every night.

Smart building design for maximum natural light (also known as "*daylighting*") can therefore be an important source of added value. Natural light reduces the need for artificial light and accompanying electricity costs. Also, perhaps even more importantly, daylighting can make indoor spaces more pleasant for occupants. Daylighting has been shown to increase productivity in offices and even to increase sales in retail settings.

Of course the arrangement of windows and skylights are key aspects of daylighting design. Light shelves and clerestories near windows can help to reflect natural light deep into interior spaces. In some newer office settings, you might encounter automated systems that measure ambient natural light and respond by delivering only needed quantities of artificial light.

Heating, Ventilation, and Air Conditioning (HVAC) Systems[24]

HVAC systems vary widely in size and complexity, and cover a broad range of equipment, pipes and ducts, and controls. It is beyond the scope of this brief appendix to address the entire gamut of HVAC equipment and their efficiency ranges. Here we present a brief overview of major system types and key components, and discuss some general principles for equipment selection and management that make for efficient systems.

Packaged HVAC systems are relatively small, complete units that offer heating and cooling, ander are ready for installation when purchased off the shelf. Packaged systems include units intended to serve entire buildings, as well as window or wall units that serve one room. *Central HVAC systems* are typically used in larger buildings. Central HVAC systems are custom designed and built, and collectively encompass a broad range of equipment types. Central systems can be quite complex.

[24] This section is adapted from the SmarterEnergy equipment guides of the Pacific Gas & Electric Company. See http://www.pge.com/customer_services/business/energy/smart/html/central_hvac_guide.html and http://www.pge.com/customer_services/business/energy/smart/html/phvac.html.

High-efficiency HVAC systems can use 35 to 40 percent less energy than conventional new systems. Savings can be even greater when new systems are custom-engineered or replace old systems. A number of factors can contribute to greater efficiency in packaged or central systems:

Efficient equipment. The overall efficiency of an HVAC system depends largely on the efficiency of the primary heating and refrigeration equipment in the system. All packaged systems have certified efficiency ratings, which may serve as a basis for comparison one against another.[25] The key components of central HVAC systems, including chillers and boilers, also bear certified efficiency ratings. Installation of a high-efficiency chiller in a central HVAC system for a multi-story office building can reduce electrical consumption by 35 percent.

Heat pumps use a refrigeration cycle to provide either heating or cooling. For cooling, they operate like conventional air conditioners; for heating, they essentially run the refrigeration cycle in reverse, removing heat from the outdoor air or the ground and sending it indoors. Heat pumps can be efficient when it is not very cold outside, since they use "free" heat instead of fuel for a portion of the building's heating needs. (When it is cold outside, heat pumps must provide supplementary heat, usually with electric resistance heating, which is relatively expensive and inefficient.)

Economizers. An economizer allows outside air to be used for cooling when its temperature is lower than the temperature inside the building. Rooftop units are particularly well suited for using this "free" cooling, and economizers are available as an option for many off-the-shelf units. Economizers can also be retrofitted to existing packaged and central systems, especially ones that are not too old.

Variable air volume systems. Larger, more complex buildings usually have multiple zones with simultaneously different space-conditioning needs. One highly inefficient way to meet differing heating or cooling loads in each zone involves reheating the cool supply air as desired just before it enters the room. This system is called "terminal reheat." Also highly inefficient and costly are dual-duct systems, which maintain separate supplies of heated and cooled air, and mix them via thermostatic controls before delivering the air to rooms — essentially, heating and cooling the room at the same time!

[25] Numerous types of efficiency ratings are used, reflecting subtle differences in the types of operating performance being measured. A detailed glossary of efficiency rating terminology for HVAC equipment may be found at http://www.pnl.gov/fta/2_appc.htm.

A much more efficient alternative, variable air volume (VAV) systems control the amount of hot or cold air flowing into each area, as needed. The systems control the flow of conditioned air by any of various means. Most efficient is the use of an adjustable speed drive (ASD) to match the speed of the supply fan to the amount of air needed. ASDs are not currently available for off-the-shelf rooftop units. Manufacturers can outfit custom and semi-custom units with ASD fan controls.

Evaporative cooling. Some packaged and central systems employ evaporative cooling, in which air is cooled by evaporating water. Evaporative cooling cuts the work that the system's refrigeration equipment must do, raising the capacity of the system.

Controls. The most basic energy-saving HVAC controls are programmable which turn heating or cooling systems down or off when facilities are unoccupied. Even more savings may be achieved by means of energy management systems (EMS), which coordinate HVAC operations among multiple units and multiple zones, helping to prevent problems such as adjacent units working against each other (one unit heating a space, another cooling the adjacent space). Upgraded energy management systems can often reduce overall energy use by 15 percent or more. In addition, these devices maintain system start-up and set-back schedules to optimize building occupant comfort.

Thermal storage. Thermal storage systems operate at night when electric rates are lower, storing cold or heat for use during daylight peak hours. Though thermal storage systems do not save energy, they do reduce energy costs, as well as offering the societal benefits of reducing the need for new power plants.

Monitoring and maintenance. Regular monitoring and maintenance of HVAC systems is absolutely critical for efficient performance, especially with advanced and complex systems. Control failures in particular — including malfunctioning thermostats, misprogrammed EMS, and stuck dampers in VAV systems — can negate any advantages that an efficient system is supposed to provide. In addition, seemingly simple problems such as slipped fan belts, clogged filters, and fouled surfaces can also have major deleterious effects on system efficiency.

Commissioning is the systematic examination of building systems and operations for opportunities to fix problems, assure proper function, and optimize energy performance. Commissioning of HVAC systems by an experienced practitioner, either upon initial construction or during the building's operating life, can be an important way to assure that efficient systems are operating as they should, and that expected energy savings will be reliably achieved.

HVAC equipment sizing. Appropriate sizing of HVAC equipment is critical. Building owners and managers often choose redundant or oversized cooling equipment for reliability against failure or for assurance of sufficient cooling during the hottest weather. In these cases, the frequent result is that the cooling system operates only at a fraction of its capacity — and at suboptimal efficiency — the rest of the time. Oversized HVAC systems can therefore lead to lower overall efficiencies and higher operating costs.

This disconnection between system size and efficient system performance demands that an appraiser be especially careful in accounting for HVAC systems, which are the most expensive sets of equipment in many buildings. A cost-based valuation approach will favor larger, more expensive systems, but if oversized, these same systems will have less value in terms of the income approach than a smaller, less expensive, correctly sized system.