



engineering a better built environment

**Member Survey
Energy Efficient Design
in the
Commercial Building Sector**

Report prepared by AIRAH

May 2003

Table of Contents

Executive Summary	3
Introduction	3
Terms of Reference	3
Reasons for Concern About Energy Efficient Design.....	3
Approach	4
Barriers to Sustainable design and Best Practice	4
Summary of the survey responses	4
Additional issues identified by survey respondents	8
Ranking of issues	8
Conclusions and Future Work by AIRAH	9
References	9
Appendix 1 – Survey data	9

Executive Summary

There is a great deal of interest amongst AIRAH members (who are specialists in a variety of disciplines in the air conditioning, refrigeration, heating and ventilation industry - HVAC), in the field of energy efficient design.

To date, AIRAH members have shown a commitment to minimising energy use in the HVAC industry by implementing a range of best practice principles through voluntary programs.

According to AIRAH members, the most crucial barriers to the adoption of energy efficient design and operation in commercial building projects today are:-

- Developers and financial backers looking for the lowest capital cost design solutions to maximise their returns on today's projects.
- Designers of buildings and their services are left out of the early decision making stages of projects.
- The lack of time allotted by developers to examine the various energy efficient options available for buildings.
- Poor maintenance standards of existing equipment.
- Poor commissioning of well designed systems.
- A general lack of formal industry training and education

Introduction

Terms of Reference

Since the late 1980's, AIRAH has been involved in the development and delivery of education on energy and its efficient use in the commercial building industry. Several energy efficiency focused education courses have been conceived and developed and are currently being delivered. In looking for future directions in energy AIRAH worked with key members to determine what areas must be addressed to minimise energy use.

A working group was convened in November 2002 to look at the major issues hindering the adoption of energy efficient HVAC designs as everyday practice in the Australian building industry. This working group comprised representation from all facets on the HVAC industry including installers, designers and academics.

Reasons for Concern about Energy Efficient Design

The efficient usage of energy is environmentally and economically beneficial and the cost of energy is likely to rise in the foreseeable future, but the building industry still appears to be reluctant to improve energy efficiency through design. Future energy supplies are limited and will have to be used far more efficiently to ensure a reduction in greenhouse gas emissions. We have already seen situations in Australia where states have had to purchase electricity from each other to meet peak demands in the summer months.

In 1999 the Australian Greenhouse Office (AGO) produced a report on the greenhouse gas emission levels from the Australian Commercial Building sector [1]. They reported that, over the next decade, the commercial building industry will need to recognise and address greenhouse concerns. It comes as no surprise that as much as 60% of energy consumed in the commercial building sector is attributed to heating, cooling and ventilation [1]. There are many opportunities for reduction in greenhouse gas emissions in the commercial building sector, including of energy efficient design and installation of heating ventilation and air-conditioning systems.

There is still a very slow uptake of energy efficient technology in the marketplace today. A few high profile financial backers and developers have delivered some excellent examples of what can be achieved with a shift in thinking about the design process and a change in approach for today's projects, but on the whole there is little change in the way commercial buildings are

being designed and built. Currently there is little or no legislation governing energy efficient design and there also appears to be very little incentive for buildings to be built to operate more efficiently.

The relatively low current cost of energy means that there is little financial incentive driving change and there appears to be very little understanding outside the HVAC industry about what can be achieved through energy efficient design.

The situation of commercial buildings being inefficient to operate will ultimately improve. Standards and the Building Code of Australia (BCA) will need to encourage market direction but that will require educating the market, and having resources and materials to design and deliver the buildings. The HVAC industry is in a position to take responsibility and educate its customers and members on the economic, competitive and social advantages that follow on from designing and constructing energy efficient buildings.

Approach

AIRAH Working Group

The group convened in November 2002 focused on the barriers to energy efficient design of HVAC systems being adopted in today's marketplace. A number of fields were addressed, including consulting issues, education matters both internal and external to our industry, and engineering practice.

The group highlighted a large number of barriers, and further work was required to determine the overall HVAC industry position. A list of the main issues given in Appendix 1.

To derive an overall position from the industry on the barriers to energy efficient design in the commercial building sector, AIRAH conducted a survey of its members.

Survey

The survey was conducted in April 2003, with a questionnaire being distributed to over five hundred AIRAH members nationwide with a specific interest in energy. Over 100 responses were received. The questionnaire topics are stated in Appendix 1 of this report and an overview of responses is outlined below. Members surveyed were representative of all States and Territories and from the following sectors of the industry:

- Energy Purchasing Managers for multinational corporations
- Energy Auditors
- Designers
- Contractors
- Equipment manufactures and suppliers
- Property owner representatives
- Facility managers
- Government employees responsible for energy
- Controls companies

Barriers to Sustainable design and Best Practice

Summary of the survey responses

Following the analysis of the questionnaire responses received, the results were compiled (see Appendix 1) and a summary is presented below of the industry position on barriers to energy efficient design in the commercial building sector.

Capital Cost Price Driven Options

Builders and developers are mainly interested in short term payback on building projects as a result of this, the majority of HVAC designs are currently measured on their capital cost value, with full life cost very rarely a consideration at the design stage. Clients are not always aware of energy efficient design options and their benefits, and hence are rarely specifying their inclusion in their briefs to designers.

Innovative design solutions that do get considered are often not adopted due to the initial capital cost forecasts by project managers.

Developers Driving Market

In the majority of cases the developers and financial backers of projects are driving the building market and their prime concern is maximising short-term profit. It would appear that there is very little input from other stakeholders at the design stage of any project. This leads to a short-term view being taken in the design process.

As an example tenants can have some very valuable input to design matters, typically only those that are considered to be “A grade” tenants have a chance to provide input.

Design Time Frame

The short time frame allowed for the services design stage (conception to tender) restricts the possibility for innovative/energy efficient solutions to be developed. Designs could be improved with more time and increased fees. Currently there is not enough time in the project cycle given to explore innovative solutions for projects. Developers and builders do not want to pay for what they perceive to be expensive, out of the ordinary systems, so they do not allow the time or money for energy efficient options to be considered. It is possible for designers to specify energy efficient system components in the current time frames, but overall improved holistic system approach takes more time.

There is also a strong case that there is more chance of energy efficient solutions being considered if the designer is involved at the building concept stage, so timing in the project is important also.

Inappropriate Fee Structure

Designers in today’s marketplace are finding themselves working for low fees and competing for jobs on price, not experience. This is precluding innovative and energy efficient solutions being delivered. With falling design fees there has been a move to reduce training of younger engineers, and as a result companies are employing less qualified, less experienced staff, which affects the quality of the resulting designs, including the design of energy efficient solutions. With lower design fees, off the shelf design solutions are repeatedly used to meet the time constraints that are imposed by limited fee budgets.

Non-Uniformity of Regulations

There are a number of different acts and regulations across Australia requiring different minimum design standards. It is difficult and time consuming for a designer to gain an understanding of the various requirements. The survey results showed that the majority of respondents do not work across state boundaries, but those that do find it a problem keeping up to date with the myriad of legislation that is continually changing. With a trend towards a more mobile workforce and it is felt that this issue will become more of a problem.

At a local level younger engineers are not always well versed in the use of the BCA and the industry related Australian Standards.

Poor Installation

The poor installation of well designed, energy efficient systems is resulting in inefficient operation of the systems.

There has been a boom in the building industry over recent years and this, coupled with reduced training in the contracting side of the industry, has resulted in a deterioration of skill levels.

These skill shortages lead to a lack of understanding of the design intent by the mechanical contractor. Aspects of building construction that affect the operation of the HVAC systems are also not picked up by staff on site (e.g. removal of shading devices, increased window areas, omission of insulation, etc.).

Today's building practices also preclude the involvement of the design consultant at installation and handover stage of a project. This comes from cost cutting strategies employed by many builders. As a result, poor installations and on site problems are not picked up in the construction phase of a project.

Poor Commissioning

Many well designed and well installed systems are inefficiently operated as a result of poor commissioning and balancing.

Good commissioning and balancing of a project is crucial to maintain user comfort and ensure the plant is operating as effectively as possible. The survey identified that there is a great lack of knowledge between the designer, who doesn't understand or get involved in the commissioning process, and the commissioning personnel that do not fully understand the way in which the design is supposed to operate. There is often very little time/budget at the end of a project for sufficient commissioning to be undertaken involving close attention to detail and spot checks.

Poor Maintenance

Poor maintenance is one of the major contributing factors to inefficient energy usage in systems. There is a great lack of understanding of the design intent by building owner and maintenance contractors. This may be due to complex designs. One of the other main factors cited a number of times is the unwillingness of owners to spend money on maintenance, resulting in plants falling into disrepair and work only being done when absolutely necessary.

Poor handover of new buildings to users and insufficient guidance on operating and maintenance manuals also has a great impact on poor operation of buildings.

Energy Modelling

There is currently a lot of skepticism about the reliability of results of energy modeling programs. The BCA will incorporate minimum energy usage targets in the next 2 years and there is currently no formal industry training or accreditation of energy modeling practitioners here in Australia. There are a number of different energy modeling software packages available on the market today but the lack of adequate training and assessment for designers using these packages limits the reliability of the results. These programs are expensive and difficult to use properly. There is also very little verification of whether energy modeling matches real performance. It has been suggested that it can be easy to alter inputs in modeling programs to provide any desired result.

Addressing BCA Design Criteria / Alternative Solutions

The BCA allows for deemed to satisfy and engineered solutions. There is a low level of uptake of engineered solutions submitted on projects.

Only a minority of those surveyed did not have strong feelings about this issue.

This low uptake of engineered solutions is a result of inadequate training of engineers in Australia, which also hinders the implementation of energy efficient solutions. There is no well-recognized building services design course available at tertiary level and staff new to the industry have to rely on the job experience.

With today's low design fees there is very little opportunity to learn about design solutions that fall outside of BCA deemed-to-satisfy type. Innovation for energy efficient performance based solutions is not rewarded, therefore there is little incentive for companies to pursue them.

Lack of Understanding by Principal Certifying Authorities (Building Surveyors)

Principal certifying authorities (PCAs) have a great lack of understanding of how energy efficient designed systems operate.

They often do not have the relevant mechanical/electrical engineering expertise that is required to satisfactorily evaluate energy efficient designs and often the certifiers generally accept the design engineer's own certification.

Problems Inherent in Systems Engineering

Poor system integration of individual plant components is leading to higher than necessary energy consumption in buildings.

There have been improvements in the efficiency of individual pieces of equipment (chillers, cooling towers, pumps etc.), but there is a great knowledge deficiency in the understanding of systems integration by many in the industry. System integration has to be considered very early in the design of any project to achieve maximum energy efficiency potential, but due to lack of education and competence of design engineers this rarely happens.

Inadequate Part Load Information for Equipment

The ability of engineers and building designers to do true and effective comparative performance and life cycle cost assessments is severely hindered by the lack of part load performance data from equipment suppliers.

In most cases equipment manufacturers are supplying the demand of the market place, which is currently focused on low cost solutions. Technical information is costly to produce and equipment manufacturers have no incentive to outlay research money in the development of it.

Inadequate Rating of Equipment

There is a lot of equipment out in the marketplace that is not correctly rated in manufacturers technical guides. Good design is undermined by equipment that does not perform as specified by the manufacturer. This is a chronic problem throughout the industry, particularly with items that involve heat and mass transfer such as cooling towers. Rating of equipment is expensive and difficult due to the wide variety of design conditions throughout Australia and on site performance measurements are difficult.

Life Cycle Costing / Cost Benefit Analysis

There is an industry wide lack of understanding of the benefits of sound life cycle costing (LCC) and cost benefit analysis. This is precluding broader understanding, and adoption of energy efficient options. Developers and builders rarely have an ongoing role in the running of a building once construction is complete so they are only interested in first cost figures of a project. They are reluctant to pay for this type of analysis; nor do they want to pay for the alternative type systems that LCC show to be beneficial.

Accounting Techniques

Today's accounting practices do not take into account the triple bottom line of economic, societal and environmental needs.

In today's marketplace, energy prices are relatively cheap and the majority of accounting practices are based on immediate maximum returns for shareholders. There is very limited knowledge in the industry about the cost of environmental degradation, and a great reluctance in looking at longer payback periods.

Rapid Technology Changes

There is a lot of new energy efficient technology available, but industry is struggling to keep up to speed with what works and what doesn't. Lack of time to research the technologies is one major factor but there is a great lack of basic knowledge and understanding of how existing technology works as well, so the understanding of how new technology works proves increasingly difficult for many in the industry. A lot of overseas technology is simply shunned on the pretext that it is not suitable for the Australian climate without it being tried and tested. People often lack the understanding of how to apply it to our situation.

Lack of Research and Development (Funding Issues)

The lack of research and development in Australia prevents the development of new and innovative energy efficient options. There is little or no funding to support research and development and there is a lack of awareness and embracement in Australia by engineers and designers of existing and tried/tested technology which is being used overseas. This is highlighted by a number of good energy efficient designs that start off in Australia but get no funding and can often end up overseas.

Energy Efficiency in Existing Buildings

Existing building stock is a huge source of wasted energy. Current energy costs are relatively low and there is little incentive for building owners to minimize energy usage. There are no requirements for existing building stock to be energy audited and have energy saving measurers put in place. The BCA has introduced energy standards for residential dwellings this year and is due to introduce energy standards for new commercial buildings. These standards are at least 2 years away and will have little impact because of the low volume of construction activity. Most of the building stock for the next 20 years already exists.

Sales Practices

Incentive / sales practices of suppliers may compromise energy efficient design integrity. It is unreasonable to think that this is a major contributing factor to poor energy efficient design. The MEPS program is reducing the opportunity for poorly rated equipment to be allowed in the marketplace and designers understand that it is their responsibility to understand products that are offered and verify supplier's claims.

Additional issues identified by survey respondents

Where requested to identify further issues that are affecting the adoption of energy efficient design in commercial buildings it was reiterated by respondents that there is a great knowledge gap in the marketplace. There is a lack of knowledge by the end user (tenant) that there are continuous and substantial savings to be made by using energy efficient designs.

There is a lack of education of developers and financial backers who currently only focus on a very short time frame for payback for their projects.

There is also a huge deficiency of training and education for today's graduates coming into the industry. Australia has no specialised building services degrees and once graduates enter the industry there is very little if any continued training amongst the consultants.

Ranking of issues

Questionnaire respondents were asked to indicate which of the topics they felt were the 5 main barriers from those discussed.

The six most significant issues were:

- Developers and financial backers looking for the lowest capital cost design solutions to maximise their returns on today's projects.
- Designers of buildings and its services are left out of the early decision making stages of projects.
- The lack of time allotted by developers to examine the various energy efficient options available for buildings.
- Poor maintenance standards of existing equipment.
- Poor commissioning of well designed systems.
- A general lack of formal industry training and education

Conclusions and Future Work by AIRAH

The initial results of the working group and survey have indicated that there are a number of issues that need to be addressed by industry to encourage the uptake of energy efficient design. Some of these problems are internal to the HVAC industry and relate to the level of education and training. Through the knowledge and expertise within its membership, AIRAH finds itself in a strong position of being able to develop and provide the training and education for this sector of the industry.

A number of the issues highlighted in this study relate to parties outside the HVAC sector and AIRAH must effectively position itself to provide understandable expert technical guidance and support to these parties. Further work is required to progress a whole of industry approach to counter barriers to energy efficient design being adopted.

AIRAH must work closely with the Federal and State governments providing effective advice to enable sound decision making.

AIRAH must also work closely with the Australian Building Code Board (ABCB) to ensure that energy measures that are to be mandated for commercial building in the BCA are realistic and achievable.

References

1 Australian Greenhouse Office "Australian Commercial Building Sector Greenhouse Gas Emissions 1990-2010" 1999

Appendix 1 – Survey data

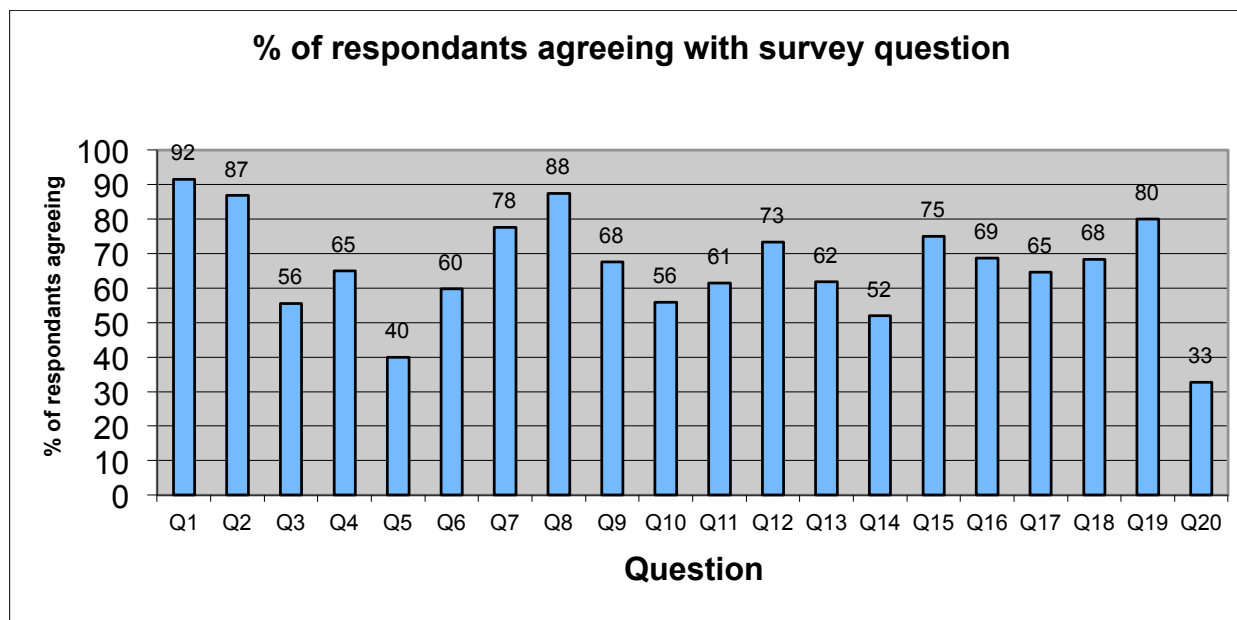


Fig 1 Summary of responses to Questionnaire issued in April 2003 (questions summarised below)

Respondents were asked to indicate, on a scale of 1 to 5, the degree to which they agreed with the following statements:

1. Capital Cost Price Driven Options

In today's market there is a tendency to adopt the lowest capital cost design solution – not the most energy efficient solution

2. Developers Driving Market

Developers and financial backers of projects are driving the market and not those involved directly with the design and operation of the buildings.

3. Design Time Frame Issues

It has been suggested that the typically short time frame allowed for the design stage (conception to tender) restricts the possibility for innovative/energy efficient solutions to be developed.

4. Inappropriate Fee Structure

Low design fees in today's market preclude innovative and energy efficient solutions.

5. Non-Uniformity of Regulations

There are a number of different acts and regulations requiring different minimum design standards. For a designer to gain an understanding of the various requirements adds an unreasonable time and cost penalty.

6. Poor Installation

It has been suggested that the poor installation of well designed energy efficient systems results in inefficient operation of the systems and negates the intention of the original design.

7. Poor Commissioning

Many well designed and well installed system are inefficiently operated as a result of poor commissioning and balancing.

8. Poor Maintenance

You can have the best designed system in the market but if it is not maintained to a high standard it is not going to operate efficiently.

9. Energy Modelling

There are a number of different energy modelling software packages available. It has been suggested that a lack of adequate training and assessment for designers for these packages limits the reliability of the results.

10. Addressing BCA Design Criteria / Alternative Solutions

The BCA allows for deemed to satisfy and engineered solutions. The low level of uptake of engineered solutions is a result of inadequate training of engineers, which hinders the implementation of energy efficient solutions.

11. Lack of Understanding by Principal Certifying Authorities (Building Surveyors)

It has been suggested that there is a lack of understanding by certifying authorities of how energy efficient designed systems operate.

12. Problems Inherent in Systems Engineering

There have been improvements in the efficiency of individual pieces of equipment (chillers, cooling towers, pumps etc.). Poor system integration of these components does not in the current market, achieve maximum potential energy efficiency.

13. Inadequate Part Load Information for Equipment

Lack of availability of part load information from equipment suppliers makes it difficult to accurately model energy usage for different systems within buildings

14. Inadequate Rating of Equipment

Good design may be undermined by equipment that does not perform as specified by the equipment manufacturer.

15. Life Cycle Costing / Cost Benefit Analysis

It has been suggested that there is an industry lack of understanding of the benefits of sound life cycle costing / cost benefit analysis prevents energy efficient options being considered.

16. Accounting Techniques

Today's accounting practices do not take into account the triple bottom line of economic, societal and environmental needs. Until there is a paradigm shift in this mentality, uptake of energy efficient designs will be compromised.

17. Rapid Technology Changes

Current industry practices do not encourage the effective knowledge management of new technological advances.

18. Lack of Research and Development (Funding Issues)

It has been suggested that the lack of funding for research and development in Australia prevents the development of new and innovative energy efficient options.

19. Energy Efficiency in Existing Buildings

The current lack of requirements for existing building stock to be energy audited and comply with new BCA standards is resulting in large-scale energy waste.

20. Sales Practices

It has been suggested that the incentive / sales practices of suppliers compromise energy efficient design integrity.

21. Other Issues

If you believe there are any other issues that are creating barriers to sustainable / energy efficient design in today's market please outline them below.

