COMMERCIAL BUILDING ENERGY MANAGEMENT

Once a building has been designed and built (or been retrofitted) for energy efficiency, there is still a large potential for wasted energy if the facility is not managed well. Facility management personnel do not always have the skills or incentives to optimise facility performance. Priorities of Facility Managers are usually focussed on keeping tenants and building owners satisfied – which does not necessarily include minimising energy use. Similarly, the tools available to a Facility Manager to better manage energy use are often limited. A fully functional Building Management & Control System (BMCS) and/or Energy Management System (EMS) may not be available. If a BMCS is installed, it may not be geared toward optimisation of energy use.

Buildings which are not well managed from an energy perspective generally exhibit consistent energy consumption increases, or 'drift' in the order of 5% per year due to issues such as ageing equipment, non-optimal operation, sensor failures and schedules / set-points slowly deviating from optimum levels. In order to minimise or even eliminate this increase, information management systems are required – as well as the skills to operate them. This is contrary to a common opinion that saving energy requires large once-of capital investments.

Significant energy savings are possible by simply optimising operation of existing equipment.

The Facility Management Profession

The Facility Management Association of Australia (FMA Australia) defines facilities management as the effective operational management of buildings. The areas of operations that are managed under facilities management include strategic operational planning, general maintenance and environmental performance. Facilities management can be undertaken by professionals and organisations. The role of facilities managers in energy management is continuously evolving, with newly-realised potential and therefore large scope for development. For example, not only do facilities managers influence the technical operations of buildings, they can also influence how the building is used by educating and influencing tenants on their behaviour and energy consumption.

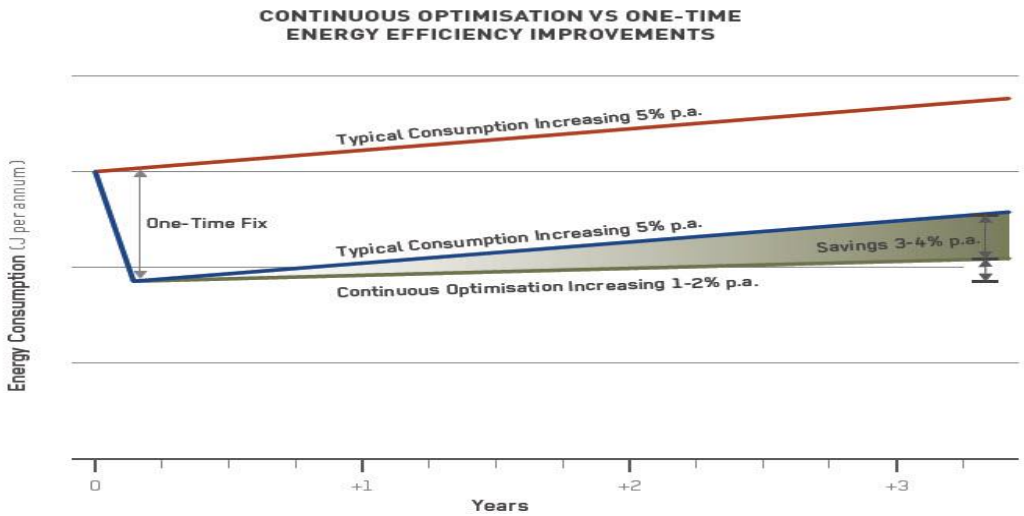

FIGURE 3.40
How a building's energy consumption typically increases over time under BAU and after a retrofit with ongoing optimisation

Good Facility Management starts with measurement to identify current status. This is followed by establishing baseline benchmarks and constant monitoring. Early intervention is performed to halt deviations from the established standards or to remedy adverse performance and to continuously improve the facility. A survey was conducted by FMA Australia and Beyond Zero Emissions into current capabilities of facilities managers and energy management demonstrates a large capacity for improvement.

The key results of this survey are:

- Only 15% of FM companies in Australia directly specify energy or environmental services.
- Of companies surveyed, only 35% implement internal energy management initiatives and a majority do not declare energy performance targets or have energy performance data available. Results also indicate limited strategies to deal with peak demand and a lack of communication between stakeholders.
- 10% of FM companies indicated that they have performance data readily available.
- 60% of companies said they have access to necessary energy efficiency technologies, information and resources and 40% had a strong understanding of potential savings achievable through better energy management. A large majority of companies monitor and report on building energy consumption and conduct

auditing, but there appears to be a lack of consistency between the benchmark used for measuring energy efficiency.

- 65% of FM companies do not have or do not specify energy performance targets.

Facilities Managers must increase awareness for all stakeholders to understand the potential savings incurred by increasing energy efficiency through increased capacity for environmental services and reporting to specified and meaningful performance targets.

Non-Technical Management, Training and Skills

Non-technical management involves all communication between stakeholders, behavioural management, direction of operations budget and information or resource sharing. Training and skills refers to the higher education and qualifications required of facilities managers. This report is proposing to substantially improve the focus on energy consumption across building managers and to specifically provide necessary training to give FMs the knowledge to act on energy efficiency.

Benefits

Some of the main incentives for building managers to implement better energy management are [153]:

1. Improvement of corporate image
2. Level of support and interest from building owner and tenants

3. Individual concern for the environment
4. Company energy management policy
5. Increase in star rating (NABERS)
6. Access to expertise, information, funding and resources
7. Financial savings from reduced capital and operational expenditure budgets
8. Cost savings from reduced energy consumption

Trough adequate training, management staff will acquire skills to improve communication between stakeholders, increase awareness and aid in improving company culture or company policy. Professionals such as managers are in a position to advise clients and therefore, with improved energy knowledge, they can influence priorities or goals of decision makers which may otherwise conflict with energy management objectives.

Implementing the recommendations will help to develop a national database on energy usage across all building sectors and to improve the nationwide lack of information and data on commercial floor space, energy use and potential savings.

Energy Demand Reduction Potential

The LEHR study indicated that it is possible for buildings to achieve 20-30% emissions savings through improved management alone, with NABERS energy improvements of greater than 1.3 stars.

TABLE 3.20

Strategy	NABERS Energy Impact
Buildings with an efficiency training program	0.5 Stars
Buildings where manager reports higher level of energy efficiency knowledge	1.3 Stars

Implementation Recommendations

Increasing energy efficiency through better energy management strategies in the built sector can be tailored and classified by building rather than industry. It is common for facilities managers to manage a particular building type which may be used in a range of industries. Some general management improvements that can be implemented across all sectors nationwide are:

- All buildings must have clear identification of energy performance targets.
- Management must meter and report to targets and ensure performance data is publicly available
- A national target or benchmark applicable to all sectors to allow for comparison between buildings
- Internal energy management schemes to enhance engagement of all staff and stakeholders
- Mandatory energy efficiency training for all facilities managers in C and D Grade Office Buildings
- Training which is tailored and applied across all building sectors

Studies show that energy efficiency training programs or specific vocational training in energy efficiency produce a greater improvement than a generic qualification.

Trained Facility managers help stakeholders to understand changes in day-to-day programs. Training must be targeted to the knowledge and skills of the building occupants with feedback, incentives and disincentives to promote support and uptake of initiatives. Such training can also lead to promotion of internal energy management initiatives, benchmarking and reporting schemes.

Costs and Economics

Benchmark training programs include: Vocational Graduate Certificate in Energy Efficiency for Facilities Managers, Australia.

If this was implemented nationwide it would have costs as outlined in Table 3.22.

TABLE 3.21

Training	**Cost**
AIRAH/FMA Australia Members	$7,920
Non Members	$9,600

These results indicate that buildings perform better if facilities managers have training and skills in energy efficiency.

The training of 1,000 personnel does not include all facilities managers in Australia however represents a sample of training for managers located in or responsible for C- and D-Grade office buildings.

Technical Tools – Energy Management Systems

The ZCA Buildings Plan proposes wide scale adoption of Energy Management Systems (EMS). A well-implemented EMS with appropriately skilled operators and support services is able to ensure that building operation is energy-efficient and problems are identified and addressed before their effects contribute significantly to energy use.

An EMS can range in complexity from basic smart metering, web portals and in-building displays (the same as those proposed for residential buildings and suitable for small commercial buildings) to highly complex systems with dozens of networked sub-meters and active diagnostics and communications.

The Figure below shows the architecture of a sample EMS. It comprises a number of metering devices connected via serial link, Ethernet, or wireless links, to a computer that is able to log the data, process it and report the results in various formats. This computer may physically reside on-site or be located off-site (possibly provided as a cloud Internet service). Processing captured energy data identifies patterns of usage and provides benchmarks for facility operation. Additionally, when usage is outside expectations, alerts can be generated. Facility Managers and other equipment operators can act on the computed findings and alerts to take action to reduce energy and water use in their building. Currently building owners often use consultants to improve their operating efficiencies and

achieve a target NABERS or similar rating. Good around the clock management is often neglected. With an EMS, the performance of a building is constantly assessed and data provided to enable benchmarking against past consumption patterns. Providing useful, actionable data provides an opportunity for buy-in from key stakeholders including building occupants and can even bring about a communal sense of ownership in achieving any efficiency targets set.

TABLE 3.22

Nationwide Implementation of Training	**Cost**
700 Facilities Managers (members)	$5,544,000
300 Facilities Managers (non-members)	$2,880,000
Total 1000 Facilities Managers in australia	$8,424,000

Consumption data and alerts can be communicated by technologies such as e-mail or SMS in addition to being logged within the system. The data is available in a variety of formats to suit different segments such as Engineering, Management and Public.

Commercially available EMSs vary widely in their cost, architecture, implementations and features. A selection of commercially available systems includes:

- The Pulse tool from Green Buildings Alive
- Honeywell Energy Manager and the "Attune" Services Suite from Honeywell
- The Edge Intelligent System from EP&T

- Noesis Energy
- OzGreen Energy

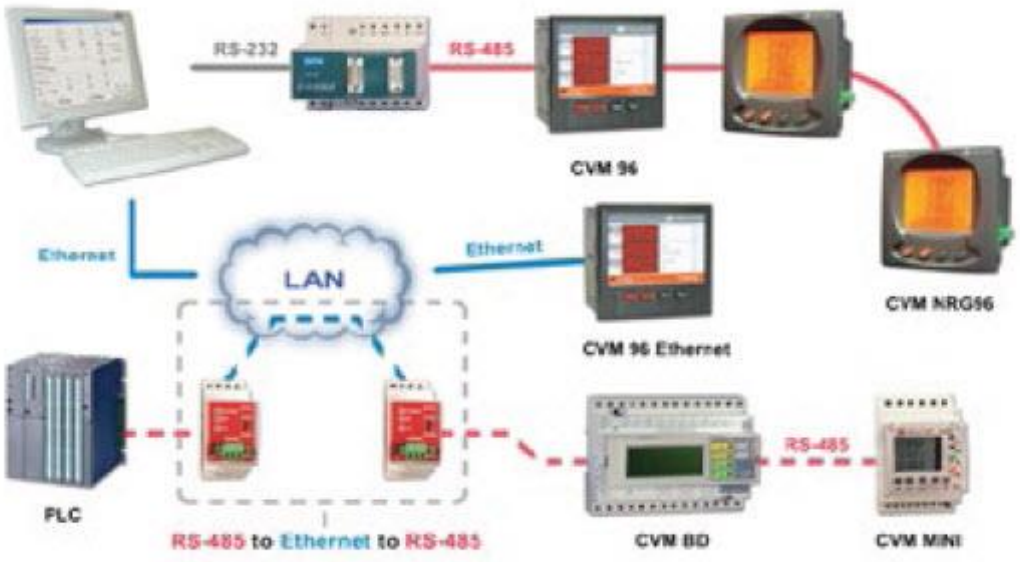

FIGURE 3.41
Example EMS architecture. [SQ Electric]

FIGURE 3.42
Sample screen from the Pulse Tool [Buildings Alive Pty Ltd]

It should be noted that many, generally larger, buildings already have Building Management & Control Systems (BMCS) installed which provide EMS-type

functionality to varying degrees. If a building has a BMCS installed, it is recommended that energy management features be utilised and customised to their full extent, or that a separate EMS be installed to run in parallel with the BMCS.

Benefits

A well-implemented EMS with appropriately skilled operators and support services can ensure that building operation is energy-efficient and issues are identified and addressed before they contribute significantly to energy use. Benefits include:

- Reduced energy consumption reduction
- Reduced peak energy demand reduction
- Drawing attention quickly to important issues through prioritised alarms (eg faulty sensors or actuators causing excessive equipment operation)
- Identifying and eliminating waste energy through automated reporting (e.g. regular reports on equipment hours of operation, energy use, temperature set-points)
- Benchmarking of the building against similar facilities, which allows better understanding of ongoing performance of the facility
- Measurement and verification of any energy conservation measures implemented, allowing assessment of financial paybacks and environmental impact

- Visibility of the building operation across all levels of the organisation, so that all stakeholders have input into operations.

Energy Demand Reduction Potential

Results of a properly implemented EMS with skilled operators can vary widely, but are usually expected to be in the order of 5% to 15% energy savings, with some cases resulting in energy savings of up to 40%.

Implementation Recommendations

It is proposed that properly installed and configured Energy Management Systems be installed in all buildings over 2,000 m^2 with high-quality automated reporting, and accompanied by skilled operators/analysts. For building size above 2,000 m^2 it is difficult to physically see and feel what is happening throughout the building, and thus an intelligent system is required to centralise control, data collection and reporting. In buildings below this size, it is recommended that at minimum, smart-metering be installed with web-based access to reporting and an in-building energy display.

Costs and Economics

EMS systems range from straight out purchase models where all equipment and software is installed on site to subscription hosted services and various hybrid models. A base building EMS with 12 sub-meters is expected to cost $30,000 and around $75,000 for 30 sub-meters[154].

Costs available online from Eaton [155] indicate the ranges for components as outlined in Table 3.23.

Payback times are quite short. Anecdotal evidence suggests that on small buildings the payback time for a capital purchase EMS could be between three and five years. With large consumers of energy, payback time could even be less than one year. Paybacks vary with energy prices and as energy prices increase, paybacks become even better.

Other Service Upgrades

Building Management and Control Systems

Most large buildings have some form of building automation system installed. For example a Building Management and Control System (BMCS) aims to automate the operation of building services. Smaller facilities usually have a certain amount of automation, but this is often in the form of 'islands of control' based around individual pieces of equipment. In larger facilities, a complete BMCS will centralise the monitoring, operations and management of a building to achieve more efficient operations ("Engineering Manual of Automatic Control for Commercial Buildings", Honeywell, 1997). A BMCS monitors conditions, and centralises the collection of data and control of set-points and other factors in the building. Depending on the building, a BMCS may encompass only basic Heating, Ventilation and Air Conditioning (HVAC) operation, or everything from lighting,

security, fire, transport (elevators etc.) and communications. An EMS may be incorporated within the BMS or may be a standalone system running alongside the BMS.

TABLE 3.23

Eaton Energy Management System costs

EMS Component	Cost per unit	Comments
Wireless Sensors	$100 to $300	
Wireless Thermostat Controller	$170	
Power Meter	$1000 to $10,000	Eaton iQ150 Meter costs $1200
Wireless gateway	$1000 and $3000	The gateways are designed with an integrated web server to enable browser-based remote system management. it usually consists of a radio module with an incorporated antenna.
Software	$10,000	Varies significantly depending on supplier

The effectiveness of a BMCS in terms of maximising energy efficiency varies immensely, depending on factors such as the skill of the Facility Manager and the ongoing management, servicing and upgrading of the system by the service provider. It is recommended that any building with a BMCS has their systems reviewed and serviced by skilled engineers on an ongoing basis to ensure they maintain or improve their effectiveness. An effective BMCS is also part of ongoing commissioning, discussed below.

Commissioning and Retro-Commissioning

HVAC systems in buildings are often complex and rarely operate as designed because the important step of proper system commissioning and tuning is often bypassed ([79] page 362). Furthermore, surveys show a high rate of undiagnosed faults in HVAC system control [79].

Commissioning is the process of testing and fine-tuning a building system to ensure efficient and effective operation. Building performance drifts over time, and commissioning should be repeated, or continuously performed to maintain energy performance and eliminate building energy "drift". Research from Lawrence Berkeley Laboratories [156] suggests that commissioning projects for existing buildings achieved a median energy reduction of 16% for the whole building with payback times from 1.1 to 4.2 years. There are also large differences observed between basic recommissioning and more thorough approaches, with more comprehensive approaches achieving nearly twice the savings. For operation close to maximum efficiency it is therefore important to perform a thorough plant commissioning, and then to re-commission every three to five years.

Source: http://decarboni.se/publications/zero-carbon-australia-buildings-plan/7-commercial-building-energy-management