

# MAKING ENERGY MANAGEMENT “BUSINESS AS USUAL”: IDENTIFYING AND RESPONDING TO THE ORGANIZATIONAL BARRIERS

Douglas Tripp, P. Eng. (President, Canadian Institute for Energy Training)  
Stephen Dixon, (President, TdS Dixon Inc.)

## ABSTRACT

To be effective, energy management needs to be “business as usual”. Energy planning should be undertaken with that goal in mind. It should also focus on all of the dimensions of energy management—the technical, organizational, and human behavioral issues.

Energy management planning is driven by information about how energy is used in the organization, and that same information—collected as an ongoing management function—flows through the business processes created for energy management. Indeed, the key outcomes of planning include those business processes needed to integrate energy management into the organizational structure.

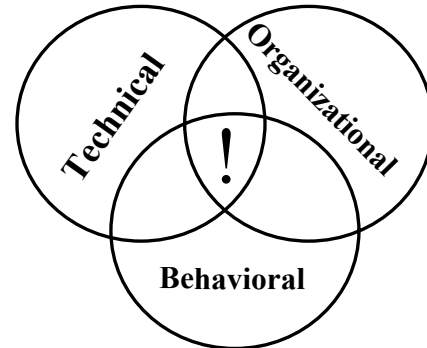
This paper describes a strategic framework for energy planning and energy management based in large measure on the approaches and tools developed in the UK in the Best Practice Program of the Department of Environment. These same tools have evolved in the authors’ experiences in working with industrial, commercial and institutional organizations in Canada and abroad.

An hierarchy of matrices that define organizational competencies related to energy management, and provide a means of assessing performance is described. The information derived from these tools is an important input to the planning process in their clarification and prioritization of the barriers to energy management.

An important component of the information base is the quantitative information about energy consumption and the variables that drive consumption. Quantitative information about energy use can be developed by means of the Energy Monitoring, Targeting and Reporting techniques introduced in the paper.

## INTRODUCTION

Organizations that successfully manage energy—achieving corporate goals while, and aided by, minimizing energy cost and related environmental impact—have business processes to plan, monitor, and control energy use, just as they do for other corporate priorities, such as labor, materials, and other costs. For these organizations, energy management is “business as usual”.



**Figure 1: Dimensions of Energy Management**  
*Adapted from Dollars to Sense Energy Master Planning Workshop, Natural Resources Canada*

Energy management is multi-dimensional, encompassing the technical aspects of facility and process operation, organizational management, and human behavior. The sustainability of energy management measures is assured when all three of these dimensions are taken into account in the development of an energy master plan.

In our work in Canada and abroad, we have evolved a method for addressing these three dimensions in a strategic approach to energy planning, based in large measure on techniques and tools developed in the UK

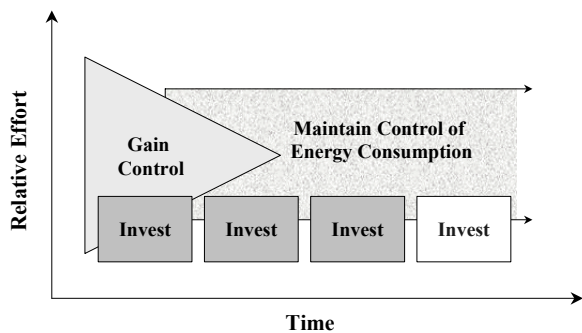
under the Best Practice Program of the Department of Environment. The “fuel” for energy master planning is information about how energy is used and managed by the organization, and the approach that we advocate facilitates the collection and analysis of information about those organizational practices.

**THINKING STRATEGICALLY ABOUT ENERGY MANAGEMENT PLANNING**

The goal of energy planning is to operationalize the steps to becoming an energy managing organization. We can find many examples of effective energy managing organizations—public, private, industrial, commercial, institutional; in general, they are characterized by their:

- providing leadership for energy management through a “champion” or group of committed staff;
- exhibiting a broad awareness of the benefits of energy efficiency throughout the organization;
- integrating the task of managing energy into the overall management structure of the organization by the creation of appropriate business processes;
- having an energy management plan—short term and long term;
- collecting and utilizing information to manage their energy use.

The context for energy planning includes an appreciation for the strategic phases of energy management. It is useful to think of energy management as a three-phase process within which the effort and resources expended on gaining control of energy use, maintaining control as a continuous business process, and investing in measures to improve energy performance vary over time.



**Figure 2: Strategic Phases of Energy Management**

**Gaining Control**

Early actions in a new energy master plan need to focus on gaining control of energy use. A criterion for deciding whether or not an organization is actually **managing** its energy use—whether energy use is under control—is how much is known about:

- **how energy is purchased**—the details of rate structure, real costs, cost trends over time, unit and incremental costs of the various energy sources;
- **how energy use compares** to historical performance, other facilities, international benchmarks;
- **when energy is used**—the energy use profile on a daily, weekly, monthly and annual basis;
- **where energy is used**—the inventory of energy consuming systems.

For example, industries may not know how energy consumption is functionally related to production and weather; commercial building operators may not know how consumption is impacted by weather and occupancy rates. They may not know which systems in their facilities are the major energy consumers, and which offer the greatest potential for efficiency improvement.

**Maintaining Control**

The effort involved in gaining control of energy use diminishes with time, but an overlapping priority is to develop those business processes that will ensure that control is maintained in the long term. For example, an energy performance information system—we like to refer to this as Energy Monitoring, Targeting and Reporting (MT&R)—within the organization’s management information system is an action taken in the “gain control” phase that is instrumental in maintaining control.

MT&R is a statistically based technique for energy performance monitoring and analysis that is widely practiced in the UK, Canada and elsewhere

**Investing**

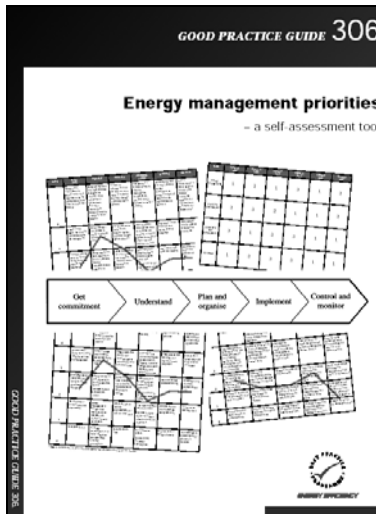
The investment of financial and human resources in measures that achieve energy management objectives is the third phase. Usually, these investments are for time-limited actions—“projects”, if you will—that may be technical in nature or not; staff training is an obvious example of a non-technical investment.

**LOOKING MORE CLOSELY AT ORGANIZATIONAL COMPETENCE AND PREPAREDNESS FOR ENERGY MANAGEMENT**

Those characteristics of energy managing organizations listed earlier only scratch the surface. The UK Best Practice Program provides a model for identifying and assessing the organizational competencies that are required for effective energy management. An Energy Master Plan could do no better than to produce these competencies.

**Competency Matrices for Assessment and Planning**  
**Good Practice Guide 306: Energy Management Priorities—a self-assessment tool** defines a three-level array of competency matrices to both describe and assess the organization in four key areas:

- energy management practices
- financial management practices related to energy management
- awareness and information
- technical aspects of energy management.



**Figure 3: GPG306 – UK Best Practice Program**

The validity of the matrix model for planning is demonstrated by the correlation that can be made between the overall scores for organizations and their relative success in achieving energy efficiencies.

A **first-level matrix** summarizes the scores for the performance revealed in four second-level matrices, one for each of the areas listed above.

The four **second-level matrices** define competence in six functional areas each, which we have combined in Figure 4 to represent a process for competency development; in this matrix, the cells are populated with performance descriptors for low to high levels of organizational competence.

For example, the Energy Management Matrix in Figure 5 defines levels of organizational competence in regard to:

- energy policy
- organizing
- skills and knowledge
- information systems
- marketing and communicating
- investment practices.

**Third-level matrices** exist for various second-level elements. For example, one of the issues in the energy management matrix—in our view, the most critical issue—is “Information Systems”; a third-level matrix can be used to assess and plan for energy information systems and the implementation of monitoring & targeting.

The Energy Management Matrix and those for the other three organizational areas serve two important purposes. They can be used for the **assessment of organizational preparedness** for energy management, and the **identification and prioritization of actions** to develop the necessary organizational competencies. Organizational “competency profiles” are defined by the selection of the cells in the matrix that best describe the current status of the organization on each element.

There are three principles that apply to the interpretation of the profiles, as illustrated in Figures 6, 7 and 8; they are:

- high scores are better than low scores;
- balanced profiles are better than unbalanced profiles;
- priorities for action are to achieve balance and to move upscale.


**A Planning Hierarchy**

These matrices yield profound insight to the barriers preventing organizations from making real progress towards their energy management goals. Together, they comprise a planning hierarchy from “the big picture” of overall organizational preparedness for energy management, down to the fine and specific details of the various energy management functions and processes.

However, the order in which various planned actions are taken—in light of the strategic phases of energy management discussed earlier—will ordinarily begin with measures to gain control of energy use, such as MT&R,

For example, one industrial company had a top-down commitment to energy efficiency entrenched in its policy structure, had an energy manager with appropriate placement in the organizational structure, had done training, had created a high level of energy awareness, and had even given preference to energy efficiency investments. Nevertheless, not much was accomplished to improve energy efficiency. The energy management matrix revealed that, while scores were relatively high on five issues, there was a very low score for “information systems”. Information required for decisions on energy management actions was not getting into the right hands in the right form at the right time, and as a result, no actions were being taken. Actions to address this barrier were taken, and progress quickly followed.

**Figure 4: Organizational Competencies for Energy Management**

Functional Area	Organizational Competency	Low Capacity	Evolution to "Energy Managing Organization" 			High Capacity
Energy Management	Energy Policy					
	Organizational Structure for EM					
	Skills/Knowledge					
	Energy Information					
	Marketing & Communicating					
	Investment Practices					
Financial Management	Opportunity Identification					
	Opportunity Exploitation					
	Management Information					
	Appraisal Methods					
	Human Resources					
	Project Funding					
Awareness And Information	EM Responsibilities					
	EE Awareness					
	Reporting					
	Energy Performance Review					
	Training					
	Market Awareness					
Technical	Existing Plant & Equipment					
	Plant & Equipment Replacement					
	Maintenance Practices					
	Operational knowledge					
	Reporting & Documentation					
	Operational Methods					

**Cells populated with  
descriptors of  
organizational  
competencies**

**Figure 5: Energy Management Matrix**  
 (Adapted from: *Good Practice Guide 306: Energy Management Priorities—a self-assessment tool, UK Best Practice Program*)

	Energy Policy	Organizing	Skills & Knowledge	Information Systems	Marketing & Communicating	Investment
4	Energy policy, action plan and regular review have commitment of top management as part of a business & environmental strategy "	Energy management fully integrated into management structure. Clear delegation of responsibility for energy consumption. "	All energy users receive specific energy training integrated into other development activities. Workshops facilitate a sharing of knowledge. "	Comprehensive system sets targets, monitors consumption, identifies faults, quantifies savings and provides budget tracking. "	Communicating the value of energy efficiency and the performance of energy management within the organisation and outside. "	Positive discrimination in favour of green schemes with detailed appraisal of all new-build & refurbishment opportunities. "
3	Formal energy policy but no active commitment from top management. "	Energy manager accountable to energy committee representing all users, "	Key energy users receive regular and specific training. Brief awareness training provided to all energy users. "	Monitoring and targeting reports for individual areas based on sub-metering, but savings not effectively reported to user. "	Programme of staff awareness and regular publicity campaigns. "	Same payback criteria employed as for all other investments. "
2	Unadopted energy policy set by senior manager or senior departmental manager. "	Energy manager in post, reporting to ad-hoc committee but line management and authority unclear. "	Key energy users receive awareness training, also occasional system-specific training. "	Monitoring and targeting reports based on supply meter data. Energy unit has ad-hoc involvement in budget setting. "	Some ad-hoc staff awareness training. "	Investment using short term pay back criteria only. "
1	An unwritten set of guidelines. "	Energy management the part-time responsibility of someone with only limited authority or influence. "	Key employees participate occasionally in awareness training. Some information passed informally to energy users. "	Cost reporting based on invoice data. Engineer compiles reports for internal use within technical department. "	Informal contacts used to promote energy efficiency. "	Only low cost measures taken. "
0	No explicit policy. "	No energy management or any formal delegation of responsibility for energy use. "	Energy users rely on their existing knowledge. "	No information systems. No accounting for energy consumption. "	No promotion of energy efficiency. "	No investment in increasing energy efficiency in the plant. "

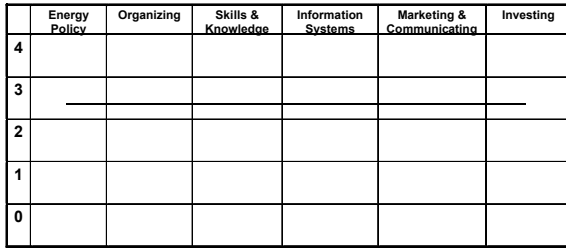


Figure 6: A Balanced Profile

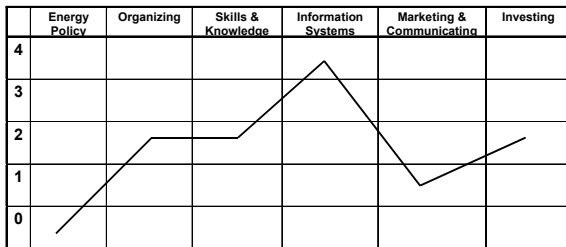


Figure 7: An Unbalanced Profile

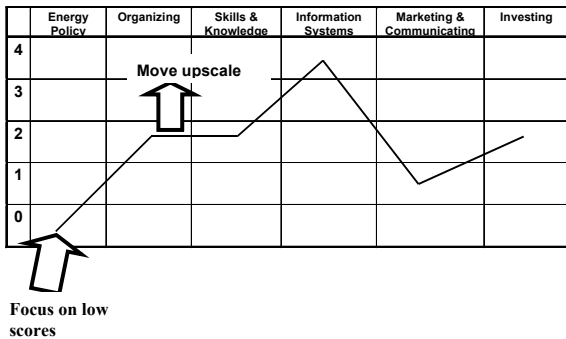


Figure 8: Action Priorities

**ENERGY PERFORMANCE INFORMATION AND PLANNING**

As the example suggests, one common and important barrier to energy management is the absence or inadequacy of energy performance information.

Upon discovering that the critical barrier was the absence of the right energy information in the right hands, the company was able to plan and implement an MT&R system that dramatically increased its knowledge of how energy consumption is driven by production as an ongoing management process.

This example illustrates the key role that energy performance information—both historical and current—plays in the development and implementation of the energy management plan. The analytical elements of MT&R may be used as an investigative tool to develop a detailed understanding of historical energy use. Fully understanding current energy use practices—the when, where, how, and how much of energy consumption—in

detailed quantitative terms is an essential pre-condition to energy management master planning.

It is important to recognize that this kind of information goes beyond the key performance indicators often used by organizations that are trying to do energy management. Energy intensity or energy performance indicators alone, such as kWh/square foot or MMBTU/ton, do not adequately take into account the contribution of base load or other consumption variables. These indicators may also be based on aggregate or average data, and so may hide important performance variations over time.

MT&R is not only a foundation for energy planning, but it is also a management tool for ongoing performance control and improvement. It is entirely consistent with continuous improvement approaches applied to other corporate priorities, as suggested by Figure 9.

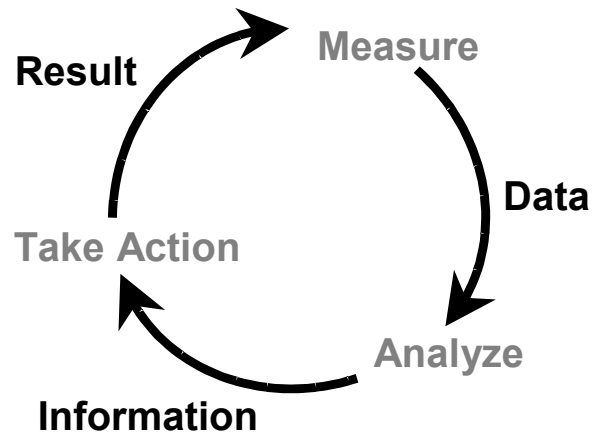


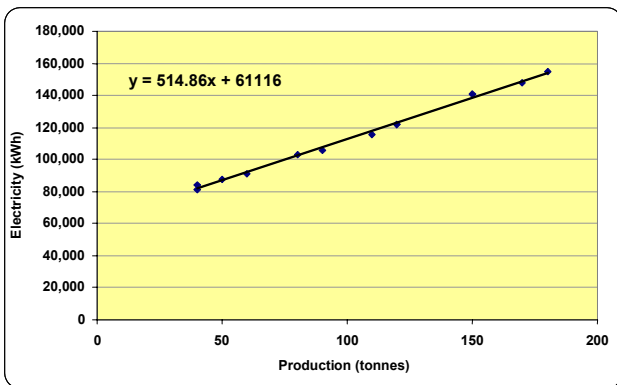
Figure 9: MT&R and Continuous Improvement

MT&R involves:

- the determination by means of regression analysis of a functional relationship between energy consumption and the driving independent variables, such as industrial production, weather, building occupancy, and so on;
- the clarification of the consumption trend historically and into the future using cumulative sum of differences (CUSUM) analysis;
- the setting of energy performance targets;
- creating performance control charts based on target performance;
- reporting regularly on performance through detailed and/or summary information to those levels of the organization that participate in management control of performance.

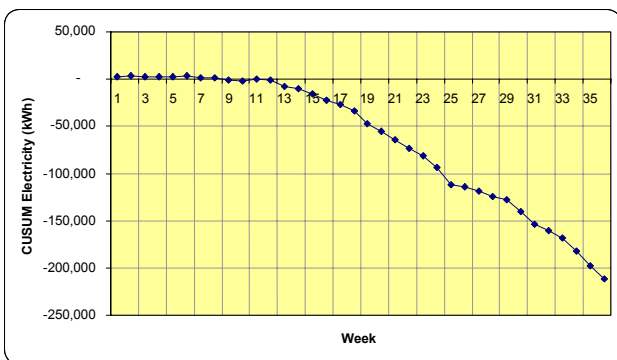
The following graphs taken from the authors' MT&R software tool illustrate the power of energy information, in this case for an industrial situation. Similar analysis can be done for buildings using degree-day data as the independent variable.

When the relationship between energy consumption and the key energy driver is understood in quantitative terms, it becomes possible to analyze historical performance in such a way that the impact of past actions can be determined, and critical issues such as the contribution to overall consumption by base load can be examined.



**Figure 10: Regression Analysis of Energy/Production Relationship for Baseline Period**

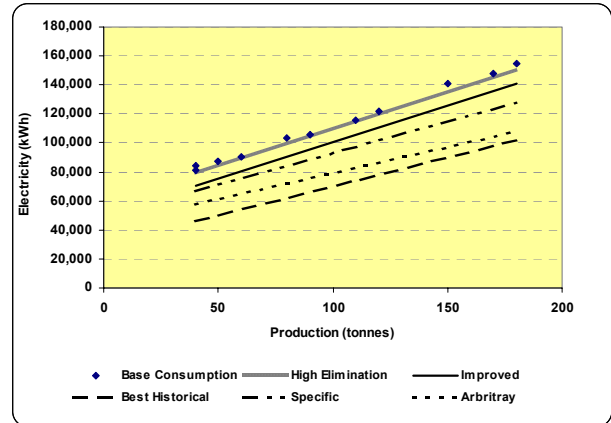
For example, Figure 10 indicates that the energy consumed in kWh is equal to 514.86 times the production in tonnes plus a constant 61,116 kWh. (It is worth noting here that weather is often found to be an additional important variable for industrial energy consumption, and that multi-variant regression may be necessary.)



**Figure 11: CUSUM Analysis of Energy Consumption for Production Example**

Figure 11 shows savings that began to accrue at about week 12 to a cumulative total of over 200,000 kWh at week 36; more importantly, the CUSUM curve highlights

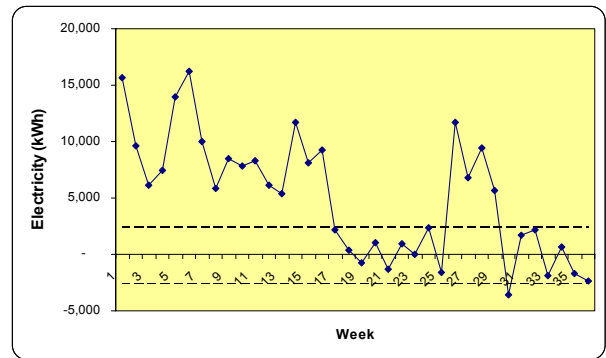
changes in energy performance that occurred at those points where the slope of the curve changes.



**Figure 12: Target-setting options for Production Example**

Setting performance targets is part art and part science; the MT&R technique offers the means of setting realistic and achievable targets based on the analysis of past performance (Figure 12). In this sense, MT&R provides a practical foundation for the energy management plan.

Energy performance control charts (Figure 13) for use by operating staff help to ensure that reduction targets are met.



**Figure 13: Control Chart for Energy Consumption based on Target Performance**

### Reporting

The energy master plan needs to ensure that a reporting mechanism exists to put the right information in the right hands at the right time.

Figure 14 summarizes the information flow cycles for operational through management purposes, and demonstrates the principle that the level of detail of performance information needed by the various stakeholders in the organizations depends on their level and the immediacy of their impact on performance.

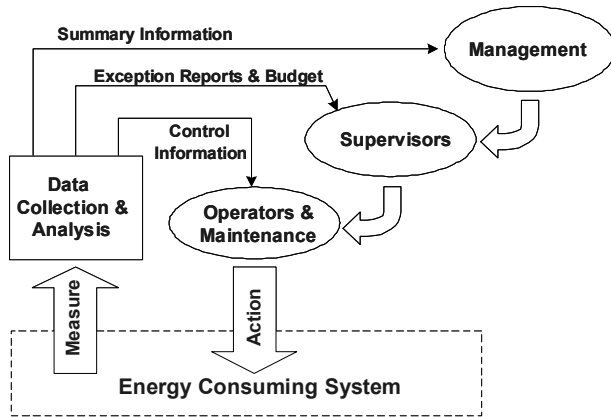


Figure 14: Energy Information Flow

### Action Planning

In the control chart of Figure 13—which, for example, might be for the energy use of the overall plant or an individual operating unit—the upper control limit signals when energy consumption is unexpectedly increasing. Likewise, the lower control limit provides an alert to unexpectedly declining energy consumption. As in any process control situation, there are two questions that arise:

- Are actions required by both of these situations?
- What action do we take when energy consumption decreases (which is what we are striving for)?

The key to answering these questions, and to effectively managing plant energy use, is to recognize that any unexpected change in energy consumption—positive or negative—must be investigated and acted upon. The action on the upper control limit would be corrective, to return consumption to normal levels. The action on the lower control limit would be investigative, to learn why consumption has dropped and to determine whether this pattern of consumption can be maintained, thereby reducing consumption further. *In this way energy use can be managed downwards.*

What this demands of an organization is business processes to:

- monitor energy use,
- report energy performance information to those that can take action,
- provide the appropriate technical training to support the corrective and investigative actions,
- make energy management a corporate priority and dedicate the necessary human and financial resources to the required actions.

Business processes that embody these four attributes are consistent with the organizational competencies identified in the Energy Management Matrix described previously. The energy efficiency actions resulting from this kind of performance information are for the most part operational. They typically focus on the elimination of energy waste.

Experience suggests that the types of actions in effective energy management fall into three distinct categories.

### 1. Match the Requirement or Eliminate Waste, for example:

- Avoid equipment idling
- Turn off lights when not required
- Trim start-up and shut-down periods
- Eliminate leaks (air, water, steam)
- Limit temperatures, illumination levels, pressures etc. to end-use requirements

### 2. Maximize the Efficiency or Reduce Losses, for example:

- Maintain combustion efficiencies at high levels
- Maintain all types of filters to reduce pressure drops
- Avoid fan, pump and compressor throttling
- Utilize the most efficient device (ie. pump, compressor, boiler, motor) for the purpose.

### 3. Optimize the Supply, for example:

- Implement heat recovery to utilize waste heat
- Implement renewable energy schemes
- Implement combined heat and power (cogeneration) systems

As the examples suggest, the first category of actions typically involve minimal or no cost, while the second and third categories may be progressively more expensive.

The Energy Management Plan needs to recognize this progression of actions from those that *gain control* of energy use, through those that *maintain control*, to those that require *investments*.

### CONCLUSION

In order for energy management to be “business as usual”, it is necessary for organizations to create appropriate business processes, consistent with those that relate to their other priorities such as labor, materials, health and safety, and so on. The business processes that characterize organizations as “effective energy managing organizations” are those that pertain to the functions listed in the assessment matrices.

To a great extent, energy management processes involve the collection and utilization of energy use information—

not just “data”, but data refined by analysis into management information. Information of this kind drives energy planning, and energy planning not only addresses the barriers that exist to creating effective energy managing organizations, but also prescribes the specific actions needed to gain control of energy use, maintain control in the long term, and investment in performance improvement.

The kinds of information needed arise from three dimensions of the energy management universe—technical, organizational, and behavioral.

Tools such as the energy matrices and the MT&R technique described here can generate the information required both for the development of the energy plan, and for ongoing management of energy performance.

The Energy Master Plan, then, both leads to the creation of the processes that generate the required information, and plans for the actions that arise from that information. The business processes that are put in place gain and maintain control of energy use, and invest in energy projects to periodically improve energy performance.

The good news is that energy and cost savings, as well as the resulting mitigation of environmental impact, inevitably follow when these approaches are implemented.

#### THE AUTHORS

**Douglas Tripp, P. Eng.**, is an independent training consultant, specializing in environmental and energy management, and President of the Canadian Institute for Energy Training (CIET). He has 27 years of experience as a Professor, Chair and Dean in the Ontario College system. Since 1993, he has been actively engaged in the development of training curricula for energy management in industrial, commercial, and institutional organizations, and the provision of a variety of training solutions for energy managers and their organizations.

CIET’s training solutions include Canada’s only comprehensive distance learning program for energy managers, **TEMOL (Training in Energy Management through Open Learning)**; Canadian marketing and administration of the **Certified Energy Manager® Program** of the Association of Energy Engineers; a web-accessed course and workshop on **Energy Monitoring, Targeting and Reporting**; and a wide range of customized workshops addressing the technical and management aspects of energy efficiency.

Doug has also provided curriculum development, training of trainers, and workshop delivery services in Africa,

India and Brazil for Canada-sponsored programs related to industrial energy efficiency and greenhouse gas emission reduction. He holds Masters Degrees in Chemical Engineering and Higher Education from the University of Toronto, and is a registered Professional Engineer in the Province of Ontario. He is a member of AEE and The Institute of Energy (UK), and a Director of the Canadian Energy Efficiency Alliance.

Doug may be contacted by Email at [dtripp@cietcanada.com](mailto:dtripp@cietcanada.com).

**Stephen Dixon**, B.Sc., M.A.Sc. is a freelance technical consultant. As Principal of TdS Dixon Inc., of Waterloo Ontario, he brings a practical hands-on approach to energy management – serving a broad range of clients including industrial, commercial, government and utility organizations. Stephen has accumulated twenty three years of energy management experience, including 800+ energy assessments and audits, the facilitation of over 300 energy management workshops and the development of a variety of energy training systems currently used on at least 4 continents.

Stephen holds a Master of Applied Science from the University of Waterloo in Systems Design Engineering, a Bachelor of Science degree in Physics from the University of Prince Edward Island.

Stephen can be contacted by Email at [sdixon@knowenergy.com](mailto:sdixon@knowenergy.com)