LBNL-1004319

ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

Escalation Rates in Energy Savings Performance Contracts

Philip Coleman

Energy Technologies Area
June, 2015

Disclaimer

Acknowledgements

This work was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Federal Energy Management Program, of the U.S. Department of Energy under Contract No. DE-AC02- 05CH11231.

Escalation Rates in Energy Savings Performance Contracts

Philip Coleman

ABSTRACT

Energy savings performance contracts (ESPCs) are very sensitive to the escalation rates applied to their flow of energy savings. For ESPC deals where annual savings must exceed annual payments (as in the federal sector), these escalation rates dictate the upper limit of the project scope that can be accommodated. The risk of overestimating escalation rates within an ESPC is obvious—actual savings could fall well short of payments made on the project. However, a less understood risk lies in the underestimation of escalation rates; not only can this limit the project's scope, it can also serve to substantially raise interest costs on the project (since actual dollar savings are underapplied toward annual payments, drawing out the project's term). Assuming the downsides to over- and under-escalating are equal, the goal in these projects should not be to lowball the expected actual escalation rate, as often occurs, but to make it accurate. The National Institute for Standards and Technology (NIST) developed and manages an energy escalation rates calculator, EERC, that employs the energy price paths forecasted by DOE's Energy Information Administration (EIA). Because EIA has somewhat underestimated future energy prices in the recent past (since 2000), EERC can be seen as not only a reliable third-party estimate of escalation rates, but also a likely "safe" one (from the risk of overescalation). Its use is recommended, even beyond the federal audience for which it was developed.

INTRODUCTION

Energy escalation rates are an important facet of energy-savings performance contracts (ESPCs). These stipulated rates dictate the flow of dollar savings that will be available, given a guaranteed level of energy savings, to pay for the debt service (i.e., initial project price plus interest), as well as any project servicing costs (such as operations and maintenance or measurement and verification). While there is virtually no discussion of them in the energy conservation literature, and it may seem that they are a trifling element of an ESPC, the implications of escalation rates in these projects are enormous. Because ESPCs are generally lengthy (the average term is more than 18 years for U.S. federal projects), small differences in these percentage escalations can mean the difference between hundreds of thousands, and sometimes millions of dollars of contractual savings over the lifetime of a deal.

As an example, consider an ESPC project with a 20-year contract term and initial (first-year) energy cost savings of $1 million. Now consider the use of a 2% escalation rate applied to those cost savings versus a 2.5% rate. This seemingly small increase of 0.5% would mean that the project's total (undiscounted) payments could be $1.4 million higher—an amount greater than 5% of all payments over the contract's lifetime. The difference in year-15 savings alone amounts to more than $100,000 ($1,345,868 versus $1,448,298). These are funds that can be used to either buy a bigger project or pay off the same project more quickly. Figure 1 shows the annual savings on this hypothetical project ($1 million in initial savings, 20-year term) given anywhere between a 0% and 5% annual escalation of energy rates.

UNDER-ESCALATING: IS IT REALLY A "CONSERVATIVE" POLICY?

Because federal ESPCs are required to be paid for exclusively out of savings, the escalation rates applied can have a "make-or-break" effect, deeming a project with a given amount of energy savings viable or not, based on the corresponding avoided dollar costs expected in future years. While over-estimating escalation rates may cause a project to include more capital investment than can be paid for from actual out-year avoided costs, creating a net negative budgetary effect from the ESPC, two less obvious but equally troublesome problems result from under-estimating these rates:

- First, if the project's term is held constant, the scope will need to be reduced due to inadequate "cash flow" at the lower escalation rates. For instance, one or more longer-payback measures could be eliminated from the scope. This means that the project's site receives less savings (of both energy and money) and also is less hedged against possible future increases in energy prices.

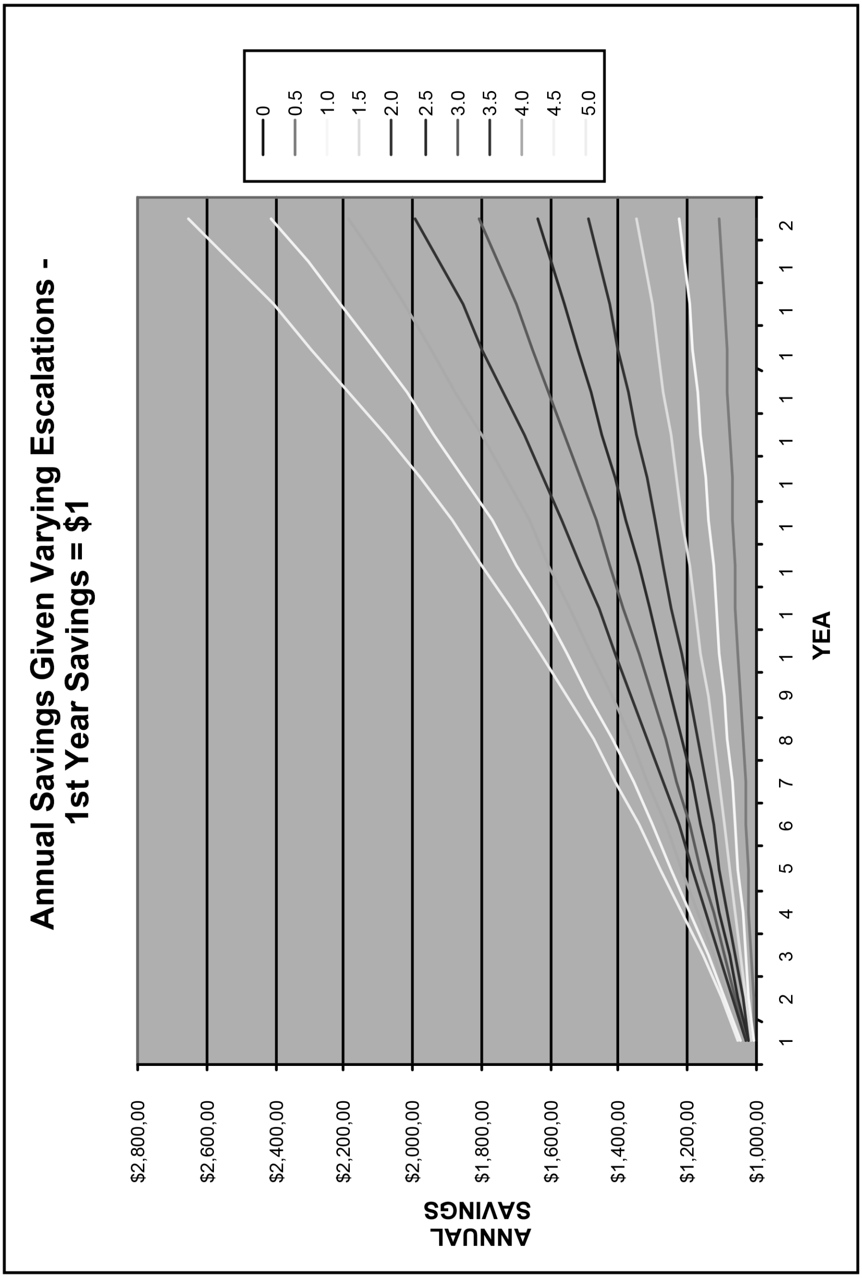
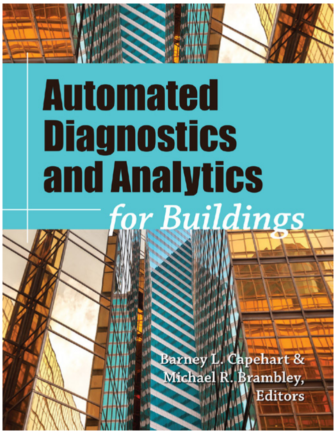


Figure 1. Sensitivity of Annual Dollar Savings to Different Escalation Rates

10% Online Discount
Use Code JR10

AUTOMATED DIAGNOSTICS AND ANALYTICS FOR BUILDINGS

Edited by Barney L. Capehart, Ph.D., and Michael R. Brambley, Ph.D.



With the widespread availability of high-speed, high capacity microprocessors and microcomputers with high-speed communication ability, and sophisticated energy analytics software, the technology to support deployment of automated diagnostics is now available, and the opportunity to apply automated fault detection and diagnostics to every system and piece of equipment in a facility, as well as for whole buildings, is imminent. The purpose of this book is to share information with a broad audience on the state of automated fault detection and diagnostics for buildings applications, the benefits of those applications, emerging diagnostic technology, examples of field deployments, the relationship to codes and standards, automated diagnostic tools presently available, guidance on how to use automated diagnostics, and related issues.

ISBN: 0-88173-732-1

8½ x 11, 615 pp., Illus.
Hardcover

$175
Order Code 0695

CONTENTS

BOOK ORDER FORM

① Complete quantity and amount due for each book you wish to order:

Quantity	Book Title	Order Code	Price	Amount Due
	Automated Diagnostics and Analytics for Buildings	**0695**	**$175.00**	
			Applicable Discount	
			Georgia Residents add 6% Sales Tax	
			Shipping $10 first book $4 each additional book	**10.00**
			TOTAL	

② Indicate shipping address: CODE: Journal 2014

NAME (Please print) BUSINESS PHONE

SIGNATURE (Required to process order) EMAIL ADDRESS

COMPANY

STREET ADDRESS ONLY (No P.O. Box)

CITY, STATE, ZIP

MEMBER DISCOUNTS—A 15% discount is allowed to AEE members (discounts cannot be combined).
☐ **AEE Member (Member No.__________________)**

③ Select method of payment:
☐ **CHECK ENCLOSED**
☐ **CHARGE TO MY CREDIT CARD**
☐ *VISA* ☐ *MASTERCARD* ☐ *AMERICAN EXPRESS*

Make check payable in U.S. funds to:
AEE ENERGY BOOKS

CARD NO.

Expiration date *Signature*

④ Send your order to:
AEE BOOKS
P.O. Box 1026
Lilburn, GA 30048

INTERNET ORDERING
www.aeecenter.org/books
(use discount code)

TO ORDER BY PHONE
Use your credit card and call:
(770) 925-9558

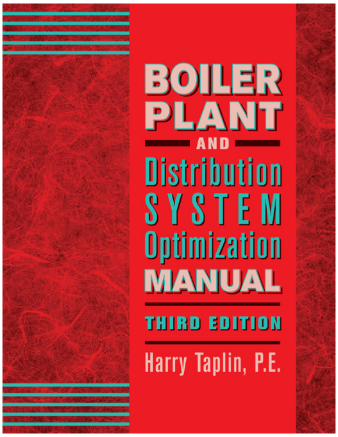
TO ORDER BY FAX
Complete and Fax to:
(770) 381-9865

INTERNATIONAL ORDERS
Must be prepaid in U.S. dollars and must include an additional charge of $10.00 per book plus 15% for shipping and handling by surface mail.

10% Online Discount
Use Code JR10

BOILER PLANT AND DISTRIBUTION SYSTEM OPTIMIZATION MANUAL, 3rd Edition

Harry Taplin, P.E



Completely revised and edited, this expert's guide to boilers details all you'll need to know to implement a proven, systematic approach to improving boiler plant and distribution system efficiency. Understanding that funds for energy come directly from your bottom line, this book has been designed for those tasked with increasing profits by reducing fuel costs and also reducing pollution, carbon footprints with attention to plant safety. The author presents many complex boiler related topics in a simple and understandable way to simplify the decision making process. This new edition has been expanded to provide over 100 proven and practical ways to improve boiler plant and distribution system performance, with 50 added illustrations to communicate specific information about applying these technologies. Ten new checklists serve as a handy reference for designing an energy plan for your plants. The author presents many complex boiler related topics in a simple and understandable way to simplify the decision making process.

ISBN: 0-88173-740-2

8½ x 11, 345 pp., Illus.
Hardcover

$98
Order Code 0697

CONTENTS

BOOK ORDER FORM

① Complete quantity and amount due for each book you wish to order:

Quantity	Book Title	Order Code	Price	Amount Due
	Boiler Plant and Distribution System Optimization Manual, 3rd Edition	**0697**	**$98.00**	
			Applicable Discount	
			Georgia Residents add 6% Sales Tax	
			Shipping $10 first book $4 each additional book	**10.00**
			TOTAL	

② Indicate shipping address: CODE: Journal 2014

NAME (Please print) BUSINESS PHONE

SIGNATURE (Required to process order) EMAIL ADDRESS

COMPANY

STREET ADDRESS ONLY (No P.O. Box)

CITY, STATE, ZIP

MEMBER DISCOUNTS—A 15% discount is allowed to AEE members (discounts cannot be combined).

☐ **AEE Member (Member No.____________________)**

③ Select method of payment:

☐ **CHECK ENCLOSED**
☐ **CHARGE TO MY CREDIT CARD**
☐ *VISA* ☐ *MASTERCARD* ☐ *AMERICAN EXPRESS*

CARD NO.

Expiration date *Signature*

Make check payable in U.S. funds to:
AEE ENERGY BOOKS

④ Send your order to:
AEE BOOKS
P.O. Box 1026
Lilburn, GA 30048

INTERNET ORDERING
www.aeecenter.org/books
(use discount code)

TO ORDER BY PHONE
Use your credit card and call:
(770) 925-9558

TO ORDER BY FAX
Complete and Fax to:
(770) 381-9865

INTERNATIONAL ORDERS
Must be prepaid in U.S. dollars and must include an additional charge of $10.00 per book plus 15% for shipping and handling by surface mail.

- Second, if scope is not compromised, then necessarily the term needed to pay off the project must lengthen, because fewer contractual dollar savings are available to devote to debt service each year (given a fixed amount of guaranteed energy savings). This means that total interest costs will be higher (because interest accrues on the remaining principal, which is being paid down more slowly).

The bottom line, then, is that with a lower escalation rate, either the project size diminishes or its term—and thus interest costs—must expand.

As an example of the consequences of the scope reduction phenomenon, there were numerous instances of federal sites in the early 2000s that eliminated boiler replacements from their prospective ESPCs because the boilers had very long payback periods that would have extended the projects' terms beyond the 25-year federal maximum (or a shorter term that had been targeted by the agency or individual site). Consider a hypothetical such site whose boiler plant used 400,000 MMBtus (or dekatherms) of gas in an average year. In 2000, the delivered cost of this gas might have been on the order of $5/MMBtu, or $2 million per year. If the proposed boiler replacement project was going to save 30% of the facility's annual gas usage, total gas costs would fall to $1.4 million annually if gas prices remained stable at $5/MMBtu. However, given the doubling of unit gas costs in the 2000s, to roughly $10/MMBtu, actual gas costs at the site would have risen to $4 million per year without the project (assuming that the existing boilers were still operating and with no further degradation in their efficiency)—but only to $2.8 million if the new boilers had been installed (i.e., the dollar savings would also double, to $1.2 million).

To illustrate the second phenomenon—added term and interest costs—assume a hypothetical project with a $10 million initial investment cost, $1 million in guaranteed first-year savings, and a 6% borrowing rate. Applying a 1% annual energy escalation rate results in a 15-year term. If the escalation rate is 4% instead, the term decreases to 12 years, and the total interest cost on the project drops by roughly $750,000 (from $5.35M to $4.59M).

For some time, the practice of underestimating escalation rates was fairly common in federal-sector projects, partly in reaction to ESCOs that were routinely seeking higher rates, to permit greater project sizes. The scope-limiting and term-lengthening consequences of this systematic underestimation, along with numerous agency appeals for assistance in setting the rates, underscored the need for the Department of Energy's Federal Energy Management Program (FEMP) to investigate the topic. DOE, primarily through FEMP, administers a very active indefinite quantity contract for federal ESPCs and is charged more generally by Congress with ESPC oversight. Consequently, FEMP began recommending that U.S. federal agencies apply escalation rates estimated by the National Institute of Standards and Technology (which incorporates energy price projections from the Department of Energy's Energy Information Administration, EIA) in their ESPCs. Initially it was a challenge to convince federal agencies that using unrealistically low escalation rates in ESPCs is not a "conservative" approach, given the deleterious effects of curtailing project size or raising total interest costs. However, most federal agencies have recognized the problem with under-escalating and now devise the rates using NIST's guidance.

NIST's EERC TOOL

The NIST tool for estimating escalation rates in ESPCs is a small, publicly available software program called the Energy Escalation Rate Calculator, or EERC. NIST develops EERC by taking the EIA's price projections for each of the U.S. census regions, which are expressed in real (excluding inflation) terms, and then superimposing an expected long-term inflation rate. This results in nominal (including inflation) escalation rates, which are appropriate for ESPCs because the cash flows (both savings and payments) are actual future ones.

Per the directives of 10 CFR 436, Subpart A ("Federal Energy Management and Planning Programs, Methodology and Procedures for Life Cycle Cost Analyses"), the inflation figure is supposed to represent "estimated increases in the general level of prices consistent with projections of inflation in the most recent Economic Report of the President's Council of Economic Advisors." For the 2013 version (EERC 2.0-13), the default figure was 2.2%*.

*Before 2012, the President's Council of Economic Advisors (PCEA) estimated only a relatively short-term (five-year) inflation rate, so NIST would calculate inflation using the implied difference between the returns of long- and short-term Treasury bonds. The 2012 and subsequent PCEA reports, however, have included a ten-year inflation estimate. NIST has incorporated these figures directly into EERC as the default long-term inflation rate.

Users of the tool need only identify the state in which their prospective project will take place, whether the utility accounts are better characterized as commercial or industrial*, the expected start date (award year) and duration of the project. With that, the tool will determine an escalation rate for electricity and one for natural gas (and any other fuel input). Alternatively, the user can identify the percentage dollar savings occurring from each energy source (in the initial year of project performance) and generate a composite escalation rate that can be applied to the project's energy cost savings as a whole (either approach will ultimately lead to the same end result in dollar terms). A short "Help" feature provides explanations, as needed. EERC is available for download from FEMP's website, www.energy.gov/eere/femp.

HISTORICAL ACCURACY OF EIA'S REFERENCE CASE FORECASTS

It is convenient to have an independent party like EIA make escalation forecasts—not to mention an organization like NIST that then packages them into tools to simplify their application to real projects. But a key question needs to be asked of these forecasts: Are they reasonable?

EIA actually conducts an historical analysis of its own predictions. The agency began publishing the Annual Energy Outlook in 1982. Since 1994, EIA has generated its forecasts using a model called NEMS (National Energy Modeling System). In the 1994-2012 timeframe most recently chronicled in EIA's AEO Retrospective Review, the agency found that NEMS (and thus AEO) overestimated the world oil price in its "Reference" case forecasts (the ones used by NIST in EERC) 18% of the time, the U.S. average wellhead natural gas price 32.5% of the time, and the U.S. average electric price 36% of the time. A 50% overestimation rate would indicate the highest degree of accuracy, i.e., that overestimates and underestimates were equally frequent.

---

*This choice has generated controversy in some instances, and the tool's only guidance states that the "Selection of commercial or industrial sector determines the type of utility rate schedule applied to the energy cost calculation." This author has advised selection based on electric load factor, with roughly 75% representing the cut-off (higher load factor facilities would use the industrial figure, lower the commercial).

So the numbers reveal that NEMS has had a propensity to under-predict prices significantly for these commodities (a finding that is discussed extensively, especially with regard to oil, in the literature*). But recent AEOs reveal an even more pronounced underestimation of prices for all three energy sources of late (from 2000 to 2012, the last year of the most recent study's data)†:

- For electricity, whose pricing is not as volatile as the other two commodities, AEO predictions were short of actual prices in 97% (88 of 91) of their forecasts (AEO 2000 under-predicted for all 13 years, AEO 2001 for all 12, etc., until the onset of the recession, when AEO 2008 under-predicted the average electricity price for the two succeeding years, 2009 and 2010);

- Similarly, oil's price (measured by the AEO as the price to U.S. refiners) was also underestimated in 97% (88 out of 91) of forecasts in the same time span;

- Natural gas estimations were somewhat better, benefitting from the large price drops that occurred in that commodity in 2008-9 and again in 2011-12. The AEOs under-predicted in just 57% (54 of 91) of their forecasts.

Why the under-predictions? There are numerous explanations for this and no shortage of calls for revisions to (and even disposal of) NEMS. But one aspect of the reference forecasts is that they must, by law, be "policy neutral," and thus do not incorporate legislation and regulation that might occur, even when these policy changes seem inevitable. In addition, if authorizing legislation is passed but funding—or the necessary regulations to enact it—are not in place, EIA must exclude the policy from its "Reference" (base case) model. In other words, the forecasts represent a strict "business as usual" scenario.

---

*See, for example, Considine and Clemente (2007)

†For the purposes of this exercise, the analyses shown do not include as "forecasts" the prior year's price estimations printed in each year's AEO. For instance, AEO 2006, which was initially released in December, 2005, shows as forecasts the commodity prices from 2005. Since a full three-quarters of the year has passed when these estimations are made, the author does not consider them in the analysis of EIA's acumen in predicting prices.

WHAT ARE THE IMPLICATIONS OF EIA'S UNDERESTIMATES FOR EERC AND ESPCs?

Because EIA's systematically low forecasts of energy prices are the ones that NIST incorporates into EERC, this underestimation is being translated to that tool as well. It is clear then that, if anything, EERC has a tendency to under-predict escalations.

For the reasons stated above, federal agencies and other ESPC customers would be wise not to exacerbate these under-predictions by using escalation rates even lower than those prescribed by the tool. These under-stipulated energy prices in ESPCs lead to "excess" dollar savings for the customer (assuming the guaranteed energy savings are achieved), which is an ostensibly desirable outcome for a host facility. However, the implication of systematic under-prediction of energy prices in ESPCs, as discussed above, is that the relevant projects necessarily have either an under-investment in energy conservation measures relative to optimal levels (since the extent of the projects hinges on the cash flow from the energy cost savings) or a longer term than they would otherwise have had, which translates to higher total interest costs for the customer (assuming the payment schedule is matched to the project's dollar savings). In other words, it may be that most ESPC projects, including those that follow EERC but especially ones that employ escalation rates below those determined by EERC, are routinely either too small or too expensive.

CONCLUSION AND RECOMMENDATIONS FOR ESPC CUSTOMERS

Making estimates of energy price escalations is an uncomfortable exercise, as no one has a clear view of the future. However, for the purposes of gauging (and guaranteeing) future savings from ESPCs, with their characteristically long terms, these estimates must be made. Using NIST's EERC tool, and thus EIA's reference case, is an appealing method, because the forecasts are conducted by an educated and objective third party. Moreover, for those concerned that EERC's escalation rates might overestimate future price trends, they can take comfort in the fact that EIA's reference case has fairly consistently under-predicted U.S. energy prices since the turn of this century.

Because of this tendency toward underestimation by EIA, EERC can be seen as having an inherently low bias in its calculation of future utility rate increases. Implementers of ESPCs should thus feel both safe and defensible in using EERC, if they are concerned about future contract payments exceeding actual savings. On the other hand, because of the very real downsides of under-escalation, choosing rates below those generated by the tool is patently unwise.

Disclaimer

This document was prepared as an account of work sponsored by the United States government. While this document is believed to contain correct information, neither the United States government nor any agency thereof, nor The Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States government or any agency thereof, or The Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or any agency thereof or The Regents of the University of California.

Acknowledgements

This work was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Federal Energy Management Program, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

References

Considine, T.J. and F.A. Clemente. 2007. "Gas Market Forecasts: Betting on Bad Numbers." *Public Utilities Fortnightly* (July): 53-59. www.fortnightly.com/fortnightly/2007/07/gas-market-forecasts-betting-bad-numbers

EIA (U.S. Energy Information Administration). 2014. Annual Energy Outlook Retrospective Review: Evaluation of 2013 and Prior Reference Case Projections. Washington, DC: U.S. Department of Energy. www.eia.gov/forecasts/aeo/retrospective/

ABOUT THE AUTHOR

Philip Coleman has worked at Lawrence Berkeley National Laboratory since 1996. He is a technical advisor to the Federal Energy Management Program's energy savings performance contracting (ESPC) program, focusing particularly on utility rates and measurement and verification of savings. Also in support of FEMP, Phil has spearheaded an initiative to educate federal facilities on efficiency and renewable project incentives, demand response, utilities procurement, and "rate-responsive building operation." Internationally, he has advised governments in Mexico, India, Chile and Jordan on developing public-sector energy conservation programs.

Philip can be reached at PEColeman@lbl.gov.