Best Practice Benchmarking in Energy Efficiency: Canadian Automotive Parts Industry

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ABSTRACT

In 2001, Natural Resources Canada's (NRCan's) Office of Energy Efficiency (OEE) launched its industrial benchmarking and best practices program. Traditionally, energy benchmarking involves the collection and analysis of energy related data that is then used to develop quantitative indicators. These indicators enable industrial companies to assess the energy-efficiency, productivity, and emissions performance of their operations vis-à-vis those of similar operations in the same sector.

But when the diversity (or non-uniformity) of a sector makes traditional benchmarking virtually impossible, how then can benchmarking still be used to help companies or a sector achieve any kind of energy-efficiency gain? Such was the challenge faced by the Canadian automotive parts industry, which is diverse with large variations in equipment, industrial processes and operating practices used across the sector, making direct comparisons difficult, if not impossible.

The Automotive Parts Manufacturers' Association (APMA) worked in collaboration with their consultant *TdS* Dixon and NRCan to adapt the traditional concept of benchmarking such that the analytical results would still enable companies in the sector to comparatively identify deficiencies and adapt to a better practice, thereby improving their energy efficiency. A survey was developed that rated APMA member-sites on their capacity for good energy management; that is their Organisational Capacity, Operational Capacity and Technical Capacity. Companies were rated against performance benchmarks in these three categories that were compiled from numerous sources including Natural Resources Canada, the United States Department of Energy and Action Energy in the United Kingdom.

- A company's organizational capacity for managing its energy use is the degree to which its practices include: formulating an energy policy, positioning energy management in the organizational structure, improving employee skills and knowledge in the area of energy efficiency, managing energy information, producing internal and external communications about energy management, and investing in efficiency measures.
- A company's operational capacity for good energy management is the degree to which it provides its employees with operating procedures and training that will help them to keep energy efficiency in mind during production. Although most operating procedures are written for specific energy-consuming systems, many have common elements that can be implemented plant-wide.
- A company's technical capacity for good energy management is the degree to which it incorporates energy efficiency into its acquisition and operation of individual energy-consuming systems.

This paper presents the results of the APMA study and describes a methodology that can be useful to many sectors where manufacturing diversity is a challenge to traditional energy benchmarking. Benchmarking diverse industries can still be accomplished by focussing on the use of good organizational, operational and technical practices, rather than quantitative measures of energy consumption. The belief supporting this approach is that the implementation of good practices leads inevitably to improved energy efficiency.

Introduction

Energy Benchmarking Survey

The Automotive Parts Manufacturer's Association (APMA) is Canada's national association representing original equipment manufacturers (OEM) of parts, equipment, tools, supplies and services for the worldwide automotive industry. The Association was founded in 1952 and has over 400 members accounting directly or indirectly for ninety five percent of independent parts production in Canada. The APMA's fundamental objective is to promote the automotive parts manufacturing industry both domestically and internationally.

The APMA has been actively engaged in the Canadian Industry Program for Energy Conservation (CIPEC) through its participation on the Transportation Manufacturing Task Force. This benchmarking survey, sponsored by Natural Resources Canada and the APMA and in collaboration with *TdS* Dixon, assesses APMA member companies on several critical organizational issues, operational practices and technical aspects that impact the energy efficiency of an organization and affect its capacity for effective energy management.

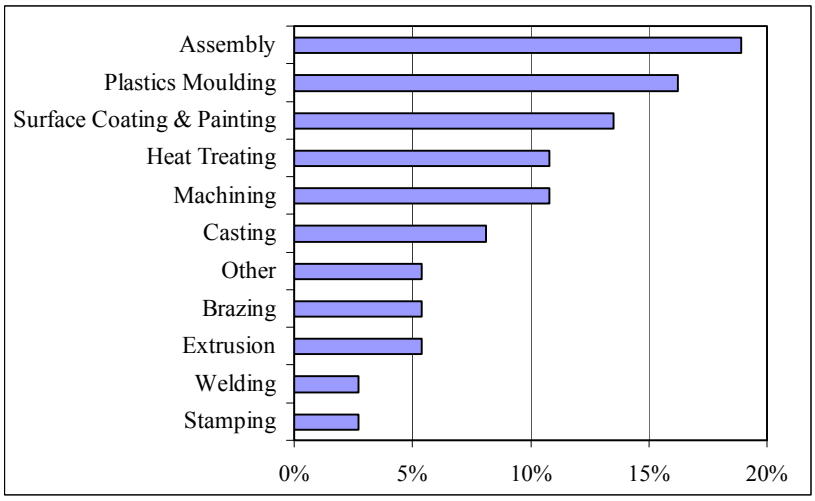
This report presents an overview of the sector in terms of its energy consumption and energy drivers. The report also summarizes and highlights the responses to the benchmarking survey and presents two self-evaluation tools that enable organizations to rank themselves in terms of their energy management practices.

Canadian Automotive Parts Industry

In 2003, automotive parts sales were estimated at $34 billion and the industry employment level was nearly 105,000 people. (APMA 2004) There are almost 900 auto parts manufacturing establishments across Canada with 64 percent of them being located in Ontario. On the whole, this sector has a relatively low energy intensity and represented 1 percent of manufacturing energy use or 25,467 TJ (STC 2003c) and 6 percent of manufacturing GDP or $10 billion (in $97) in 2002. (STC 2003a)

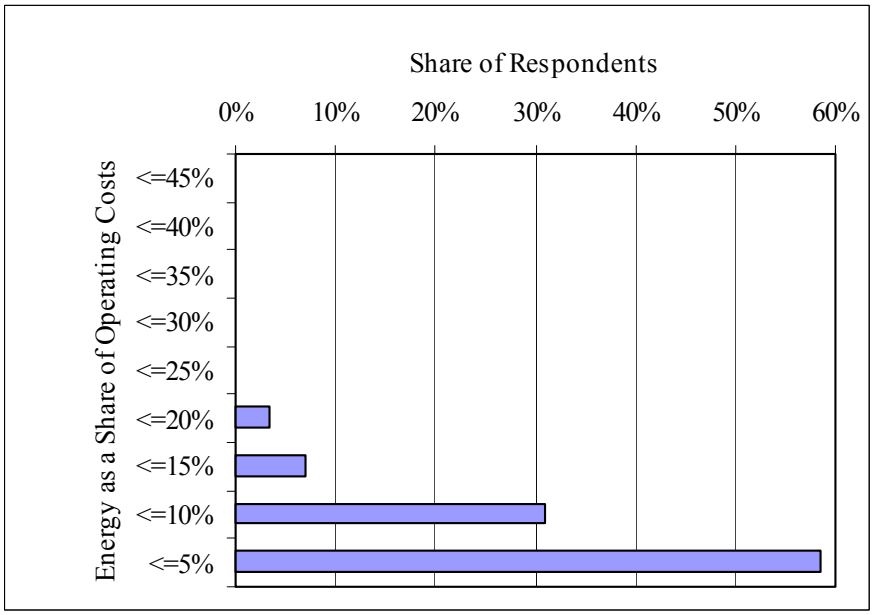
A diverse sector. Because of the diversity of manufacturing processes found in the automotive parts sector, there are many processes that are the major energy consumers in member companies. As per Figure 1, assembly, plastics moulding, and surface coating & painting are the three most common major energy-consuming processes in this sector.

Figure 1. Major Energy Consuming Processes



Energy cost as a percentage of operating costs. Energy cost is typically a relatively small component of total operating cost in this sector representing on average 1.6 percent (STC 2003b) with only a very small percentage of respondents reporting a cost share greater than 10 percent. However, many companies find that energy cost can be more manageable—in terms of the potential reductions available—than other components that comprise a greater share of operating costs.

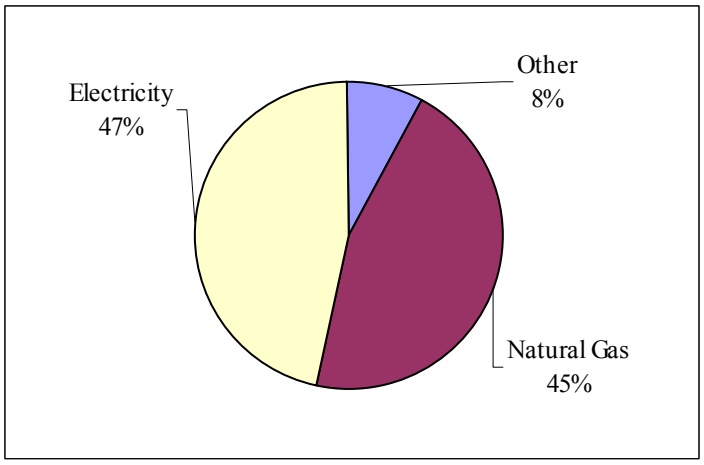
Figure 2. Energy as a Share of Operating Costs



Fuel mix. Industries in this sector in aggregate utilize, by rank order, electricity, natural gas and others as their energy source. While the specific technical interventions that can be taken to improve energy efficiency may depend on the energy source, many of the competencies

identified in the benchmarking study are applicable to all. As well, opportunities for savings may be found by considering the selection of energy source.

Figure 3. 2002 Canadian Auto Parts Industry Fuel Mix



Source: STC 2003c

Methodology

A survey was conducted by *TdS* Dixon with forty-three APMA member sites. Due to the diversity of industries that comprise the automotive parts manufacturing sector, the survey focused on the use of good management and technical practices, rather than focusing on quantitative measures of energy consumption. The belief supporting this approach is that the implementation of good practices leads inevitably to improved energy efficiency.

Respondents were categorized as Level 1, 2 or 3 on organizational, operational and technical energy-related practices, based on their responses to the survey: Level 1 being the most energy efficient and Level 3 being the least energy efficient. The performance benchmarks that determined where a given company was classified were developed and compiled from a variety of different sources including Natural Resources Canada, the United States Department of Energy and Action Energy in the United Kingdom. (NRCan 2005)

The objective of this study is to help companies identify the steps that they can take to optimize the energy efficiency of their plants. Organizations that rank at lower performance levels have opportunities to implement the practices associated with Levels 1 or 2; those that are rated at Level 1 performance may wish to consider other best practices associated with their industrial sectors, which further exploration through the references included in this report can reveal.

Benchmarking Survey Findings

Undertaking effective energy management is a function of the organizational, operational, and technical capacities of an organization. The findings of the benchmarking survey are presented according to these three capacities:

1. **Organizational Capacity** relates to placement of energy management and decision-making capacity in the organizational structure of a company including: *investment, marketing and communicating, information systems, skills and knowledge, organizational structure and energy policy.*
2. **Operational Capacity** refers to the operational practices that contribute to the energy efficiency of all energy consuming systems, including: *operating procedures, employee awareness and training, energy measurement and data analysis (instrumentation).*
3. **Technical Capacity** addresses the use of technology and practices that are specifically focused on improving a system's energy efficiency including: *energy efficiency technologies and practices.*

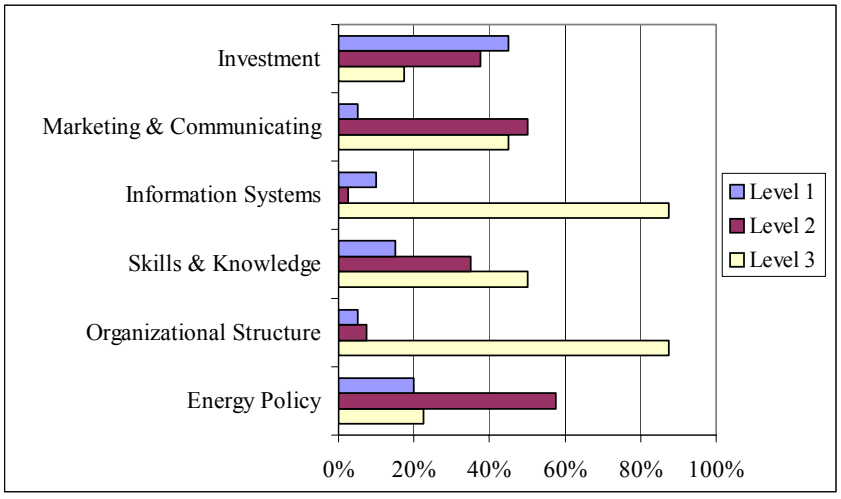
Organizational Capacity

The organizational capacity for energy management comprises core competencies that address formulating an energy policy, the placement of energy management in the organizational structure, improving employee energy efficiency related skills and knowledge, the management of energy information, internal and external communications about energy management, and investment practices related to efficiency measures.

There is a logical sequence to the implementation of sound energy management practices in industrial organizations. Ensuring that the company is prepared for energy management is an important first step. Survey respondents were rated on these issues using the energy management matrix (Table 1).

As presented in Figure 4, survey results indicate that the enhancement of energy measurement and information management systems, and the integration of energy management as a clearly designated function into a company's organizational structure are two measures that many companies would do well to consider to improve their organizational capacity for energy management. For example, although 58 percent of respondents have a person or team that is responsible for energy in their facility, only 25 percent currently have or are developing a written energy policy.

Figure 4. Organizational Capacity Rating



Organizational profile. Using the Organizational Energy Management Matrix (Table 1), companies can rate themselves on the elements of their organizational capacity that make for good energy management. The *organizational profile* is the line joining the boxes that describes the current status of the company in each of the six columns. The experience of energy managing organizations suggests that good "next steps" are actions that can be taken *to move the lowest scores up scale*, in order to achieve both a *balanced profile* and a *higher overall score*.

Table 1. Organizational Energy Management Matrix

	Energy Policy	Organizing	Skills & Knowledge	Information Systems	Marketing & Communicating	Investment
1	Energy policy and action plan are reviewed annually and have commitment of top management as part of a business & environmental strategy	An energy committee, team and/or energy manager reports to executive or senior manager.	Key energy users receive regular and specific training. Brief awareness training is provided to all energy users.	Comprehensive system sets targets, monitors consumption, identifies faults, quantifies savings and provides budget tracking for key departments and areas.	There is a program to build staff awareness, supported by regular publicity campaigns.	Same payback criteria employed as for all other investments.
2	An un-adopted energy policy of unwritten, but generally accepted set of guidelines.	An energy committee, team or part time energy manager reports to mid level manager or supervisor	All energy users receive informal on the job training dealing with energy efficiency	Regular reporting of consumption based upon utility meter data or utility to key energy users or departments.	Some ad-hoc staff awareness training.	Investment using short term pay back criteria only.
3	No explicit policy.	No energy management or any formal delegation of responsibility for energy use.	Energy users rely on their existing knowledge.	No accounting for energy consumption.	No promotion of energy efficiency.	No investment in energy efficiency and/or only low cost measures taken.

Source: Based on BRECSU 1993.

Operational Capacity

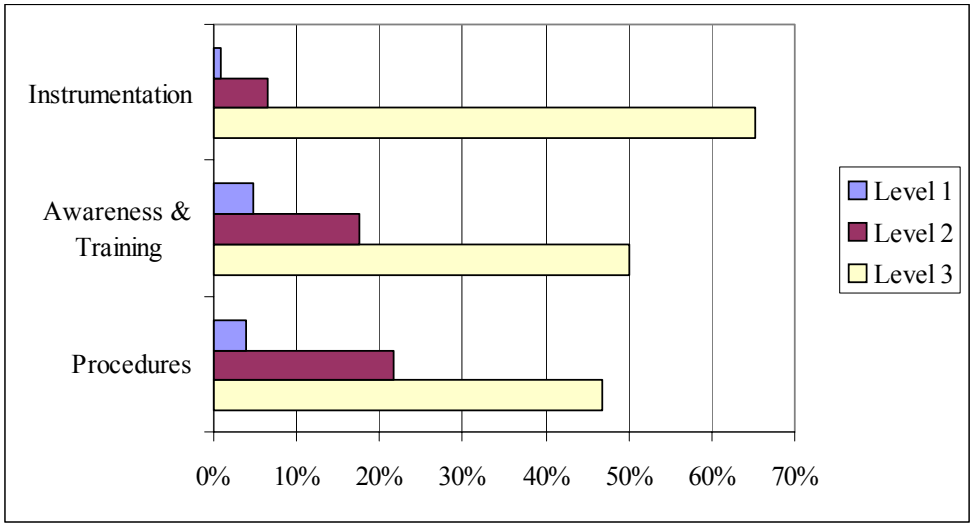
The operational capacity for good energy management involves providing employees with operations procedures and training that will help them to keep energy efficiency in mind during production. Although applied to individual energy-consuming systems, these procedures have common elements across systems that could be implemented plant-wide. For that reason, Figure 4 presents the aggregate results for operational capacity for energy management across the energy-consuming systems presented in Section 2.3.

As Figure 5 shows, Level 3 was the most frequent rating because while many companies address energy efficiency in their operational procedures, training and measurement for a few systems, few companies consistently implement all measures across all systems.

For example, training that addresses energy efficient operating practices is provided to employees for at least one energy-consuming system in 65 percent of facilities surveyed. However, only 27 percent of facilities surveyed provide this training in for three or more systems. Similarly, although 14 percent of facilities have documented operating procedures that

address energy efficiency for one system, there were no facilities for which this detailed documentation was available for all systems.

Figure 5. Aggregate Operational Capacity Rating



Operational profile. Using the Operational Energy Management Matrix (Table 2), companies can rate themselves in terms of their operational capacity for good energy management; the *operational profile* is the line joining the boxes that describe the current status of the company in each of the six columns. The experience of energy managing organizations suggests that good "next steps" are actions that can be taken *to move the lowest scores up scale*, in order to achieve both a *balanced profile* and a *higher overall score*.

Table 2. Operational Energy Management Matrix

	Procedures	Awareness & Training	Instrumentation
1	Operating procedures that specifically address energy efficient operation are documented, reviewed and updated on a regular basis	Training on energy efficient operating practices is given to operators and maintainers through either formal training sessions or informal, on-the-job instruction.	Energy metering is installed in such a way that system consumption can be measured directly; data generated is correlated with production and is used to minimize consumption.
2	Operating procedures addressing energy are unwritten but well understood by operators and maintainers	Training on energy efficient operating practices is given to operators or maintainers through either formal training sessions or informal, on-the-job instruction.	System consumption can be calculated directly or indirectly; data generated is correlated with production or used to minimize consumption.
3	Operating procedures addressing energy do not exist.	There is minimal or no training on energy efficient operational practices	Energy metering does not exist.

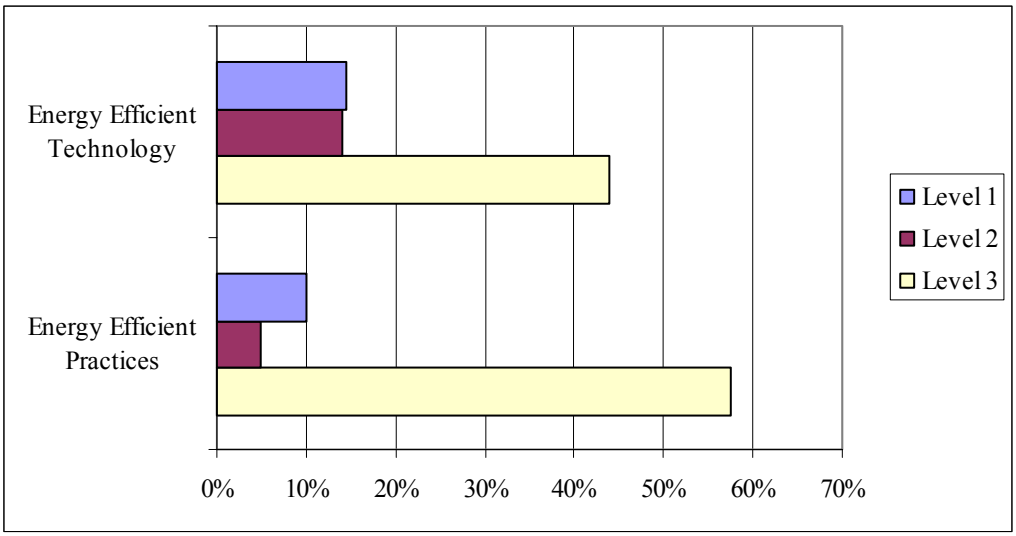
Technical Capacity

While operational capacity provides employees with resources to include energy efficiency in operations, a facility's technical capacity for good energy management includes incorporating energy efficiency into the acquisition and operation of individual energy consuming systems. The technical capacity for energy management is split into two groups: EE Technology and EE Practices. The characteristics of facilities achieving Level 1 status are described below:

1. **Energy Efficient Technology.** Facilities make energy efficiency a criterion for new equipment acquisition. Plant systems are designed and fitted with appropriate controls and other components that optimize their end-use energy efficiency.
2. **Energy Efficient Practices.** Facilities regularly monitor, clean, adjust, maintain, and operate their energy consuming systems to ensure that they function at the highest possible energy efficiency. Employees are aware of system-specific O & M measures and implement them when possible.

Figure 6 presents the aggregate results of technical capacity across all energy-consuming systems. Over 50 percent of facilities were rated as Level 3 in both energy efficiency technology and practices, illustrating a significant potential for improvement.

Figure 6. Aggregate Technical Capacity Rating



System-Specific Results

Although Figure 6 presents the overall technical results, companies were surveyed across seven different energy-consuming systems. Although there are opportunities for improvements in all types of equipment, compressed air, cooling systems and exhaust and make-up air systems offered the largest room for improvement. Highlights of these results are presented in Table 3.

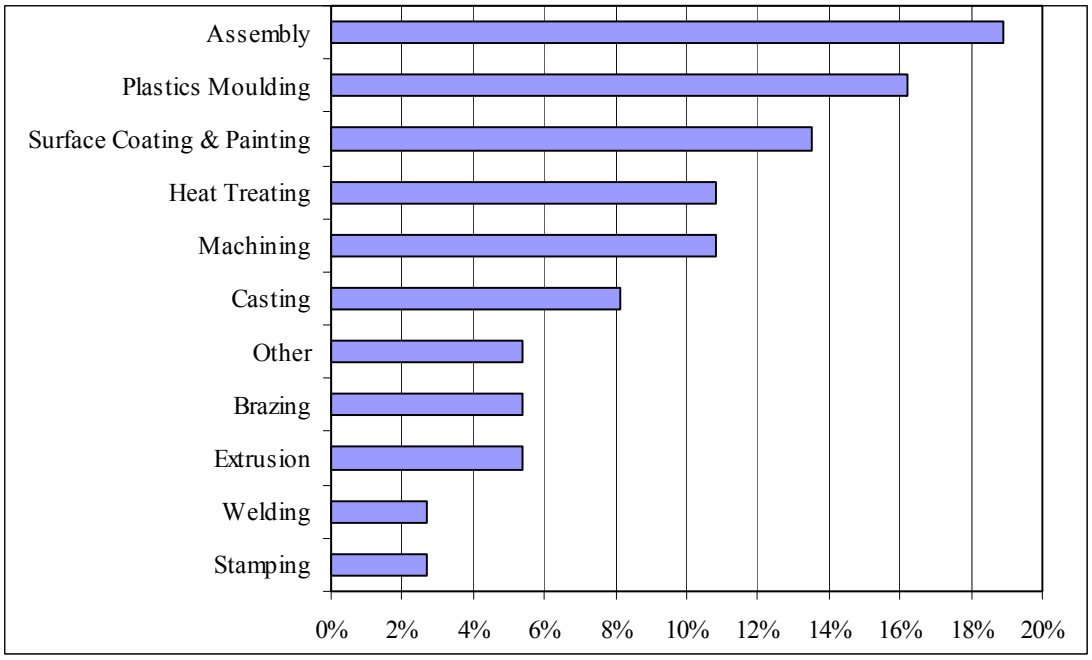
Table 3. System-Specific Results

Compressed Air Systems	Exhaust and Make-up Air Systems	Lighting Systems	Fuel-fired Equipment	Boiler Plant Systems	Cooling Systems	Process Equipment
Facilities surveyed have implemented on average two compressed air end-use management practices with the most popular being shut-off valves and engineered nozzles.	20 percent of facilities reported checking and adjusting combustion controls on make-up air heaters at least once a year.	20 percent of respondents reported that motion sensors were used in their facilities.	Although 30 percent of facilities reported that combustion efficiency was measured by staff or a contractor at least once a year, combustion controls are checked and adjusted annually in only 15 percent of facilities surveyed.	25 percent of facilities reported that they have operators that calculate, track and maintain boiler efficiency.	63 percent of facilities surveyed have insulated chilled water distribution lines.	30 percent of respondents reported that process equipment maintenance practices address energy consumption.
59 percent of facilities reported having a procedure in place for identifying and reporting air leaks.	Air re-circulation with filtering systems is implemented in 24 percent of facilities surveyed.	20 percent of facilities reported using a group re-lamping strategy.	50 percent of facilities reported using either oxygen trim control or electronic combustion controls (no oxygen trim) with their fuel fired equipment.	45 percent of facilities reported determining the combustion efficiency of their boilers using oxygen trim control, electronic combustion controls (no oxygen trim) or mechanical combustion controls (no oxygen trim)	25 percent of facilities surveyed shut down chiller compressors in the winter to allow "free cooling" of chilled water with outside air.	Energy efficiency is a consideration in the procurement of new process equipment in 75 percent of facilities surveyed**.**
Compressors are shut down during non-production periods in 71 percent of facilities surveyed.	Although 39 percent of facilities surveyed have undergone an air balance or similar study, only 6 percent of those have been within the last 10 years.				38 percent of facilities surveyed have either variable speed chillers or a chilled water temperature reset controls in place to control capacity.	

Good practice for the operation of energy-consuming systems includes periodic assessment of their operating efficiency to identify operational or technological measures that can improve efficiency. System audits have been employed more regularly in some systems than

in others, as summarized in Figure 7 below. Opportunities exist to assess other systems more frequently as part of the ongoing energy management strategy.

Figure 7. System Specific Audits – Share of Facilities Surveyed



Conclusion

Although diversity of a sector can make traditional benchmarking challenging, it is possible to focus on organizational, operational and technical issues that exist across all industrial facilities. This type of benchmarking technique enables the identification of opportunities that do not necessarily require a large capital investment. Using the Canadian automotive parts industry as an example, we see that investment is not the only key to improvement; Companies need to look at among other things putting a written energy policy in place, monitoring energy use as well as training their staff to look at energy in a new way.

This benchmarking study is only a first step in helping the Canadian automotive parts industry improve their energy efficiency. Follow-up work will include a series of workshops that will help the sector implement the measures that the benchmarking study presented. The workshops will hopefully focus on a case study showing how a company has moved from Level 3 to Level 1 or the Energy Management Matrices presented here. Further to the workshops, an analysis of implemented measures and their associated energy savings will be conducted.

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