PART II

"Energy Balancing"

How to Use the Energy Balance Data You Have Collected TO MAKE FINANCIAL DECISIONS

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ABSTRACT

This article extends the energy balance described in Part I of this two-part series, "Analyzing Facility Energy Use: A Balancing Act," published in *Strategic Planning for Energy and the Environment*, Fall, 2001. Once you know how much energy your various pieces of equipment are using, you can then make informed decisions on what changes will make that equipment operate more efficiently.

In this article, we describe ways to expand the basic energy balance format to help select cost-effective energy saving projects. We also discuss the advantages of using various financial analysis techniques such as **Simple Payback Period, Savings-to-Investment Ratio, Internal Rate of Return, and Net Present Value**. We describe these techniques in an extended energy balance spreadsheet.

INTRODUCTION

Part I, "Analyzing Facility Energy Use: A Balancing Act," gave a starting point for investigating the energy use of a facility. We described our method for simulating the energy-related operations of a facility by constructing a detailed energy balance and validating it using the facility's historical energy use patterns. Part II shows how to analyze some energy efficiency measures with an expanded energy balance. We describe several common engineering economic analysis techniques that you may use to make financial and capital investment decisions and then we show how to further expand the energy balance by incorporating these techniques into it.

This economic analysis of energy efficiency measures can be a time-consuming activity if the facility is very large at all. As with any capital investment, you will have to weigh the time and money required to produce the analysis against the value of the increased confidence with which you can approach these capital investments.

Of course, the greater the amount of the capital investment, the more the increase in confidence (and corresponding decrease in risk) will be worth. For example, if you are trying to decide whether to replace 25 incandescent light bulbs with 25 compact fluorescent lights, you can afford to trust the analysis that most manufacturers print on their box.

However, if your decision involves changes costing thousands of dollars or more, then you will need a more rigorous analysis. In other words, when the stakes are large enough, the time spent to perform a detailed energy and economic analysis is worth the cost.

USING THE ENERGY BALANCE TO ANALYZE ENERGY SAVINGS

Part I in this series set up a format for analyzing the energy use in a facility. We did that with an Excel spreadsheet that itemized pieces of equipment by category (lighting, motors, HVAC, air compressors, etc.). We calculated a projected annual energy and demand use for each piece of equipment, totaled the energy and demand use for all the equipment and compared that to the historical (actual) energy and demand use of the facility over a twelve-month period.

If the calculated totals matched the actual totals within one percent, we were satisfied that we had a reasonably representative distribution of energy use in the facility. We also described the methods we used to check our calculations and adjust our various parameters (such as load factor, use factor and diversity factor) if the totals for demand or energy were either too high or too low.

Table 1 shows a section of the sample energy balance used in our previous article. You will find a more complete description of our energy balance technique in Part I, "Analyzing Energy Use: A Balancing Act,"

Table 1: Sawmill motors section of a sample energy balance

MOTORS

Location and Equipment Name	HP (rated)	Units	Hours per year	lf	uf	df	Efficiency	kW	kWh	Estimated Annual Cost ($/yr)
Saw Mill										
Motor line items								= (Hp/unit × number of units × lf × 0.746 × df)/Efficiency	= kW × hours per year × uf/df	= kW × $/kW/month × 12 months/yr + kWh/yr × $/kWh
Chipping edger	75	2	2,025	0.4	0.6	0.9	0.94	42.81	57,793	5,701
Head saw	100	1	2,025	0.4	0.6	0.9	0.95	28.42	38,366	3,785
Log trimmer	15	1	2,025	0.4	0.6	0.9	0.91	4.43	5,976	590
Conveyor	5	2	2,025	0.7	0.85	1.0	0.875	5.97	10,272	896
Saw mill motors sub-total:								**81.63**	**112,407**	**10,972**

Strategic Planning for Energy and the Environment, Fall, 2001.

Once we are satisfied with the results of our energy balance, we take the basic energy balance and extend it to help us evaluate a variety of energy efficiency recommendations. To do this, we add new columns to the spreadsheet for analyzing the proposed changes.

First, we replicate the columns in the existing energy balance except for the equipment description. This allows us to analyze recommendations that make changes in any of the other column categories.

For example, if our recommendation is to replace a motor with a higher efficiency motor, we can modify the efficiency number in the Efficiency Changes column. If our recommendation is to replace the equipment with equipment that uses fewer watts or kilowatts, we can modify the numbers in the Equipment Rating Changes column. If our recommendation is to reduce the number of hours that the equipment is used, we can modify the numbers in the Hours of Operation Changes column.

Then, we add four more columns in which we calculate the energy and demand savings and the energy and demand *cost* savings for our recommended changes. See Table 2—Extended Energy Balance for Sawmill Motor Section. We will use the sawmill motors section of the energy balance throughout our article for demonstration purposes.

We generally start with many of the same recommendations at each facility, so we have developed macros to fill in this analytical portion of the energy balance. For example, in the area of lighting, one common recommendation is to replace T-12 fluorescent lamps with T-8s. The T-8 macro examines the lighting section and looks for each entry of T-12 lamps.

When it finds a T-12 entry, the macro fills in the rest of the line by copying the operating hours and the number of lamps from the existing lamps section. Then it fills in the equipment rating with the new wattage and the ballast factor with the new ballast factor for a T-8 lamp. This step is repeated until all T-12s have been processed.

At this point the macro calculates the energy and demand use for the new lamps and also the energy and demand savings and cost savings. It then sums these savings for all the new lamps to give the total savings in each column for this recommendation.

Similarly, we can modify our motors section. We can vary any of the motor parameters according to the recommendation we are analyzing; e.g., reduce number of motors, downsize motors, reduce operating hours, increase motor efficiency.

For example, we use a macro to help analyze the costs of increasing the efficiency of the motors. The macro checks the rated horsepower of the existing motors, and then fills in the new motor efficiencies using information from the US Department of Energy MotorMaster program. Once the new efficiencies are inserted, the macro calculates the energy and demand use and costs for the new motors.

Table 2 shows this method applied to the recommended high-efficiency motor for the conveyor belt. For demonstration purposes, we only show one modified line item; however, the macro works with each motor line item in the energy balance and gives us the total savings for replacing all the motors with high efficiency motors.

VALIDATING DOLLAR SAVINGS FROM ENERGY SAVINGS DATA

Now that we have the results of our extended energy balance—the energy savings data— we must decide which projects to implement. While saving energy is a great goal, most companies expect an energy-saving project to pay for itself in a reasonable time period. Before you receive approval for an energy-saving project, you must demonstrate that the project in question will provide an acceptable rate of return. Often, you must also compete with all other company projects for the capital (money) you need for your project.

Finally, your project may have to compete with other energy-saving projects. You must be able to answer several questions: **Which energy-saving project will provide the best return? Why should your energy project be implemented instead of another company project?**

We describe several methods for helping answer these questions. We also show how to extend the energy balance further to include the results of these economic and analytical methods.

PROJECT SELECTION

Capital is a limited resource for any organization. Therefore, it is important not to waste capital on projects that provide a low return when compared to other available projects. Decision makers generally

Table 2: Extended energy balance for sawmill motor section

MOTORS

									Calculations for Recommended Efficiency Measure					
Standard equipment information		**Equipment information after recommendation is implemented**							**Expected Energy Use and Demand**		**Expected Annual Costs & Savings from Efficiency Measure**			
Location and Equipment Name	*Equipment information and calculations of kW and kWh, energy cost and demand cost are omitted here to have sufficient space*	Rated HP	# of units	Hr/yr	lf	uf	df	Efficiency	kW	kWh	**Energy Savings** (kWh/yr)	**Demand Savings** (kW/mo)	**Energy Cost Savings** ($/yr)	**Demand Cost Savings** ($/yr)
Saw Mill														
Motor line items														
Chipping edger	…	75												
Head saw	…	100												
Log trimmer	…	15												
Conveyor	…	5	2	2,025	0.7	0.85	1.0	0.9	5.8	9,812	460	0.17	25	9.49
Saw mill motors sub-total:	…										460	0.17	25	9.49

institute basic rules for making financial decisions. Many organizations use a Minimum Attractive Rate of Return (MARR) to screen out projects with very low economic benefits.

We leave the discussion concerning how decision makers or a finance department calculates MARR and the related concepts of Weighted Average Cost of Capital (WACC) and Project Cost of Capital (PCC) to another article. For an in depth discussion of these concepts you should read an appropriate finance or engineering economy text. [3] In this article, we will describe these concepts within the context of using the energy balance as an analysis tool.

Economic Analysis of Energy Efficiency Projects

First, you must collect the following information about each piece of equipment that you want to consider for an efficiency improvement recommendation:

- Historical pattern of usage;
- Energy unit costs;
- Expected energy savings;
- Expected project savings;
- Expected project cost; and
- Expected project lifetime.

The first four of these pieces of information come from the production of the basic energy balance. Now, how do you use this information to make a good decision? As an example, we will discuss two potential motor efficiency improvement projects: 1) replacing the conveyor motor with a high-efficiency motor, and 2) using a high-efficiency V-belt on the conveyor motor.

These two projects are interdependent; that is, the actual savings from implementing both projects is less than the sum of the individual savings from each project. This is because the energy savings from using a V-belt on a motor depends on the efficiency of the motor itself. The higher the efficiency of the motor, the lower the savings of the V-belt. The opposite is also true. If a motor already has an efficient V-belt, then the savings from making the motor more efficient will be less.

However, we assume that this is a first-pass calculation, and we are analyzing these two projects as if they were independent. In other words, we are deciding which of these projects should be the lead project. Once we decide which project is more profitable when we analyze them as independent projects, then we can analyze the other project after recalculating its dollar savings based on the final operating characteristics of the lead (more profitable) project.

Table 3 shows the pertinent financial characteristics for each of these projects.

Table 3. Example project financial characteristics

	High-Efficiency Motor	High-Efficiency V-belt
Expected dollar savings ($/yr)	25	10
PCC or project MARR (%)	14	14
Expected project cost ($)	100	10
Expected project life (years)	10	2

We will describe four methods for evaluating our example project:

- **Simple Payback Period;**
- **Internal Rate of Return;**
- **Saving-to-Investment Ratio; and**
- **Net-Present Value.**

We will point out advantages and disadvantages of each method. At the end of our discussion, we will add these analytical measures to our energy balance.

Simple Payback Period (SPP)

The SPP determines the number of years required to recover the project cost through the project savings. Almost all organizations use, or want to see the SPP for each project. Many organizations use the SPP exclusively for project analysis. It is easy to calculate and easy to understand. It is essentially the only method used by most small and medium-sized companies. It is also often used by major corporations, sometimes in conjunction with other analytical tools.

Most organizations that use SPP for project go/no-go decisions usually set a threshold, or hurdle, for the SPP—for example, a two or three-year maximum period. The Federal Government uses a ten-year maximum SPP.

To calculate simple payback, divide the project cost by the annual cost savings:

SPP = Expected project cost ($)/Expected project cost savings ($/yr)

For our High-Efficiency Motor sample project:

SPPm = $100/$25/yr
= 4 yr

For our V-belt sample project:

SPPv = $10/$10/yr
= 1 yr

When we examine these results together with the information on the project lifetimes, we can gain some valuable information rather quickly. For example, we see that each of these projects has a payback less than its project life. If the payback period is longer than the life of the project, then we would eliminate that project as unprofitable.

If your organization uses a threshold SPP, you can modify the macro to eliminate all motors that have an SPP greater than your threshold. In our example, a high-efficiency replacement motor for the conveyor belt motor would be eliminated at any facility that set its SPP threshold lower than four years.

Using the SPP comparison, the V-belt project appears to be the better project because it has a shorter payback period. However, this example highlights one of the disadvantages of the simple payback method. It does not explicitly take the lifetime of the project into account. Ask the following question: What would you rather have? A $10 a year cash flow for two years, or a $25-a-year cash flow for 10 years?

With the simple payback method, you would choose the project that would pay your investment back faster, but in this case the V-belt project would not give you as large a savings in the long run. **Thus, the SPP method is limited in terms of its economic correctness for making project decisions, but it is still widely used in spite of its limitations.**

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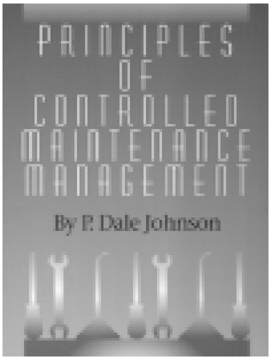

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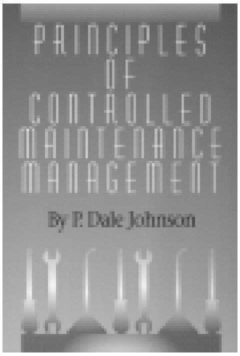

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Internal Rate of Return (IRR)

IRR is the interest rate that makes the present value of the benefits of a project equal to the present value of the project costs. If the IRR is greater than the MARR of an organization, the project is economically feasible. IRR can be quite complicated and time consuming to calculate by hand or with interest rate charts; however, spreadsheets and financial calculators can make quick work of these calculations. Using the energy balance macro, you can again eliminate projects that have an IRR greater than the organization's MARR.

IRRp = IRR(annual cash flows)
= IRR(-expect project cost($),
expected annual savings for year 1($),
expected annual savings for year 2($)
…
expected annual savings for year N($))N is.

Where,
N = the life of the project

For our High-Efficiency Motor example project, we use the following equation within Microsoft Excel to get the internal rate of return. We use the project financial information from Table 3.

IRRm = IRR(-expected project cost,
(Cash inflows less cash
$\text{outflows)}_{\text{for each year for the life of the project}}$)
= $\text{IRR(-100, (25)}_{\text{for 10 years}}$)
= IRR(-100, 25, 25, 25, 25, 25, 25, 25, 25, 25, 25)
= 21.4%

For our V-belt sample project, we use the following equation within Microsoft Excel to get the internal rate of return. Again, we use the financial data from Table 3.

IRRv = IRR(-expected project cost,
(Cash inflows less cash
$\text{outflows)}_{\text{for each year for the life of the project}}$)
= IRR(-expected project cost,
expected savings for year 1,

(expected savings for year 2—expected cost
to renew project for year 2),
…
expected savings for year 9,
(expected savings for year 10—expected cost
to renew project for year 10)
= IRR(-10, 10, (10-10), 10, (10-10), 10, (10-10),
10, (10-10), 10, 10)
= IRR(-10, 10, 0, 10, 0, 10, 0, 10, 0, 10, 0)
= 62

To make a valid comparison of two projects with different lives, we have to make adjustments to the calculations. You may use several techniques for these adjustments. One such technique is to make the project lives the same by repeating one or both the project lives until each has a matching horizon. For our example, we can match project horizons, since the V-belt project is repeatable. Therefore, we must calculate five 2-year V-belt projects to match the one 10-year high-efficiency motor project.

Using the IRR analysis, the V-belt project again appears to be the better project. Generally, if a project IRR exceeds that organization's MARR, that project is acceptable, and will be implemented. For example, if MARR = 14% then either project would be acceptable.

Because of the interrelationship of energy savings discussed above, another analysis of the high-efficiency motor project would be needed. However, if it still had an IRR greater than 14%, it too should be implemented.

If only one project were to be implemented, comparing or ranking IRRs is not an economically correct approach to use. The reason for this is somewhat complex, but is related to what happens to the funds not used by a project—or returned by a project. A full explanation is beyond the scope of our article, but can be found in most engineering economy or finance textbooks [3].

Even though ranking of projects by IRR is not really economically correct, it is still widely done by those using the IRR method. Choices among projects are correctly made using the Net Present Value method discussed in a following section.

Savings-to-Investment Ratio (SIR)

The Savings-to-Investment Ratio, also known as Benefit-to-Cost Ratio (BCR), is calculated by dividing the present value (PV) of the benefits of the project by the present value of the costs of the project: If the SIR of a project is greater than one it is considered profitable. With the energy balance macro, all projects with a SIR less than one are automatically eliminated from consideration.

While the SIR method allows you to determine whether projects are profitable, it still does not answer the project comparison question correctly. Choosing the project with the highest SIR among a group of projects does not necessarily give the correct economic choice. Of the methods we discuss, only the Net Present Value method gives this correct choice. Because of this limitation of the use of the SIR or BCR method, we recommend that you do not use this method unless contractual requirements, benchmarking, or corporate standards require it.

The SIR or BCR method is most often used in the public sector projects. The Army Corps of Engineers is one of the large organizations using the BCR method. If incremental cash flow analysis is used to calculate the SIRs or BCRs, it can give the correct project selection results [3].

SIR = Present value of the benefits ($)/Present value of the costs ($)
= NPV(MARR,
expected savings for year 1,
expected savings for year 2,
…,
expected savings for year N)/
(NPV(MARR,
expected costs for year 1,
expected costs for year 2,
…,
expected costs for year N) +
initial cost in year 0 to implement project)

Where,
N = the life of the project

For our High-Efficiency Motor project, we use the following equations within Microsoft Excel to get this ratio. We use the cash flows and MARR from Table 3.

SIRm = NPV(14%, 25, 25, 25, 25, 25, 25, 25, 25, 25, 25)/
(NPV(14%, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)+100)

= $130.40/$100
= 1.3

For our V-belt project, we use the following equations within Microsoft Excel to get this ratio. We use the cash flows and MARR from Table 3.

SIRv = NPV(14%, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10)/
(NPV(14%, 0, 10, 0, 10, 0, 10, 0, 10, 0, 0)+10)
= $52.16/$31.68
= 1.65

As in the previous method, we must calculate five 2-year V-belt projects to match the one 10-year high-efficiency motor project.

The V-belt project again appears to be the better project, but both projects have acceptable ratios and would be retained by our energy balance macro.

Net Present Value (NPV)

NPV is the present dollar value of all benefits minus the present dollar value of all costs of a project. The greater the NPV, the more cost-effective is the project.

Again, spreadsheets and financial calculators can make quick work of NPV calculations. Note the similarity of the parameters of the NPV method and the SIR method.

NPV = Present value of the all the cash flows ($)
= (NPV(MARR,
expected costs for year 1,
expected costs for year 2,
…,
expected costs for year N) –
initial cost in year 0 to implement project)

Where,
N = the life of the project

For our High-Efficiency Motor sample project, we use the following equations within Microsoft Excel to get this ratio. We use the cash flows and MARR from Table 3.

NPVm = NPV(14%, 25, 25, 25, 25, 25, 25, 25, 25, 25, 25) - 100
= $30.40

For our V-belt sample project, we use the following equations within Microsoft Excel to get this ratio. We used the cash flows and MARR from Table 3.

NPVv = NPV(14%,10, 0, 10, 0, 10, 0, 10, 0, 10, 10) - 10
= $20.48

This time the high-efficiency motor project appears more profitable than the V-belt project. In fact, the high efficiency motor project is the more profitable project in terms of correct economic analysis. NPV is the only method that will always provide the correct selection decision between projects. Therefore, when performing project selection analysis, this is the best method to use for project ranking.

However, this method has several pitfalls. For example, when comparing projects you must be careful of project horizons. In this case, we were able to do this by repeating the V-belt project five times. However, if a project is not repeatable, then you cannot stack the projects in such a manner. For instance, if you could not repeat the V-belt project then you could only calculate the cash flow for the two years. In this example the V-belt project would appear even worse than the high-efficiency motor project although the project ranking would not change.

Table 4 below summarizes the advantages and disadvantages of the four methods we have discussed.

EXTENDING THE ENERGY BALANCE TO INCORPORATE ANALYTICAL METHODS

Because these four methods can all be calculated quite easily by computer programs, we have incorporated the results into our extended energy balance. We have added a column for project capital costs. We have also added a column for the results of each economic method. Table 5 shows that part of the energy balance for the sawmill motors.

This extended energy balance can be easily modified to include only the economic measure(s) that your particular company uses. The macro that calculates these measures asks for input of parameters that

Table 4

SPP	IRR	SIR	NPV
Easy to use	Most complicated to use	Complicated to use	Complicated to use
Easy to understand	Requires understanding of present values	Requires understanding	Requires understanding of present values
Does not consider project life	Considers project life	Considers project life	Considers project life
Does not include time value of money	Includes time value of money	Includes time value of money	Includes time value of money
Only meaningful for fairly short-term projects	Can be used to evaluate long-term projects	Can be used to evaluate long-term projects	Can be used to evaluate long-term projects
Does not correctly rank multiple projects	Does not correctly rank multiple projects	Does not correctly rank multiple projects	Gives accurate answer for ranking multiple projects
Most-used technique	Frequently used technique	Used primarily in the in the public sector	Best method, but underutilized

Table 5. Extended energy balance including economic measures: evaluation of high-efficiency conveyor motors in sawmill motor section.

MOTORS

		Calculations for Recommended Efficiency Measure									
Standard equipment Information		**Expected Annual Costs & Savings from Efficiency Measure**						**Analytical Measures**			
Location and Equipment Name	*Information omitted here to save space*	Energy Savings (kWh/yr)	Demand Savings (kW/mo)	Energy Cost Savings ($/yr)	Demand Cost Savings ($/yr)	Total Cost Savings ($/yr)	Total Project Cost ($)	**SPP** (yrs)	**IRR** (%)	**SIR**	**NPV** ($)
Saw Mill											
Motor line items											
Chipping edger											
Head saw											
Log trimmer											
Conveyor		460	0.17	25	9.49	34.49	110	3.2	24	1.4	45.53
Saw mill motors sub-total:		460	0.17	25	9.49						

are company-specific such as MARR.

By extending the energy balance to incorporate decision-making information, we believe that it is a valuable tool for energy managers and others working in the energy analysis industry.

PITFALLS OF ENERGY ANALYSIS

We would be remiss if we did not point out a few pitfalls lying in wait for unsuspecting energy project analysts.

Compare Area Dollar Savings to Actual Area Costs

What if you have used the same average costs of usage and demand for both your cost savings and your original area cost, your demand and energy savings for a potential project is less than the original energy balance, but your annual estimated dollar savings is greater than the annual estimated cost? A carefully designed energy balance and a process that includes calculation checks and balances will help minimize this situation, but there are several ways that it could occur. We will discuss two examples: **Mutually Exclusive Projects and Double Counting Savings.**

Mutually Exclusive Projects

Suppose that you have found two potential recommendations that include the motors in Table 1:

- A high-efficiency motor recommendation; and
- A process improvement recommendation for the sawmill.

When you calculated the savings for the high-efficiency motor recommendation, you included the chipping edger motors and found that it would yield an acceptable return. A second recommendation was to reduce the chipping edger motors from two motors to one. These two projects, with respect to the chipping edger motor that is to be retired, are mutually exclusive. Certainly, you cannot count the high-efficiency motor savings for a non-operating motor.

However, it may not be obvious when viewed in the context of two seemingly different recommendations. Hopefully, if you use tools like the energy balance, you will be able to notice the relationship between these two recommendations. The correct analysis technique would be to take any savings from the process improvement recommendation, remember to consider changes in the operating characteristics of the remaining chipping edger motor, then consider the high-efficiency motor recommendation of the remaining chipping edger motor.

Double Counting Savings

All mutual exclusive projects would double count savings; however, not all double counted savings are necessarily mutually exclusive. For example, consider the interaction of the high-efficiency motor recommendation with a high-efficiency V-belt potential recommendation, touched on earlier in this article. When you calculate the savings for the high-efficiency motor recommendation, you include the conveyor motors and find that would yield an acceptable return.

Likewise, you include the conveyor motors in the V-belt recommendation, and that also yields an acceptable return. If you consider these two recommendations in isolation, then the interaction between these two recommendations may not be readily apparent.

Separately, your calculations showed that they yield an acceptable return; however, once the interactions are considered, one of the projects may no longer yield an acceptable return, or perhaps both will yield an acceptable return albeit a lower return.

Regardless, once the interaction is understood, then the proper way to calculate the savings is to first calculate the savings of the project with the higher net present value (NPV) using the original data, then calculate the savings of the next project using the final data of the first recommendations.

If these types of interactions are not readily apparent, then your process of calculation checks using the energy balance may help expose these interactions and improve your understanding of how the electrical systems of the facility work. One technique to perform calculation checks would be to produce a "before and after" energy balance. The "before" energy balance would be energy and demand use of the system before your recommendations, and the "after" energy balance would be the energy and demand use of the system after your recommendations.

Once you begin collecting data about estimated gains in efficiency and actual gains in efficiency after implementations, then you may compare the differences between your estimates and the actual results. You can then take these differences as an input to improve your future estimates. All of these calculations and verifications will help improve the confidence in projects and therefore lower the risks associated with these projects.

CONCLUSION

The basic energy balance presented in Part I of this series gives a relatively low cost and reasonably accurate alternative to understanding the energy use at a facility. In this article, Part II, we have extended the basic energy balance to include a systematized inclusion of the energy, demand and dollar savings from proposed energy efficiency projects. In addition, we have extended the energy balance further to calculate and display four common economic performance measures—SPP, ITT, SIR and NPV.

Calculation checks and tools such as the energy balance can help you save money by avoiding the implementation of projects without acceptable returns. Using dollar costs and savings provide another data point that could help validate historical usage and expected savings. Finally, the financial analysis techniques demonstrated put energy savings projects into terms that decision makers can easily understand, i.e. in a manner that is consistent with how decision makers evaluate other investment opportunities.

References

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EDITOR'S SUMMARY

"ENERGY BALANCING"—A Continuing Series of Reports

Part I of this series on "Energy Balancing" (Fall 2001 issue) introduced readers to the usefulness of this energy auditing concept, and showed energy managers how to improve the accuracy of facility audits when they have limited time to gather energy use data.

Part II, presented in this issue, extends the Energy Balancing concept and shows you how to use the facility energy data you have collected to make sound financial and capital investment decisions, to implement the most cost-effective new energy projects.

In **Part III**, coming up in the Spring 2002 issue of *Strategic Planning for Energy and The Environment*, the authors will provide a copy of the spreadsheet template they have used to make many Energy Balancing audits. It can be found and downloaded now, from http://www.ise.ufl.edu/capehart. This spreadsheet template is in Microsoft EXCEL, and requires detailed information on equipment characteristics and operating hours to use it successfully.

A more user-friendly version of the Energy Balance procedure is in the form of a Graphical User Interface (GUI). It was developed by the authors' colleagues Dr. Cristian Cardenas-Lailhacar, Mr. Shiva Krishnamurthy, Dr. Diane Schaub, and Dr. Dale Kirmse of the University of Florida Industrial Assessment Center. This user-friendly interface greatly speeds up the entry of data, and the analysis of potential energy improvement projects.

It is included in Part III, which will discuss the Utilization of the Energy Balance Method, and give examples. **Title of Part III: An Interactive Energy Balance: A Case Study.**

ABOUT THE AUTHORS

Klaus Pawlik is a consultant with Accenture working within the utilities industry. Klaus is the author of the *Solutions Manual for Guide to Energy Management*, Third Edition. Additionally, Klaus spoke on the topic of "Analyzing Facility Energy Use: A Balancing Act" at the World Energy Engineering Congress 2000. Klaus holds a master of business administration and a bachelor of science in industrial and systems engineering graduating with highest honors from the University of Florida.

While at the University of Florida, Klaus worked in the Industrial Assessment Center, leading teams of undergraduate and graduate students performing energy and waste minimization, and productivity improvement assessments for manufacturing facilities. Additionally, for two years, he assisted Dr. Barney Capehart with teaching industrial energy management.

Before attending the University of Florida, Klaus served six years in the United States Navy, where he worked as an electrical operator on nuclear power plants. For two of those years, he served as an instructor training personnel on the electrical operations for nuclear power plants.

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Barney L. Capehart, Ph.D., CEM, is a professor emeritus of industrial and systems engineering at the University of Florida in Gainesville, FL. He has broad experience in the commercial/industrial sector having served as the founding director of the University of Florida Energy Analysis and Diagnostic Center/Industrial Assessment Center from 1990 to 1999. He personally conducted more than 100 audits of industrial and manufacturing facilities, and has helped students conduct audits of hundreds of office buildings, small businesses, government facilities, and apartment complexes. He regularly taught a University of Florida course on energy management, and currently teaches energy management seminars around the country for the Association of Energy Engineers (AEE). He is a Fellow of IEEE, IIE and AAAS, and a member of the Hall of Fame of AEE. He is the co-author of *Guide to Energy Management*, author of the chapter on energy management for the *Handbook of Industrial Engineering*, and wrote the chapter on energy auditing for the *Energy Management Handbook*.