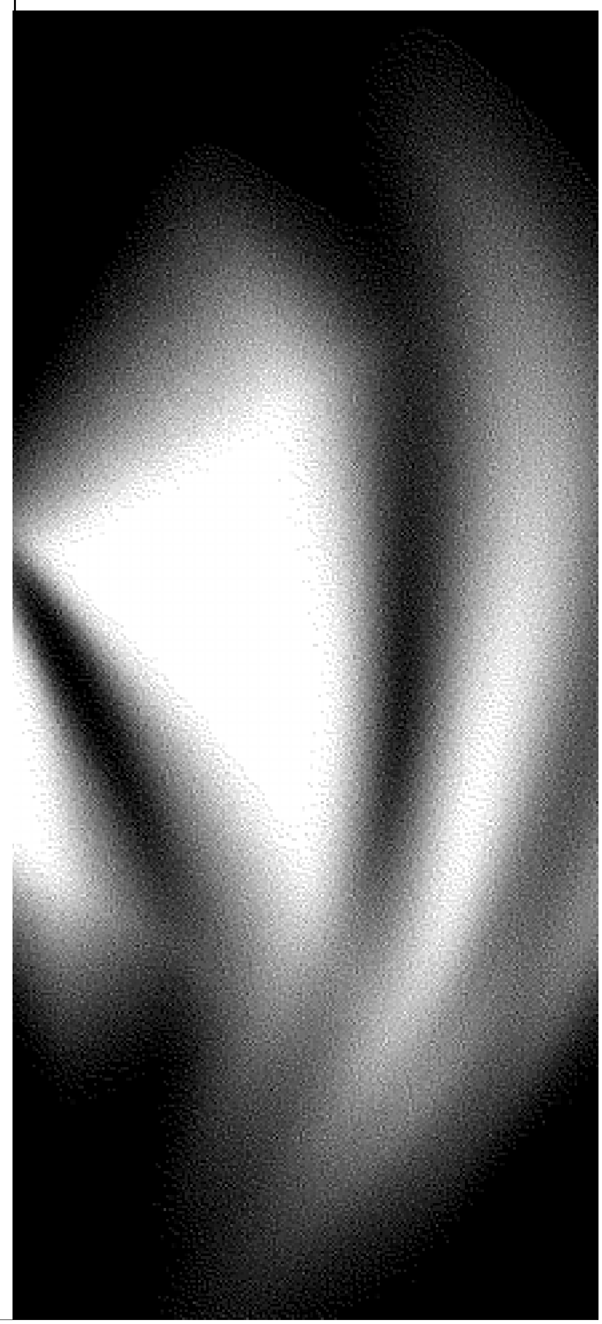
The Environmental Performance of Commercial Buildings

Research Report



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The Productivity Commission

The Productivity Commission, an independent Commonwealth agency, is the Government's principal review and advisory body on microeconomic policy and regulation. It conducts public inquiries and research into a broad range of economic and social issues affecting the welfare of Australians.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

Information on the Productivity Commission, its publications and its current work program can be found on the World Wide Web at www.pc.gov.au or by contacting Media and Publications on (03) 9653 2244.

Foreword

This research report has been prepared by the Commission in response to a request by the Assistant Treasurer on behalf of the Department of Industry, Science and Resources.

The objective of the study was to analyse the factors influencing the adoption of environmentally sustainable features in commercial buildings, to identify any significant impediments to their adoption, and how to overcome them.

The Commission's early public consultations and assessment revealed that a key environmental concern was the use of greenhouse gas intensive energy in commercial buildings. While the study therefore focuses on energy use, the analysis is broadly applicable to a range of other environmental effects of commercial buildings.

This study has drawn on information obtained through consultations with a variety of people and organisations and from public submissions. The Commission thanks everyone who has contributed.

Gary Banks
Chairman
November 1999

Terms of reference

The Productivity Commission is requested to undertake a research study examining the performance of commercial buildings and analyse any impediments to better performance of such buildings, and how to overcome them.

Background

The Government is concerned that in some instances the current processes of developing and procuring buildings may not be consistent with the adoption of environmentally sustainable design features relating to energy consumption and durability. For example, it has been argued that the speculative nature of certain parts of the construction industry may constrain the adoption of environmentally sustainable building designs.

The Government is keen to ensure that the overall cost (including design, construction, maintenance and other operating costs) of 'fit for purpose' commercial buildings is minimised over the economic life of the building. This may involve more effective 'asset' management practices including the analysis of whole-of-life building performance, and how such information could be fed back into improving the long term performance of buildings.

Scope of the study

The study should:

- identify the indicators of building performance used by building owners and/or tenants (such as indicators of the extent to which a building is 'fit for purpose', as well as its environmental performance);
- use case studies to assist in an evaluation of the performance of buildings, as well as the factors affecting building performance within the context of design, construction and subsequent use;
- analyse factors influencing the extent to which environmentally sustainable design features are incorporated at the building design, construction, maintenance and management stages;
- examine the current incentives for developers to incorporate environmentally sustainable building design features and their impact on whole-of-life building costs; and
- identify any impediments to better performance of buildings, including innovation in building design and construction.

The Commission is to report by November 1999.

The Report is to be published.

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Abbreviations

ACTHERS	ACT Housing Energy Rating Scheme
AEPCA	Australian Energy Performance Contracting Association
AMCA	Air Conditioning and Mechanical Contractors' Association of NSW Ltd
BDP	Australian Council of Building Design Professions
HIA	Housing Industry Association
HVAC	heating, ventilation and air conditioning systems
IC	Industry Commission
ISTs	Input saving technologies
ISTPs	Input saving technologies and processes
NatHERS	Nationwide House Energy Rating Scheme
NECA	National Electrical and Communications Association
PATHE	Partnership Advancing the Housing Environment
PC	Productivity Commission

Key Messages

- A range of innovative, input-saving technologies and processes (ISTPs) could be incorporated in commercial buildings during their design, construction, operations, maintenance, refurbishment or demolition stages to reduce their environmental impact. Many appear to be inexpensive and commercially viable.
- However, at current prices, ISTPs (particularly for energy conservation) in their commercial buildings, are simply not a high priority for many businesses. The costs of inputs of energy and other environmental resources used in a building are commonly only a small fraction of a firm's costs. However, ISTPs have been, and are, adopted where input costs are significant (such as energy and water costs in hotels), and they do not detract from the firm's other objectives.
- There are numerous "hidden costs", like disruption to business, and risks, such as lower reliability, which reduce the apparent attractiveness of many ISTPs.
- Information about ISTPs is widespread and readily accessible. The main reason the information is not widely applied is that improving the environmental performance of commercial buildings is generally a low priority for business.
- But there are environmental externalities, where businesses do not take into account the environmental costs of their use of natural resources (particularly the greenhouse gas emissions from burning fossil fuels in electricity generation).
- Market-based approaches are the best way of accounting for externalities, the effects of which will be economywide, flexible and transparent (such as with the tradable emission permits currently being investigated by the Australian Greenhouse Office).
- In contrast, mandatory technical performance standards for energy- or input-efficiency are likely to be distortionary, inefficient and inflexible, targeting only the commercial buildings sector and possibly stifling further innovation.

Overview

Background

Environmental issues such as climate change, local air pollution, and threats to biodiversity are of concern to many Australians. Reflecting these concerns, the Australian government has introduced national policies and made commitments through international agreements to address environmental matters. A significant example is the Kyoto Protocol, through which Australia has agreed to limit the growth of its greenhouse gas emissions.

Commercial buildings form an important part of our built environment and our economy. How they are constructed and operated can affect the environment generally as well as the working environment of staff and clients.

This research study examines the environmental performance of commercial buildings and analyses this within a framework of the broader objectives of firms in the commercial building sector. It discusses the factors that affect a firm's decision-making about issues that impact on the environmental effects of a building. These decisions are made at any stage of a building's life cycle. The study also examines the range of options available to government should it wish to improve the environmental performance of buildings as part of a more general environmental strategy. It focuses on energy use in commercial buildings because energy is typical of 'environmental performance' concerns and because of the potential economywide significance of Australia's response to the Kyoto Protocol.

The way that energy and other resources are used in commercial buildings can have implications for Australia meeting its environmental objectives and commitments. The designers, owners and occupants of buildings can adopt 'input saving technologies and processes' (ISTPs) to reduce a building's environmental impact. Various ISTPs are available during the design, construction, operation and demolition phases of a commercial building's life (see box below).

Input saving technologies and processes (ISTPs)

'Input saving technologies and processes' include all technologies and processes that could be incorporated in commercial buildings during their design, construction, operation and maintenance, and refurbishment or demolition stages to reduce the use of inputs, and thus reduce the building's environmental impact. Examples of ISTPs in commercial buildings include:

- passive features such as increased use of natural light (daylighting), siting of buildings, or flexible design which easily adapts to changing uses of the building over time;
- resource conservation features such as improved insulation, efficient lighting controls, and lower water consumption fixtures;
- staff training in energy efficiency and recycling; and
- increased recycling of building materials and fixtures at the demolition stage.

What determines firms' decisions about ISTPs?

Firms (whether building owners, constructors or tenants) focus on the financial implications of their decisions. Any particular firm's perspective of the appropriate level of ISTP adoption may differ from that of other interested parties.

This report focuses primarily on factors affecting the decision making of firms about the adoption of ISTPs, and why those decisions may or may not reflect broader environmental concerns. Some observers consider that commercial buildings are less 'environmentally friendly' than they should be, because designers and builders do not incorporate enough ISTPs, and that even profitable ISTPs are not adopted.

Firms' decisions about whether to adopt ISTPs depend on the benefits and costs *to the firm* of their adoption. A firm could be expected to invest in a particular ISTP if it is well-informed about the benefits and costs of adopting the ISTP, and if the financial benefits of doing so outweigh the costs. Firms are clearly unlikely to adopt ISTPs that are not profitable to them.

The potential benefits of adopting ISTPs can include savings in input use (such as energy) and productivity benefits if ISTPs contribute to improved workplace conditions and employee productivity.

The main costs of ISTPs are those associated with their purchase, installation and maintenance. There are also several indirect costs. These include hidden costs such as management time spent identifying ISTPs, determining their suitability and allocating resources to train staff in their use. For some firms, ISTPs can also bring an additional risk because they may not be widely accepted or may not have an established record of operational quality.

In addition, for many firms the environmental performance of their commercial buildings is such a low order priority, relative to other demands on management, that ISTP options are not seriously considered. Compared to the range of other costs incurred by a firm, the costs of energy incurred in commercial buildings are often small. As a result, ISTPs are often not considered 'core business'.

Some participants in this study argued that contractual arrangements established between firms to construct, occupy and demolish buildings (such as split recurrent and capital budgets and low design budgets) act as barriers to the adoption of ISTPs. However, these voluntary arrangements reflect the current priorities of the contracting businesses (and the current low priority of ISTPs). They are not immutable arrangements that *determine or constrain* ISTP adoption and may be altered to reflect changing priorities.

Why firms' decisions may not be in the community's best interests

The adoption of ISTPs per se is not an objective of public policy, merely one means towards balancing broader social, economic and environmental goals. It is important to determine whether there are market failures which hinder society's ability to meet these goals. Market failure may mean that environmental outcomes generated by firms' decisions about their commercial buildings are not in the best interests of the wider community. The Commission examined three sources of market failure:

- information deficiencies;
- the public good nature of research and development; and
- environmental externalities.

Where such market failures exist, government initiatives may be warranted to improve the environmental performance of commercial buildings. However any government action should only proceed in cases where the anticipated community benefits of the action exceed the costs.

Information deficiencies

Access to reliable, timely and appropriate information is necessary for firms to make decisions that best promote their interests after taking into account all of the potential benefits and costs of alternative courses of action. To be useful, information must be available, accessible and comprehensible.

Some participants in this study argued that information problems are a key concern and that government should deliberately stimulate supply of information (through regulation such as mandatory labelling) or the demand for information (through mandatory minimum performance standards). Others considered that information from a wide range of sources has been readily accessible for some time, and that there are abundant opportunities to acquire professional information and advice from specialists in ISTPs.

Sources of information include firms that supply ISTPs, architects and other building professionals, independent companies providing advisory services, peak industry groups, and universities and research organisations such as CSIRO. This wide range of sources suggests that the supply of information is responding to needs and demands. As well, this market should be able to respond to changing demands over time as the market for ISTPs develops further.

Public good nature of research and development

Some argue that government has a role to play in supporting research and development on ISTPs. Significant government support is already provided for general research through funding to bodies such as the Australian Research Council and CSIRO. Given this support, there is little evidence that additional research and development funds, directed specifically to ISTPs in the commercial building sector, should be a high priority.

Externalities

Externalities occur when decisions taken by individual consumers or firms have spillover effects which affect other members of society. In the case of ISTPs, their adoption may result in a reduction in environmental damage, the benefit of which accrues to society at large. Because these external benefits are not taken into account by firms when making decisions about ISTPs, their level of adoption may be lower than is socially desirable.

In the case of energy that is highly greenhouse gas intensive, the price charged to firms does not include the environmental costs of its use. To the extent that the price does not reflect these costs, too much greenhouse gas intensive energy will be used, including in the construction and operation of commercial buildings. This is the key source of market failure: greenhouse gas externalities caused by fossil fuel energy production (rather than any market failures inherent in the commercial building market).

What role should government play?

Achieving the targets set in the Kyoto Protocol will have very broad national, multi-sectoral ramifications, particularly in the production and consumption of electricity that is highly greenhouse gas intensive. Commercial buildings are a relatively minor user of electricity and are more likely to be influenced by, rather than drive, economywide energy reforms.

Through the Kyoto Protocol, Australia has committed to significant reductions in the growth of greenhouse gas emissions. Meeting these restrictions will impose significant costs on the economy, regardless of the method used to achieve them. A range of options exist including economywide market based approaches and sector specific regulations. The task for government is to choose those methods that are the most efficient and equitable means to meet the emissions targets.

The most appropriate response to greenhouse gas externalities is to use market based mechanisms to ensure that the price of greenhouse gas intensive energy reflects the social cost of its production. Raising the price of greenhouse gas intensive energy, through market based mechanisms, would provide an incentive for firms to alter the amount and type of energy they use. Firms may respond by investing in additional ISTPs that save energy, or in other ways such as switching to non-polluting energy sources. It would also provide an incentive for firms to re-examine contractual arrangements such as leases between building owners and tenants. Higher energy prices would stimulate the provision of additional information on ISTPs, and would encourage further research into ISTPs.

Alternative means of addressing externalities also exist. These can include setting minimum energy efficiency standards for commercial buildings — an option currently under consideration by Commonwealth and State Governments in cooperation with industry. By requiring commercial buildings to incorporate a certain level of energy efficiency, standards can indirectly address the externalities attributed to commercial buildings and reduce their environmental impacts. As a second mechanism, governments are also considering energy efficiency labelling of commercial buildings.

These regulatory initiatives focus primarily on altering ISTP use per se. In contrast, adjusting the price of greenhouse gas intensive energy to account for any environmental damage may alter ISTP decisions, but would also alter decisions about other activities that involve energy use. Dealing with the environmental consequences of greenhouse gas intensive energy use ‘at source’ means that pricing these externalities affects incentives in all sectors of the economy that use greenhouse gas intensive energy, rather than just the commercial building sector.

Moreover, the flexibility provided by accounting for greenhouse gas externalities in energy prices would allow reductions in greenhouse gas emissions to be achieved at lowest cost. This is because firms with the lowest costs of abatement have an incentive to undertake a larger share of the required reductions. In contrast, other initiatives under consideration such as energy efficiency standards and labelling, if mandatory, impose one standard solution across all firms regardless of their individual cost structures. Such regulations impose real, significant costs on industry, consumers and the economy.

Another advantage of emissions trading is that the costs are both apparent and transparent as they are reflected in the energy prices (and other prices through flow on effects) faced by firms. In contrast, many of the costs imposed by regulations such as standards are hidden.

Governments could also provide support for information and education campaigns and voluntary labelling schemes. These are low cost and do not create economic inefficiencies in the building sector, or between that sector and others.

1 Introduction

1.1 The broader context

Many Australians are increasingly aware of environmental issues. In particular, there is concern about the effects of greenhouse gas emissions, the depletion of both renewable and non-renewable resources, waste disposal methods and threats to bio-diversity. Reflecting these concerns, the Commonwealth government has introduced national policies and made commitments through international agreements to address environmental matters.

In this context, attention has focussed on industries considered to be major users of natural resources or major emitters of substances that cause environmental damage. This study is concerned with the environmental performance of commercial buildings. Environmental resources are used in these buildings at the construction, operation, refurbishment and demolition phases of their life cycles. The environmental performance of buildings thus contributes to the environmental performance of the economy and society.

However, firms that design, build, maintain, operate, refurbish or demolish commercial buildings make their decisions based on a range of criteria, only one of which might be related to environmental concerns. In most cases, firms operate on the basis of financial considerations. Environmental aspects are usually only a separate consideration if they affect financial performance.

It is important to understand the broader goals outlined above when assessing both the actual and potential environmental performance of commercial buildings.

Energy used in commercial buildings may have implications for Australia's agreement to limit its greenhouse gas emissions (see section 1.5). Thus, the environmental performance of commercial buildings is important not primarily as an end in itself but as one means for achieving a broader government objective — minimising environmental damage. It is the contribution of the environmental performance of commercial buildings to these broader social goals that is of interest to policy makers, especially to the extent that commercial behaviour may be inconsistent with these social goals.

1.2 Objectives of the study

The environmental performance of commercial buildings needs to be considered in the broader context outlined above. The terms of reference (page x) for this research study asked the Commission to consider the environmental performance of commercial buildings and to identify impediments and incentives affecting it. The terms of reference reflects a concern that, in some cases, the designers, builders and occupants of commercial buildings may consistently overlook environmentally sustainable features that would be worth adopting.

The objectives of this study can be summarised as being to:

- identify the indicators of commercial building performance used by building owners and/or tenants;
- analyse factors influencing the extent to which environmentally sustainable features are incorporated at the building design, construction, maintenance and management phases; and
- identify any impediments to the improved environmental performance of commercial buildings and how to overcome them.

1.3 The Commission's approach

In preparing this report, the Commission visited a range of relevant organisations and received 27 submissions from interested parties. Three independent, external referees also critically reviewed the preliminary report and the Commission held a roundtable to discuss the preliminary conclusions. These processes, and the organisations involved, are outlined in Appendix A.

As in all its research and public inquiry undertakings, the Commission has taken an economywide view in this study and not focused exclusively on the particular sector under consideration. Many of the incentives and impediments for improving the performance of commercial buildings lie outside the sector — a point raised by many of the participants in this study.

In this report, some relevant examples are drawn from the residential building sector as experiences in that sector may provide useful lessons for the commercial building sector.

Input saving technologies and processes

To consider factors affecting the environmental performance of commercial buildings, the Commission has adopted the term 'input saving technologies and processes' (ISTPs). ISTPs include all technologies and processes that could be incorporated in commercial buildings during their design, construction, operation and maintenance, and refurbishment or demolition phases to reduce their use of inputs, and thus reduce their environmental impact.

'Technologies' refers to new machinery or equipment. 'Processes' refers to management techniques and design features. Examples of ISTPs in commercial buildings are:

- passive features such as increased use of natural light (daylighting) siting of buildings or the design of buildings to be 'loose fit' (so that commercial buildings can more easily be adapted to changing uses over time);
- resource conservation features such as improved insulation, efficient lighting controls, and low water consumption fixtures;
- staff training in areas such as energy efficiency and recycling; and
- increased recycling of building materials and fixtures at the demolition phase (Attenborough 1997, Levin 1997).

As this suggests, ISTPs are diverse. They include physical machinery, new ways of doing things and different approaches to design. They may be relatively expensive to purchase (energy efficient air conditioning) or essentially cost nothing (building orientation). They may be risky new developments (hybrid ventilation systems), or established known methods (window sizing). Finally, it is also possible that some ISTPs are inconsistent: for example, small double glazed windows designed to assist in internal temperature control are incompatible with larger windows designed to maker greater use of natural light.

Technical versus economic potential of ISTPs

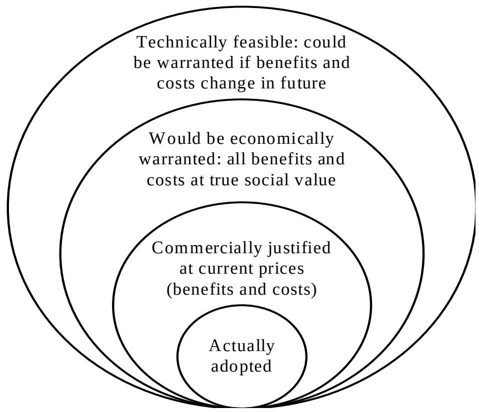
Before considering ISTPs further, it is important to note the difference between their potential technical and economic applicability. Sioshansi (1991, p. 232) summarised the distinction between the two:

> … [technical potential] looks at the *hypothetical* maximum that may be achieved if every energy appliance and end-use device were to be replaced with its latest and most energy-efficient counterpart regardless of the relative costs, commercial availability, customer awareness and predisposition and so on … [real-world market potential]

looks at what is *economically justified* and may reasonably be achievable given what we know about how individual consumers go about replacing appliances and other energy devices with their newer, more-efficient counterparts … Confusing the two [technical and economic potential] can only lead to misdirected efforts, misplaced priorities, disappointment, disagreement, confusion and wasted resources.

Actual adoption of ISTPs can be lower again as illustrated in figure 1.1.

Figure 1.1 **Various levels of ISTP adoption**



1.4 Stakeholders and the life cycle of commercial buildings

Commercial buildings have a finite life. The physical life of some buildings may last only a few decades, while for others it may be centuries. Buildings also have an economic life, which is generally shorter than their physical life.

A commercial building reaches the end of its economic life when tenants' requirements cannot be met by the existing structure or fixtures or when it is no longer financially viable to keep refitting or refurbishing. This will occur despite the fact that the building may have decades of physical life left.

Many stakeholders will be involved with a commercial building over its life. These stakeholders will have varying needs and therefore require the building to meet different performance objectives or desired attributes. The interaction of stakeholders, and their performance requirements, can have a major impact on the environmental performance of a commercial building.

The Athena Sustainable Materials Institute (1998) considers that there are six distinct life cycle phases of a commercial building:

- resource extraction;

- manufacturing;
- on-site construction;
- occupancy/maintenance;
- demolition; and
- recycling/reuse/disposal.

Decisions made at each phase can have important environmental consequences.

Each phase of a building's life cycle involves a range of stakeholders and presents differing opportunities for the adoption of ISTPs. For example, some ISTPs, such as more energy efficient lighting, can be adopted at almost any stage of a building's life cycle. Other ISTPs, such as the siting and orientation of the building, can only be adopted at the design and construction phase of a commercial building's life.

Each stakeholder generally has a set of performance requirements which may, or may not, emphasise the environmental performance of the building, and its components and materials, as important. While many of these requirements may not be explicit, they must be met substantially for a stakeholder to regard the commercial building as suitable for its purpose.

Because the many stakeholders involved in the different phases of a commercial building's life have different requirements, there is no unique set of performance requirements or criteria that defines the one adequate level of building performance. Yet, decisions taken by each stakeholder can influence aspects of performance sought by other stakeholders. The interdependence of stakeholder decisions, throughout all phases of a commercial building's life, is an important factor in the long term performance of buildings. For example, decisions about the adoption, or otherwise, of an ISTP at the design and construction phase can have major implications for the life cycle cost of a commercial building.

Resource extraction and manufacturing

Resources must be extracted, materials processed and refined, and fittings manufactured prior to a commercial building being constructed. Most of these materials, components and the processes used to refine, manufacture and transport them will have some form of environmental impact.

Those involved in the supply and manufacture of materials and components for commercial buildings generally stress the durability, suitability and price competitiveness of their products, rather than environmentally sound extraction and production methods. Constructors of commercial buildings will most likely be unaware of the environmental implications of the materials and resources used in the construction of their building unless there is some special client demand for a particular environmental attribute.

Design and construction phase

This phase of a building's life involves a building initiator who may be the building's future owner and operator, a speculator or a long term investor. The building initiator who starts the process of developing a commercial building generally contracts design and construction to specialist firms.

During design and construction, the initiator is free to adopt all available ISTPs. In fact, this phase presents the only opportunity to adopt some ISTPs, particularly those that primarily affect the building shell, such as orientation to take best advantage of natural light and heat. The quality of design and construction at the initial stage will affect the length of a building's life. This often has financial and environmental consequences.

Operation and maintenance phase

The primary measure of performance for building occupants is the extent to which the building provides a suitable space, location and facilities to support the efficient operation of the occupant's core business.

Those who occupy commercial buildings, either as tenants or owner/occupiers, usually bear the running costs of a building. During this phase, occupants are faced with a building in which some ISTPs are fixed (reflecting its initial design). However, many ISTPs can be introduced after construction. While it may not be financially feasible to upgrade equipment that has not reached the end of its economic life (unless the new equipment offers substantially superior performance), upgrades can occur where they form part of usual building maintenance. Management and process oriented ISTPs are also available. These may include pro-active facilities management to save inputs such as energy. It may also include training staff to make them aware of the impact of their actions on resource use.

The running costs (for inputs such as energy and water) of a building are usually a small proportion of an occupant's total business costs. Other aspects of building performance, such as appropriate location, may outweigh a desire for a building that is efficient in the use of inputs. For example, the speed of lifts may be considered (by the building owner and tenants) as more important than their energy efficiency.

Refurbishment or demolition phase

Owners typically renovate or refurbish their commercial buildings to improve the quality of the premises and the facilities offered to tenants. This might occur as a result of pressure to compete with more modern buildings or to attract a new type of tenant. Refurbishment may also be driven by the need to replace many of the engineering components (for example, air conditioning) and fittings (for example, carpets and lighting) of a building many years before the building reaches the end of its physical life. As a result, refurbishment represents a significant proportion of commercial building activity. For example, in 1994-95, 75 per cent of commercial building work undertaken in Australia included some renovation (ERDC 1996).

Building design may dictate whether the building can be upgraded or whether it should just be demolished. CSIRO (1999, p. 18) noted that: '… upgrading the performance of poor building envelopes is often difficult and much more expensive than efficient new construction'. A commercial building is generally demolished when renovation is no longer viable or economic. This frees up land so a building more suitable to the location, or more suitable to the required use, can be built.

Recycling, re-use and disposal

In the demolition process, recycling or re-use of existing fittings may receive little attention because construction and demolition methods do not usually allow for easy separation of recyclable materials. Materials chosen at the design and construction stage will also affect the recycling rate. But currently, however, there is little incentive during design and materials selection to consider the ease of recycling at the demolition or refurbishment phase. This is exacerbated by the long time that elapses between these two phases.

1.5 Environmental impact of commercial buildings

Commercial buildings have many varied impacts on the environment. The major impacts are associated with the manufacture, use and subsequent disposal of certain inputs, but the effect on local and internal environments of a commercial building can also be significant. Other environmental effects of buildings include atmospheric emissions, water effluent, and solid waste.

In 1990 greenhouse gas emissions attributable to the operation of commercial buildings represented 8.5 per cent of Australia's total emissions for that year. These emissions are growing at annual rate of 5 per cent (AGO 1990a). Greenhouse gases contribute to a global phenomenon known as the enhanced greenhouse effect (box 1.1).

Box 1.1 Enhanced greenhouse effect and government strategies

The greenhouse effect is a normal phenomenon. The *enhanced* greenhouse effect is attributed to the burning of fossil fuels and the release of greenhouse gases. Carbon dioxide concentration in the atmosphere is increasing, trapping heat (normally radiated back into space) and potentially leading to increased global warming.

In response to the enhanced greenhouse effect, industrialised nations signed the Kyoto Protocol, an international agreement to limit greenhouse gas emissions. Australia agreed to limit its emissions in the target period (2008–2012) to no more than eight per cent above 1990 emission levels. When ratified, the Kyoto target will become legally binding. Australia has in place a National Greenhouse Strategy which contains three key goals: limit net greenhouse gas emissions in accordance with Australia's commitments; foster knowledge and understanding of greenhouse issues; and develop adaptation responses to climate change.

Sources: World Bank (1990); CoA (1998).

In addition to potential impacts on greenhouse gas emissions, commercial buildings can have environmental effects through the use of other resources. For example, commercial buildings are a major source of waste, generated at all phases of a building's life. Construction waste includes material such as concrete, bricks, and fittings (which may be recyclable).

The materials used to construct a commercial building may also have been produced using environmentally damaging processes. Some materials used in construction can contain high levels of embodied energy (box 1.2).

Box 1.2 Embodied energy

Embodied energy refers to the total energy used over a product's life. This may include energy used to mine the product's components, to process the materials, to manufacture the product, to transport it to site and possibly even the energy used in its disposal.

Commercial buildings may contain significant amounts of embodied energy. Estimates of embodied energy associated with a typical commercial building range from equivalent of around 30 years (or more) of operational energy to 6 to 8 per cent of whole of life emissions. Efforts to reduce embodied energy could be important for minimising the environmental impact of commercial buildings.

Sources: CSIRO (sub. 18); David Ness-Chang (sub. 8), EMET Consultants and Solarch Group (1999).

As well as affecting the surrounding environment, the design, operation and maintenance of a commercial building also impacts on the amenity of the building's internal environment. This can have implications for occupants' health. For instance, materials such as carpets may be backed by synthetic latex, which may emit a number of toxic gases (Best 1997). Similarly, techniques adopted for lighting, air conditioning, heating and so on may also impact on occupants' health and may affect productivity.

Focus on energy use

While all of the environmental impacts outlined above are important, in the rest of this report, the Commission focuses on energy use in commercial buildings. There are several reasons for this approach. The first is to keep the task manageable. The second is that greenhouse gases, and Australia's response to the Kyoto Protocol, are an important concern for policy makers. The third reason is that greenhouse gases may be seen as representative of a whole class of environmental problems. Therefore, responses to limit greenhouse gas emissions efficiently and effectively may be relevant to policy discussions in other areas of environmental impact.

1.6 Measuring a commercial building's performance

This report does not attempt to assess directly the performance of commercial buildings in an environmental, or any other, sense but examines the framework within which performance is judged. Appendix C examines the methods and lists some of the indicators used by the industry to assess the performance of commercial buildings.

Performance indicators are commonly used to focus on different aspects of building service, such as the inputs used or the outputs produced. It is important to obtain a wide range of information when measuring the performance of commercial buildings, particularly given the diverse performance requirements of the different stakeholders. Stakeholders often seek performance information in areas such as: up-front costs; location; staff and/or customer comfort; health and safety; and ease of upgrade/alteration. Analysis of performance information on these different aspects can be used to assess the effectiveness and efficiency with which a commercial building's services are provided.

For those involved in construction, performance measures focus on production issues rather than the ongoing operation of the building. Performance indicators used to measure building performance from a tenant's (and manager's) perspective are typically broader, reflecting a more diverse range of objectives.

Environmental performance of commercial buildings

For stakeholders in the building sector, environmental performance may be only one of a number of aspects of performance that may be of interest. Moreover, its significance among a range of performance criteria will vary depending on the stakeholder involved.

Firms may be motivated to improve the environmental performance of commercial buildings for a range of reasons, from the purely financial to notions such as corporate environmental leadership. Firms concerned with the environmental performance of their buildings can use a variety of measures to assess this performance including:

- thermal performance of the building fabric;
- feasible technical improvements to the heating, ventilation and air conditioning (HVAC) systems;
- the management and maintenance of, and operational improvements to, HVAC systems;
- feasible technical improvements to lighting;
- the management and maintenance of, and controlled improvements to, lighting;
- efficiency of hot water services;
- efficiency of lifts; and
- other services, plant and equipment.

1.7 Structure of the report

The next chapter contains a discussion of factors affecting the environmental performance of commercial buildings, while chapter 3 examines various means to improve this performance. Chapter 4 presents the Commission’s conclusions.

2 Factors affecting the environmental performance of commercial buildings

This chapter examines the factors that influence firms' decisions about the adoption of input saving technologies and processes (ISTPs), because these decisions by firms largely determine the environmental performance of commercial buildings. The nature and scope of decisions about ISTPs varies according to whether the building is at the design, operation, or renovation or demolition phase. Because of the interdependence of these phases (discussed in chapter 1), overall or life cycle performance may be enhanced by communication between firms throughout all the life cycle phases. First however, the chapter looks at decision making by individual firms. It then considers what is the 'appropriate' environmental performance of these buildings from an economywide perspective and compares ISTP outcomes generated by firms' decisions against this broader perspective.

2.1 The firm's decision making framework

A firm's decision to invest in ISTPs, that should improve a commercial building's environmental performance, is based on the benefits and costs that the ISTPs are expected to generate for the firm.

Benefits of adopting ISTPs

ISTPs generate both public and private benefits, but many of the benefits of private investment in ISTPs accrue to wider society. For instance a firm which invests in an energy saving technology generates private benefits through decreased running costs, and public benefits through the resultant decrease in greenhouse gases.

The public benefits generated by ISTPs are important. But they may not significantly influence ISTP adoption because they largely accrue to the community rather than the individual firms that make ISTP decisions. The National Electrical and Communications Association (NECA) (sub. 15, p. 5) noted this:

> The common beneficiary [of ISTPs] is the greater community, who benefits from:
>
> - Reduction in Greenhouse gases

- Reduction in demand for fossil fuels
- Reduction in demand for water
- Reduction in the need for waste water disposal.

> The Owner Occupier and Lessee will benefit from a reduced expenditure basis only … the benefit to these "users of the inputs" is marginal at best.

As firms usually make decisions about their investments on the basis of private costs and benefits alone, the Commission has paid particular attention to the way firms make ISTP decisions and the factors affecting them.

The main benefit to the firm of adopting ISTPs at the design or operation and maintenance phases of the life cycle is the savings in costs brought about by a reduction in the inputs (such as electricity) required to operate the building. These savings represent the most recognised and quantified benefit of buildings that incorporate higher environmental standards. Attenborough (1997) noted that naturally ventilated buildings typically use 50 per cent less energy than that used by fully air conditioned buildings. The Royal Institution of Chartered Surveyors, Queensland Branch (sub. 5, p. 8) also noted that these savings are the main incentive for firms to adopt ISTPs:

> The motivation for ISTs [ISTPs] is the saving in operating cost … If there are no significant demonstrable savings then it is highly unlikely that any scheme will be initiated.

Another benefit to the firm of adopting ISTPs at any phase of the building's life cycle may be positive publicity, or an enhanced public image, from constructing or occupying an environmentally sound building or from demolishing and disposing of it in a way that minimises environmental damage. In terms of a return on financial assets, these benefits are difficult to quantify. Nevertheless, many firms voluntarily promote environmental aspects of their activities which implies that they consider this is of value to some clients. In a similar way, some firms may incorporate or implement ISTPs to anticipate and avoid criticism and liability in the future. However, this may be more important for firms occupying high profile buildings, or for firms involved in industries where environmental issues are highly visible.

A further benefit of adopting ISTPs can be the intangible benefit that a building owner or occupier may obtain by acting in a way that reduces harm to the environment. This could be significant, albeit difficult to quantify, if the firm or decision maker is motivated by 'green' issues.

Some authors (for example, Pye 1998) consider that improving the environmental performance of buildings also improves workplace conditions and the productivity of staff. Supporters of this view argue that environmentally sustainable buildings can provide more pleasant, healthy and attractive work environments than those provided by conventional buildings. While the potential impacts of ISTP adoption on workplace productivity are difficult to quantify, if beneficial, they are likely to far outweigh benefits achieved through input savings. The Australian Cooperative Research Centre for Renewable Energy (sub. 13, p. 4) noted this potential:

> … there are often intangible benefits which may be significant … but can not easily be quantified. The most obvious of these is improved amenity of a commercial building, which, if it leads to improved worker productivity, can have a huge value owing to [the] high costs of people compared to energy.

Similarly, the Department of Architectural and Design Science, University of Sydney (sub. 14, p. 2) referred to UK research suggesting that 'occupant satisfaction is often highest in buildings that are low in energy consumption'.

Costs of adopting ISTPs

The major cost for firms adopting ISTPs is that of acquiring and adopting the technologies and/or processes, although ISTPs do not always increase the capital cost of a building (National Electrical and Communications Association, sub. 15). Apart from the direct costs of adopting ISTPs, indirect or 'hidden' costs may include lost production through downtime while the technologies or processes are being implemented, or the costs of training staff to use ISTP features correctly (see section 2.2). Additional costs and delays may arise when preparing designs that incorporate better energy efficiency or reduced input use. There is also the opportunity cost of investing funds in ISTPs instead of investing these funds in another activity.

From the firm's point of view it is optimal to invest in ISTPs, and thus improve the environmental performance of a commercial building, only if the benefits from doing so exceed the costs. Firms therefore, would be expected to adopt all ISTPs that are cost effective or profitable, provided that firms make well informed decisions and that markets operate reasonably well. However, the conditions needed to achieve this result may not be met in practice (see section 2.4).

2.2 Factors affecting the firm's adoption of ISTPs

Various factors affect a firm's benefit-cost decision about adoption of an ISTP:

- costs which are 'hidden' to external observers but are relevant to the firm making the ISTP decision;

- the greater risk associated with many ISTPs over conventional technologies, which may hinder their adoption;
- the often minor component of the firm's activities accounted for by energy and other inputs used implies they (and mechanisms to reduce them) can be a low priority for management attention; and
- the use of evaluation tools.

These factors are often reflected in the discount rates or payback periods that firms apply to their ISTP investments.

Hidden costs and benefits

An analysis of an ISTP would essentially compare the initial purchase price of the technology or process to the savings stream it is expected to generate in future. However, a firm choosing whether to adopt an ISTP would also consider a broader range of benefits and costs. Some of these are described as 'hidden' because they are not immediately apparent and because they do not necessarily form a part of the ISTP itself.

The costs of acquiring and processing information about ISTPs represent a significant example of hidden costs. They include the costs of collecting information about ISTPs from various sources, analysing how ISTPs affect a commercial building or fit in with other operations, and conveying this information to key decision makers in the firm. ABARE (1998, p. 56) suggested that these processing costs can be significant and can create an 'inertia in favour of the status quo'.

In the context of individual decisions about the purchase of energy-related durable goods, Chernoff (1983, p. 84) summarised why the costs of searching for information can have a significant bearing on their adoption. This is also applicable to a firm's ISTP decisions:

> … to evaluate energy efficiency, the consumer must obtain and evaluate information that would otherwise be of little value. This task imposes a search cost on the buyer. If the individual does not expect the energy savings to be worth the costs of the search, or if the individual is unable to evaluate conflicting claims for costs and benefits, he has no economic basis for searching …

Of course, instead of searching for information themselves, firms can employ specialists, such as energy consultants, to provide the information required. However, as this involves paying some fee to a specialist, it is another form of search cost.

Other hidden costs of adopting ISTPs are:

- *decision making or administrative costs* — assessing the range of potential ISTPs suitable for the task may require the use of significant resources such as funds and staff or management time;
- *disruption costs* — installing ISTPs in an existing building (rather than in the design phase) may involve costs from disrupting day-to-day activities;
- *training costs* — staff often need to be trained in the operation of new equipment or procedures and further effort and cost is incurred to update staff skills;
- *monitoring costs* — incurred when new technologies and processes are monitored to ensure they are correctly implemented and that they operate satisfactorily; and
- *assessment costs* — incurred when ISTPs are evaluated post-implementation to ensure that projected cost savings are actually being achieved.

The adoption of many ISTPs may also produce hidden benefits. An example mentioned earlier is improved worker productivity from measures such as the increased use of natural light. Hidden benefits may be large, but they can also be uncertain and difficult to measure. This may limit the extent to which they are considered in firms' decisions to adopt ISTPs. In contrast, firms (especially if risk averse) are likely to give greater weight to certain costs (even those that are hidden) rather than uncertain productivity benefits (see section on 'risk and uncertainty' below).

A recent guide released by the Australian National Audit Office et al (1999) provides an example of how hidden costs can easily be overlooked. The Office's guide to better energy efficiency practice in Commonwealth operations provides examples of energy and operating cost savings (benefits) for a single large building. The following examples stated that the cost of these initiatives was 'immaterial':

Energy efficiency initiatives	Annual saving ($)	Energy saving	Cost ($)
Installation of automatic lighting controls	3 000	0.20 GJ	Immaterial
Control of lighting available and changes to the building cleaning hours of operation	3 500	0.23 GJ	Immaterial

Certainly the financial costs may be immaterial as little or no new equipment is required. However the total cost of implementing these initiatives incorporates additional elements as discussed above.

Risk and uncertainty

Some ISTPs do not have as lengthy a history of commercial application as 'conventional' products. While this does not imply that newer products or processes are necessarily inferior to existing products, it can mean that there may be additional risk and uncertainty associated with their adoption.

Firms generally require a premium to bear risk. A higher risk requires a higher premium. This premium often manifests itself in tougher criteria for selecting any activity that is considered risky. In terms of ISTPs, several risks can be identified:

- market risks;
- risks in the marketability of the building;
- risks of technology failure; and
- risks of change to the building's purpose.

Market risks

Adoption of ISTPs is subject to several market risks such as uncertainty regarding the future price of inputs and the inherent risks of the business cycle. The Royal Institution of Chartered Surveyors, Queensland Branch (sub. 5, p. 8) highlighted the effect of uncertainty relating to future input prices:

> The uncertainty in the market does make it more difficult to perform meaningful analysis of cost and energy saving measures. Until the market becomes more stable in pricing terms, analysis of these schemes will need to show a greater level of saving or risk margin than might otherwise have been the case.

Due to these risks, firms may expect ISTPs to produce a rapid payback. For instance, in the case of retrofitting ISTPs:

> Most developers look for a simple payback of less than 12 months. Two to three years is probably the most that can be expected to be considered even marginally interesting. ISTs [ISTPs] with a longer payback period are considered poor risks in the light of uncertainties inherent in the business cycle. (Department of Architectural and Design Science, University of Sydney, sub. 14, p. 3)

Risk in the marketability of the building

An owner may be reasonably certain of the prospect of selling or leasing a 'conventional' building that has a well established market, but the marketing of a building incorporating ISTPs may be more risky. This risk is particularly relevant if it must be put on the market at a higher price than broadly comparable buildings (to compensate, if necessary, for any additional costs incurred in adopting ISTPs). The Department of Architectural and Design Science, University of Sydney (sub. 14, p. 4) noted the risks associated with marketing a building incorporating ISTPs:

> Risk Attempting to use new input saving technologies involves substantially increased risk to marketability of buildings and is not attractive to developers unless some exceptional reward can be confidently predicted.
>
> Real estate industry inertia Real estate industry advisers to developers are well aware of the extra risk attached to the marketing of unconventional technologies and will exert pressure to avoid them.

The Department (sub. 14, p. 10) also commented:

> The building and real estate industries are highly conservative. Proven technology carries a substantial premium because the risks are low and well defined. There have been notable disappointments in energy saving technologies … and the industry has a long memory for them. [but] A prestigious name can be used to force change …

To offset potential risks associated with marketability, initiators or developers may design and construct buildings that appeal to a broad market:

> … the tighter the "fit" [of a commercial building], the smaller the market niche and the higher the risk arising from not being able to let the space ...
>
> To offset this risk the building is made more generic to appeal to a wider market and so be easier to let. This lack of knowledge of tenant requirements also mitigates against the introduction of input saving technologies which are perceived as appealing to a smaller segment of the market. This is particularly the case where input saving technologies are associated with increased initial cost (borne by the building initiator) leading to decreased operational costs (borne by the tenant).
>
> If the building initiator perceives there to be a limited market for, or appreciation of, input saving technologies, then to incorporate them into the building increases risk. (Australian Council of Building Design Professions Ltd, sub. 16, p. 8)

Another aspect of this risk is that many ISTPs implemented at the construction phase require ongoing management and maintenance to realise their benefits. Zoned lighting control systems (that allow users to isolate lighting only to those areas of the building in use) are an example. They require users to be familiar with the purpose and method of their operation. If the purchaser or lessee does not have staff or resources to ensure proper use of the ISTPs a building contains, they will not be prepared to pay a premium for a building that incorporates them. If this occurs, the cost savings (or benefits) associated with the ISTPs may not be capitalised into the selling or leasing price, and the firm that invested in the ISTPs may not realise a return on the investment. According to the Building Division, Queensland Department of Public Works (sub. 4, pp. 10–11):

> There appears to be little incentive for tenants to pay higher rentals for the increased capital cost of sophisticated ISTs [ISTPs], if the input savings are not very substantial.
>
> A developer generally wants to achieve the lowest cost possible in the construction of a building. It may be that the installation of IST's [ISTPs] is not cost-effective in terms of what the market will pay for the completed building. Similarly, an owner will generally want to extract the maximum market rent for the building and state-of the-art IST's [ISTPs] may not increase rental levels at all. However, the owner will benefit from IST's [ISTPs] in the form of savings on non-recoverable building outgoings i.e. the owner's direct operating expenses.
>
> A scenario could also exist where one tenant may want ESD compliance and another may not. This could also constrain the uptake of IST's [ISTPs].

Risk of technology failure

If an ISTP represents a new technology or process, it is likely to have undergone less testing in an operational context than would have an established or well accepted technology or process. The ISTP may have a higher failure rate or possess greater variability in the quality of its operation or, at the very least, information and operational evidence on these variables may be less widely known or certain (box 2.1 provides an example).

The reliability of the ISTP can be an important decision variable. For example, service providers such as hotels generally require highly reliable heating and cooling systems. An ISTP in the form of a newly released energy efficient system may not have a proven track record of reliability. If reliability is a paramount concern, the benefits of potential input savings may not outweigh the risks of technology breakdown. The costs of possible system failure would be significant for such firms:

> Risk is important. Many ISTs [ISTPs] are new and unproven. Should a commercial building fail due to IST failure, the large potential liability would be unacceptable to most owners. Proven technology only is likely to be acceptable unless the IST cannot cause the building to become unusable through the IST's failure. (Building Division, Queensland Department of Public Works, sub. 4, p. 9)

Box 2.1 **Hybrid ventilation (HybVent)**

Mechanical methods are most commonly used to create a comfortable and stable internal building environment. These systems use large amounts of energy. Hybrid ventilation systems are dual modal systems of building ventilation that incorporate both mechanical and natural elements.

HybVent systems incorporate features such as windows that can be opened and systems that allow untreated external air to be drawn into the building (if desired). These systems may substantially reduce the energy needs of commercial buildings and could also provide benefits by producing a more comfortable environment for occupants. Despite the potential benefits and advantages of these systems, there are several impediments to their use:

- they are difficult to retrofit as they usually require a fully integrated building design;
- developers have an aversion to new, untried systems; and
- the system requires extra research and modelling to ensure its success.

Fire protection requirements in the Building Code of Australia may also impede their use because the Code requires compartmentalisation (to control the spread of fire) whereas HybVent systems require open buildings to promote air flow.

Source: Commercial Building Energy Forum 1999 in Department of Architectural and Design Science, University of Sydney (sub. 27).

Risk of change of building purpose

The purposes for which buildings are used, and how they are used, change over time. In this context, there is an incentive for developers and building constructors to build relatively simple and readily adaptable buildings. This may not always be consistent with application of the more complex ISTPs. However this approach can be environmentally beneficial if it reduces the need to build new, purpose built commercial premises at a later date. The State Office Block in Sydney was an example of how inflexible building design can generate excess waste:

> Sydney's State Office Block was designed in 1967 in an era when the size and position of offices was correlated to the Public Service's staff grading system … [it] duly adopted a structural grid of closely spaced columns that defined the placement of the partition walls of the offices. The problem was that the functional life of the building … far exceeded the model of workplace design on which it was based. It was demolished in 1998, one of the major reasons given by the building's owner being that the preponderance of columns made it incompatible with the requirements of contemporary open space office design. While the technology existed in the 1950s to produce large clear span spaces, in this case the cultural imperative did not. The result was a building locked into its era, which was then rejected by a later era. (Eco Design Foundation sub. 3, p. 9)

This example illustrates the longevity of commercial building assets and the notion that decisions about ISTPs or other elements of building design have far reaching implications. Uncertainty about the future use of a building may create an incentive for constructing simple, alterable commercial buildings rather than complex, innovative, but specifically designed, ISTP laden buildings.

Low energy costs

Chapter 1 highlighted a range of stakeholder concerns for the performance of commercial buildings. Environmental performance is just one of these.

Firms have limited management time to dedicate to the assessment of investment opportunities, the examination of costs, or the design and implementation of programs. As a result, firms generally focus on their core business and the most significant cost areas. Currently, inputs such as energy use in commercial premises often represent a minor component of these costs (box 2.2). Grubb (1990, p. 785) noted this almost ten years ago:

> *Lack of interest in peripheral operating costs*. Energy costs are often a small part of personal or business expenditures. People may simply not be interested in them, and cannot be bothered to take steps to save money in this area. Cost-effectiveness is not the only criterion; 'cost relevance' is also required. The attitude may be crudely summarized as one of '*don't know and don't care*'.

If environmental performance of commercial buildings is a low priority, this can have very significant implications for adoption of ISTPs. It can mean that even profitable ISTPs are not adopted simply because firms do not get around to assessing their potential benefits and costs or their commercial applicability. Eyre (1997, pp. 36–37) summarised this by saying:

> Priority is given to output and the productive process, which is the raison d'être of the company; other issues such as energy efficiency are peripheral, so their potential is not exhaustively investigated, whatever the potential effect on profitability.

Box 2.2 Cost savings from implementing energy ISTPs

Energy costs can be a small component of total building costs. The Building Division, Queensland Department of Public Works (sub. 4, p. 10) stated:

> Because the operating costs associated with a tenancy are a small fraction of the rent cost, most tenants concentrate on lower rentals to achieve savings … a 10 per cent rent saving can typically equate to a saving of $30/m². A 10 per cent saving in electricity, cleaning, etc. might deliver savings of only $3/m^2.

The Department of Architectural and Design Science, University of Sydney (sub. 14, pp. 3–4) stated:

> … energy ranks very low in the hierarchy of costs associated with constructing and operating a building. The last energy Report published by the Property Council in 1995 suggested a target cost figure for owner's component of energy at just under $14 per m^2. If tenant energy is assumed as 40% of the total it will amount to about $12 per m^2. A comparison with other costs is as follows:-
>
> - Owner's component of energy cost say $14 per m^2 per annum.
> - Tenant component of energy cost say $12 per m^2 per annum.
> - Construction say $1,000 to $2,500 per m^2.
> - Rental say $150 to $800 per m^2 PA.
> - Cost of average employee say $4,000 per m^2 per annum.
>
> A saving of 10% on total energy consumption would yield a cash saving of about $2.50 per m^2 per annum. This is hardly a sum to excite serious interest.

The low priority or attention given by firms to environmental issues has implications for ISTP adoption across the whole building chain from design to maintenance to demolition. If environmental performance does not rate highly relative to other issues, there will be little demand for buildings to incorporate ISTPs in the design phase. If tenants are not particularly interested in the environmental performance of their accommodation, such performance will not be a selling point for a developer or owner marketing a building. The developer has an incentive to supply buildings incorporating the features that tenants most prize, such as location, proximity to clients, suppliers and public transport, or an impressive looking facade or lobby. Through flow-on effects, ISTPs are therefore unlikely to feature highly in the developer's list of priorities. The Ecological Architects Association (sub. 23, p. 1) noted this:

> A look across the spectrum of new office buildings would show that it is the marble culture of expensive materials, tasteful design and an excellent location that dominate discussions about a building's design.

Overall, '… ISTs [ISTPs] do not rank highly in the priorities for design of commercial buildings against such issues as location, access to views, image, capital cost and rental income' (sub. 14, p. 8). The low priority attached to energy efficiency in commercial buildings is of long standing. In 1988, a study of the barriers to energy efficiency in the industrial and commercial sectors conducted by KPMG (p. ii) found:

> Energy was generally assigned a low importance relative to other operating expenses. For the Victorian manufacturing sector for 1983/84, energy expenses averaged 2.3%. As a consequence, energy efficiency was assigned a low priority versus other areas competing for managerial attention.

Many firms do not regard energy efficiency and other aspects of a building's environmental performance a high enough priority to even be a factor in their choice of building. Appendix C discusses the tradeoffs between different objectives when assessing the performance of a commercial building.

If, in future, energy prices were to rise, one result might be that firms would pay more attention to energy use in their commercial buildings and therefore might devote more time and resources to considering ISTP options.

Use of evaluation tools

Some observers argue that firms apply discount rates to ISTP investments that are 'too high' or that firms expect excessively short payback periods, and that this implies there is a failure in the market for ISTPs. More extensive use of life cycle costing is at times raised as a possible means to promote adoption of ISTPs.

Payback periods and discount rates

Firms use a range of assessment tools to evaluate the viability of ISTP investments. Two common methods involve the use of payback periods and discount rates. A survey of participants in the Commonwealth Government's now defunct Enterprise Energy Audit Program (ABARE 1998, p. 39) found that: 'By far the most widely used decision making rule is the payback period'. In a study of small to medium enterprises the Bureau of Industry Economics (1996, p. 26) found that '… the firm's payback period … seems to be the crucial decision variable'.

The payback period is the period of time required for the return on an investment to fully cover initial investment costs. However, it can be a flawed measure as it does not account for the magnitude of benefits after the initial investment is repaid, nor does it discount for benefits that are accrued in the future.

A discount rate can be used to express the expected future costs and benefits of an investment in their equivalent in the present period. Economic theory would suggest that the most appropriate discount rate is the weighted average cost of capital (depending on the firm this may be around 8 to 18 per cent).

Some researchers have attempted to estimate the apparent discount rate used by decision makers for ISTPs. Train (1985) reviewed estimated apparent discount rates for consumers making energy-related *household* decisions, and found:

- measures to improve thermal integrity of dwellings — 10 to 32 per cent;
- space heating system and fuel type — 4.4 to 36 per cent; and
- air conditioning — 3.7 to 22.5 per cent.

It is difficult to determine whether apparent discount rates reflect higher discount rates than theory would suggest, or whether they diverge from the weighted average cost of capital for a variety of reasons, such as risk.

Discount rates applied to ISTP or energy efficiency investments can appear excessive when compared with an average interest rate for borrowing (the benchmark usually used to determine an appropriate discount rate), but as Chernoff (1983, pp. 81–3) pointed out:

> Most life cycle analysts, however, ignore the imperfections and risks and assume a discount rate based on the individual's interest rate for borrowing or lending … Such a rate assumes that buying an energy-related durable is as safe and secure as putting money in a perfectly liquid, perfectly controllable, insured bank account. As observations of durables prices and purchases make clear, this discount-rate assumption could hardly be farther from the truth … high discount rates (and short payback periods) are consistent with economic theory. Economists have long recognized that market imperfections, uncertainty, risk, and a host of other variables increase discount rates.

Chernoff (1983) suggested that rates could be expected to be above market rates for several reasons:

- investments in durable goods are illiquid — a premium is required to entice a firm to forgo liquidity;
- these investments involve a higher risk than lending or borrowing;
- the value of these investments depends on the price of energy — while the supply and price of energy fluctuates a premium must be added for uncertainty;
- if the firm must borrow to invest and is unwilling or unable to do so, this implies a high discount rate;

- the possibility of rapid obsolescence or technological change also raises the discount rate if firms believe that they may incur a financial penalty for not waiting until an improved model is available;
- the possibility that the firm will not reap all of the future benefits of the durable good further raises the discount rate —life cycle costing evaluates benefits and costs over the physical life of the durable good but the owner may only evaluate these over the period she or he expects to own the item; and
- if building occupants tend to move often, say every five to seven years, then energy related benefits occurring 10 to 20 years in the future will have little present value.

Some of these reasons reflect hidden costs and risks which were discussed earlier.

However, other authors express concern that the use of 'excessive' discount rates may well bias investments away from those which are socially beneficial:

> Discount rates that include loadings for risk, uncertainty or investor attitudes are now generally discredited. Discount rates in excess of the weighted cost of capital are in direct conflict with sustainable development goals, lead to intergenerational bias and impede adoption of solutions that deliver long term benefits. (Langston, 1994)

Payback periods and discount rates suffer from several flaws, and there is some confusion about their use. The Commission has avoided using them in its analysis, focussing instead on factors that may affect the discount rates implicitly selected by firms.

Life cycle analysis and costs

It has been argued that broader use of more sophisticated decision making tools, such as life cycle costing, could promote the adoption of ISTPs. The Building Research Association of New Zealand (sub. 21, p. 4) considered that performance could be improved through the use of '… life cycle cost techniques, particularly in the design phase'. Life cycle analysis is a method for estimating the total costs and benefits associated with an asset over its useful life. It can be defined as:

> … the total cost of a system or product over its full life, including design and development, production, operation, maintenance and support, retirement and disposal … All costs should be considered, regardless of funding source or management control. (ANAO 1998, p. 69)

This tool is designed to ensure that decision makers account for all the costs of a decision rather than considering only the purchase price of an item. It marries the initial capital cost or outlay with long term recurrent operating and maintenance costs (using the appropriate discount rate) to develop the true cost of a proposal over its full life cycle.

Life cycle costing is a more sophisticated costing technique than a simple comparison of the up-front capital outlay of competing proposals. However, reflecting its relative sophistication, it is more expensive and time consuming to undertake. This may act to preclude its use in certain circumstances:

> LCC [life cycle costing] is not feasible for whole-of-building options comparisons in the design process because of the detailed information input required for meaningful results. Clients are also often reluctant to commit additional fees or time for full LCC analysis. (NSW Government, sub. 25, p. 4)

Information about life cycle costing analysis is available. The NSW Department of Public Works and Services has published comprehensive guidelines on life cycle costing, and software solutions are also available in the marketplace (such as LIFECOST) to perform such analyses. Case studies have been undertaken on actual projects, such as Albion Park High School, and the methodology has been used on projects such as the Olympic Stadium at Homebush Bay (DIST 1998). Yet, the Department of Architectural and Design Science, University of Sydney (sub. 14, p. 6) considered that widespread use of the technique is uncommon:

> Life cycle costing is a useful technique for achieving a balance between first [up-front] and operating costs. It is believed that it is used only on the largest and most prestigious projects because of pressures on the construction bottom line and on design costs.
>
> Some large financial organisations are likely to require lifecycle costing of options when the building is intended to be held as a long term investment. Speculative developers whose only interest is the construction bottom line would not be prepared to pay for this service.

The Australian Council of Building Design Professions (sub. 16, p. 12) held a similar view, noting that ‘Life cycle cost assessments are more likely to be requested by long term building owners such as government, property trusts, hospitals, etc’.

The Eco Design Foundation (sub. 3, p. 8) considered that life cycle costing is a technique that is not well understood:

> It needs to be pointed out that there is still a very limited understanding of life-cycle costing in the industry (and among most quantity surveyors). Rarely is a quantity surveyor asked to cost building construction, plus ongoing operation over a designated period, plus end of life materials recovery (the fact that the latter, when it is rarely considered, is referred to as ‘scrap’ or ‘salvage’ is in itself indicative of short term thinking).

However, life cycle costing is a core competency for professional advisers such as quantity surveyors (Australian Institute of Quantity Surveyors 1998). This suggests that reasons other than a lack of understanding may better explain why it is not widely adopted. A possibility is that if ISTP decisions are a low priority, firms are unlikely to commit to the additional work associated with life cycle costing or other sophisticated costing or decision making tools.

2.3 Contractual arrangements affecting ISTP adoption

Contractual arrangements between firms involved in the procurement, occupation, maintenance and demolition of commercial buildings can affect ISTP adoption.

Split budgets

Some submissions argued that the split in budgets between capital and recurrent expenditure (more prevalent within government procurement) impedes the adoption of capital intensive ISTPs. A split in budgets between expenditure categories (such as an accommodation budget versus the marketing budget) is another variation of this potential problem. The Sustainable Energy Industry Association argued (sub. 17, p. 4):

> Budget considerations also act as an impediment in many cases. Recurrent and capital budgets are often separated resulting in savings made by a capital investment being kept by a department or division other than that which made the investment meaning that the savings are not available to repay that investment and/or the investing party not being able to receive the benefits of that investment.

In contrast to a process allowing joint consideration of capital and recurrent budgets, a separation of these budgets can make it difficult for decision makers to focus on life cycle costs (South Australian Government, sub. 26). While such mechanisms for allocating budgets may impede investment in ISTPs, this would occur with any type of capital expenditure that produces savings in the future. Thus the distortionary effect of organising budgets in this way would influence a range of decisions not just those related to ISTPs. The introduction of more sophisticated accountability and reporting frameworks (such as output based budgeting) in government is likely to reduce the hampering effects of this arrangement as noted by the South Australian Government (sub. 26, p. 13):

> The more recent development of output based budgeting in government is now providing a much more certain link between the building assets and the service delivery outputs they support.

The Building Division, Queensland Department of Public Works (sub. 4, p. 11) also noted:

> There is a clear separation of capital and recurrent budgets in the Queensland Government sector. However, the adoption of accrual output budgeting will require that all asset-related costs be identified at the project initiation stage for the whole life of the asset. This factor will enhance adoption of ISTs [ISTPs] because the financial costs and benefits will be clearly apparent.

The move towards output based and accrual budgeting highlights that this type of impediment to ISTP, or other capital investment, can be altered if there are sufficient advantages from doing so. An organisation is unlikely to change its method of allocating budgets solely to improve its decision making about ISTPs in its commercial buildings. However, it may make such a change for other 'core' business reasons, and thus indirectly also remove a potential impediment to ISTP adoption.

Selection process for building designers and constructors

Several submissions considered that the process typically used to select design professionals such as architects, interior and landscape designers, engineers and quantity surveyors leads to a reduced emphasis on ISTPs. This argument particularly relates to low budgets available for the design aspect of the construction process. It is argued that low budgets do not allow scope for the creativity, additional design and further research and analysis required to identify and introduce ISTPs:

> One of the main barriers to implementing IST&Ps in new construction is the diminishing consultant design component of building projects. Reduced competitive design fees and compressed deadlines work against assessing IST&Ps and exploring innovative approaches. (Energy Efficiency Victoria, sub. 7, p. 2)

The Department of Architectural and Design Science, University of Sydney (sub. 14, p. 4) had a similar concern:

> <u>Intense price competition for design services</u> The current practice of inviting tenders for design services brings intense pressure to bear on consulting architects and engineers to minimise costs. Consideration of options and integrated team design both exert upward pressure on costs and the tendency is to reduce these services. This leads to compartmentalisation of design with each party in the team seeking to produce the lowest cost solution without consideration of its effect on the work of other members.

A limited design budget is likely to affect opportunities to identify ISTPs for the project. And, in fact, a seriously compromised design budget is likely to have negative implications for all aspects of design. But, it is not clear if budgets are limited *because* building initiators do not expect or require designers to identify and propose ISTPs. Some clients may seek only basic design services (at lower cost) rather than innovative or original solutions to meet their building requirements. This would be reflected in their design briefs and in the budget they allocate to the task.

Other clients may place more priority on the quality or uniqueness of the design task over its cost. Or they may have other objectives, such as environmentally sustainable design, as a primary criterion for awarding a contract (box 2.3). In these cases, the need to contain financial costs may be subordinate to achieving these other goals. For example, the Australian Council of Building Design Professions recommends the use of qualification based selection as the most objective method for selecting a building and construction design professional. This method recommends selecting a design consultant on the basis of attributes such as skills and qualifications, reputation, and experience on similar projects with fee negotiation occurring *after* a consultant has been selected. This method places emphasis on attributes other than price as the primary consideration for selecting a consultant. The South Australian Government (sub. 26) sees qualification selection as a way to reduce the risk of sub-standard design and construction.

Box 2.3 **Novotel/Ibis Hotel (Homebush Olympic site)**

The Novotel/Ibis Hotel being constructed at the Homebush Olympic site aims to be one of the most ‘environmentally friendly’ hotels in Australia. In full operation it should use about 36 per cent less energy than a conventional hotel of similar occupancy.

Reflecting the Sydney Olympic Coordination Authority’s commitment to staging a ‘Green Games’, the developers (Lend Lease Projects and Accor), incorporated many ISTPs in the building, such as:

- solar hot water systems (one of Australia’s largest commercial systems);
- extensive use of natural gas;
- increased insulation of the building; and
- use of a hybrid ventilation system which should allow the hotel to operate for over 100 days per year with little or no air-conditioning.

To ensure that environmental targets are met, frequent audits of the building’s energy use will be conducted.

Source: Energy Manager (1999a).

It should also be noted that even in cases where design budgets are considered adequate, ISTPs may not necessarily be adopted. The HIA (sub. 19, p. 5) considered that:

While the environmental awareness of consumers generally is growing, these consumption preferences are yet to percolate through to influence building decisions. The building and construction industry is fundamentally a service industry, so limited demand for environmental features, such as energy efficiency, will act to restrain the adoption of environmentally sustainable building designs.

Some submissions highlighted that there can be methods of promoting ISTP adoption while keeping initial design costs low:

… some interesting incentive schemes have been established in the USA — called Savings by Design incentives — … incentive payments are linked to energy savings at various points; say the design conclusion, at building commissioning, and over the life of the building. This is one way to defray the initial extra costs associated with good energy efficient design. The design team only gets part of the premium up front but can gain a lot more down the track if the designs achieve their goals in practice. Thus the design team will seek better solutions and become more aware of the technologies and techniques available. An ongoing return is linked to performance … If performance expectations are not met then incentive payments are reduced or not received. (University of Technology, Sydney, sub. 22, p. 3)

Hubbard (in sub. 16, p. 33) also highlighted similar arrangements:

The concept is simple. The architectural/engineering (A/E) firm receives a bonus if the building exceeds energy performance targets set in an initial agreement with the client and pays a penalty if it falls short.

These schemes are indicative of the types of methods firms can use to ensure building designs match their requirements. Firms have different priorities and expectations of the design component of commercial building construction. Some firms emphasise minimising cost when allocating their budget across building tasks, including design, while others may be willing to allocate a larger budget to the design task in return for a higher quality or more unique service, or in return for a design that identifies opportunities to adopt ISTPs. Individual firms are best placed to make the tradeoffs between quality, price and other design attributes that reflect their priorities and building needs.

Contractual arrangements at the construction phase

Some submissions considered that the contractual chain model (appendix B) predominantly used at large commercial construction sites may deter adoption of ISTPs at the construction phase:

The contractual chain model demonstrates … the potential for introducing a bias towards a cumulative risk aversion for the project as a whole. The network of interlinked decisions, where the output price of one decision feeds into other decisions as an input cost, opens the possibility that discounting present values for risk can be

> incorporated into a series of different decisions This can generate a risk discount multiplier … (Housing Industry Association, sub. 19, p. 10)

The concern that contractual arrangements deter ISTP adoption seems to presuppose that there must be a direct link or face to face contact between the final purchaser (in this case, the tenant or occupier of the building) and the developers for the marketplace to deliver products that satisfy the demands of the final purchaser. In a market economy this is generally not necessary. Tenants' demands will become known to those who market buildings, who then pass on messages to investors and constructors about the most profitable types of buildings to create. Flow on effects through separate transactions should feed information back to construction and design decisions, just as this occurs in other markets. For example, farmers receive information about which crops to grow in order to satisfy consumer demands through intermediaries such as retailers and food processors. In this manner, the marketplace delivers products that consumers demand.

Relationship between occupier and building owner (or 'split incentives problem')

Often the building owner and the occupier are different parties. This separation may impede adoption of ISTPs because the occupier (who receives the on-going benefits of ISTP adoption) has limited scope to implement them. This is sometimes referred to as the split incentives problem because one party selects the technology or process and another party pays the energy costs.

This problem is sometimes attributed to the original investor not retaining property rights over the investment long enough to recoup fully a return on the investment. However this, of itself, should not necessarily deter adoption of ISTPs. As ABARE (1991, pp. 28–29) pointed out '… an exchange economy would not function if property rights over an investment had to be retained for the life of the investment'. Resale or lease prices for the property should reflect the value of the future ISTP benefits (although this does depend on access to adequate information at the point of sale).

If tenants demand buildings that incorporate ISTPs and are willing to pay a higher rental (whether because of their lower operating costs or to compensate the building owner if additional costs are incurred) contractual relationships would not necessarily impede adoption of ISTPs. In the competitive market for commercial building space, owners or suppliers of commercial buildings would quickly learn that profit could be made by catering to the demand for commercial buildings that incorporate a higher level of environmental performance. In existing buildings, contractual arrangements to share future savings between landlords and tenants could allow adoption of ISTPs if desired (although this can be more difficult where there are numerous tenants).

Thus, the separation of owner and tenant need not impede adoption of ISTPs. In 1996, the Bureau of Industry Economics (1996, p. 45) examined incentives for small and medium sized enterprises to invest in energy efficiency and found: 'few people from the commercial sector regard it [the split incentives or landlord-tenant problem] as a serious problem'.

However, re-negotiation of contracts to promote adoption of ISTPs does rely on access to information about the environmental sustainability of the building. Potential problems with information in the market for ISTPs are discussed in section 2.4.

Gross leases

Gross leases are another contractual relationship between the building owner and tenant that may impede the adoption of ISTPs. Under a gross lease, a tenant's lease or rental payment is inclusive of outgoings such as energy costs. This differs from a net leasing arrangement where the rental payment and the payment for ongoing costs, such as energy expenses, are separate. With a net lease, the cost of energy and other operating costs are transparent to the tenant, and they may also be more accurately apportioned across tenants. As a result, the tenant has a stronger incentive to monitor these costs and adjust behaviour to alter their magnitude. In contrast, with a gross lease there is less incentive, and it is more difficult, to analyse and alter energy consumption and costs.

Under a gross lease, it is argued that tenants have little incentive to adopt ISTPs because they will capture only some of the energy savings and the owner has little incentive to invest in ISTPs because energy costs (even if excessive) are fully reimbursed by the tenants. However, this may not be strictly correct from the owner's point of view. Once a lease is agreed, any reduction in energy and input costs that the owner can realise will add to the owner's profits. Even prior to signing a lease, improved energy efficiency should enable an owner to offer the property at a lower price which can be important in highly competitive markets.

It is unclear whether the gross lease arrangement always impedes ISTP adoption. At the least, it should not be a fixed impediment to the adoption of ISTPs as arrangements could be altered to reflect an interest in investing in ISTPs. This is starting to occur:

> … many leases (NSW and the ACT) are gross leases in which electricity costs are included in the total rental figure … There are however several trends working against

> these impediments [to ISTP adoption]. These are the rise of Asset and Facilities Management and also Energy Performance Contracting, especially as the Australian Building Industry concentrates on building refurbishments rather than new building construction (Sustainable Energy Industry Association sub. 17, p. 3).

Appendix E provides examples of the role of facilities management.

2.4 A broader social perspective

Are ISTP outcomes generated by firms consistent with broader community interests?

So far the report has considered the appropriate level of ISTP adoption from an individual firm's perspective. However, it is also important to consider a broader perspective because of the potential impact of commercial buildings on the environment.

Normally a market economy like Australia's proceeds from the proposition that firms are best placed to make decisions that are in their own best interests. Furthermore, these decisions will also be beneficial for society (in the sense of the community's resources being allocated to their most valued uses) provided there are no market failures. This section examines whether market failures exist with regard to the environmental performance of commercial buildings.

Three potential problem areas or market failures can be identified:

- externalities;
- information related market failure; and
- the public good nature of research and development.

The presence of market failures would result in a misallocation of society's resources — what is best for the individual firm is not in the best interests of society as a whole. While identifying market failures may not necessarily help explain non-adoption of ISTPs by particular firms, it can highlight whether investment in ISTPs may be lower than the level that is socially optimal. If this is so, there may be a case for using public policy to correct these distortions and thus promote investment in ISTPs (see chapter 3).

Externalities

A firm's consumption of resources through commercial buildings has an impact beyond the confines of the building (as discussed in chapter 1). The additional impacts, or costs and benefits, for those external to the firm are called 'externalities'. The firm does not usually take these external benefits and costs into account when making its decisions. Yet, from society's perspective these should be taken into account.

If a decision not to invest in ISTPs generates external costs that the firm does not have to account for, or it generates benefits for which the firm is not paid, the firm will adopt fewer ISTPs than what is socially desirable. If firms decide not to adopt ISTPs in their commercial building, the external costs include:

- climate change brought about by greenhouse gas emissions generated through the use of greenhouse gas intensive energy, particularly electricity, in the operation of the building;
- the environmental impacts of waste disposal, depending on how much waste is generated and how firms dispose of it;
- the depletion of the ozone layer if ozone depleting substances such as hydroflurocarbons and halons are used in equipment such as air conditioning and refrigeration systems; and
- the depletion of freshwater resources.

Chapter 1 provides more detail on the environmental impact of commercial buildings.

These external costs often cannot be entirely avoided if society is to benefit from the construction and use of commercial buildings. However, ISTPs may provide some scope to reduce them by using inputs and resources as efficiently as possible. If the prices of resources or inputs used by firms more accurately reflected the external costs of using them, then firms would account for these externalities when making decisions about ISTPs. Eyre (1997, p. 35) noted the effect of externalities on ISTPs: 'Non-inclusion of external costs in prices produces a systematic bias against energy efficiency'. The SEIA (sub. 17, p. 5) summarised the effects of externalities this way:

> The fact that energy suppliers are able to offer their product to the market at just the marginal cost of production, without including any of the associated societal or environmental costs, totally distorts customers buying decisions in favour of the status-quo.

Policy action by government may be justified to address externalities if the benefits of government action outweigh the costs. This issue is discussed in the next chapter.

Information related market failure

Market failures can also occur in the provision of information. In any market, including that for the construction, refurbishment, operation or demolition of commercial buildings, individuals need access to reliable information on the potential costs and benefits (or advantages and disadvantages) of alternative actions to make decisions that best reflect their interests. To the extent that this is the case with investment in ISTPs, firms may be unable to make optimal decisions.

To consider the adoption of an ISTP, a firm needs information on the ISTP's key attributes, the most obvious being price and quality. However obtaining information on even these obvious and critical attributes may not be straightforward. 'Price' for example, includes not only the direct up-front costs of the ISTP, but also the costs of implementing it (see discussion of hidden costs in section 2.2) and the estimated costs of maintaining a process or repairing a technology in future. The price is also 'reduced' by the expected savings in the use of inputs, like energy, that the ISTP is expected to generate.

Some submissions consider that information problems in the building and construction sector explain the lack of adoption of ISTPs. The Queensland Master Builders Association (sub. 12, p. 2) noted:

> The major issues that impede the adoption of IST's [ISTPs] are:
>
> — lack of information on the types of products and services available
>
> — [lack of] accurate details on "costings" of IST's [ISTPs]
>
> — the lack of information for clients, designers, cost planners and building contractors that is simple to read and comprehend
>
> — a lack of knowledge amongst architects, designers and clients on the benefits of IST's [ISTPs]
>
> — restricted budgets that prevent the use of high cost solutions
>
> — a lack of promotion of the building energy rating schemes and "best practice" options and successes.

Submissions to this study identified three main types of information problems that may arise for firms making decisions about ISTPs: lack of information, information processing problems and information asymmetry.

Lack of information

Information may not be available. The market may not provide enough information about ISTPs that firms need to be able to incorporate them in their commercial buildings.

Firms providing ISTPs have an incentive to supply information about them in response to demand for ISTPs from potential buyers. This information can be provided through advertising, direct marketing or independent equipment testing to ensure buyers know about the product and its quality.

Similarly, other firms have opportunities to sell their independent expertise to firms investing in commercial buildings. Consultancy services offering advice, energy audits or even the contracting out of energy efficiency aspects of operations and other ISTPs are available to supplement the information available to firms.

Information processing problems

Information may be readily available but firms may have trouble correctly processing that information — aspects may be ignored or not correctly incorporated into decision making. This may occur, for example, because information is technically complicated and/or because it is costly to process and understand. The benefits of improving the environmental performance of a commercial building can be subject to significant uncertainty which firms may have trouble dealing with in their decision making. The Eco Design Foundation (sub. 3, p. 9) considered that information about ISTPs, despite its availability, from both government and non-government sources, is not adequately transmitted to the building industry:

> … the reason [that information is not transmitted adequately to the building industry] goes not to the degree of technical information available as is often assumed, but to the need and desire for better professional development education within the building and construction industry.

In some cases, design tools are available to help practitioners assess the potential benefits and costs of implementing ISTPs. However, these tools may not necessarily address all information processing problems. The Australian Cooperative Research Centre for Renewable Energy (sub. 13, pp. 2–3) noted:

> One of the difficulties with the design tools is the complexity of these tools for most participants in the building industry. Programs like DOE2.1 … Radiance … ESP II … and CHEETAH … are extremely useful, but tend to require substantial input and require extensive technical knowledge to use effectively. Transparency and simplicity (in presentation) are required to ensure that all participants in the construction process are aware of the process of arriving at the design, and trust this process.

Information asymmetry

Information asymmetry occurs when one party to a transaction has more information than that held by another party to the transaction. A supplier of a particular ISTP typically has more information about its quality and performance than its potential purchaser, yet the supplier may have difficulty effectively transferring this information to the purchaser. This problem is not exclusive to ISTPs and can be common with other 'experience' goods. Merely inspecting or observing an experience good before purchase will not readily reveal its quality as individuals assess the quality of such goods through their own direct experience of them. The former Bureau of Industry Economics (1995) argued that asymmetry of information exists in the market for energy efficient appliances. This could apply to ISTPs more generally. In practice, one response to the problem of information asymmetry is to evaluate goods and services on the basis of 'substitute' indicators of quality such as reputation and past service.

Public good nature of research and development

Research and development relating to ISTPs is another potential area where market failures may occur. Some aspects of research and development display 'public good' characteristics. Public goods are:

- non-rivalrous — they can be used by many users simultaneously at no extra cost to the supplier; and
- non-excludable — users cannot be denied access to them once they are available.

Public goods may be readily used and copied by others. As a result, there is little incentive to invest in them because it is difficult for a private producer to appropriate financial reward for supplying it. Basic research about ISTPs may be more characteristic of a public good than is applied research (IC 1995), particularly given that non-excludability is an essential component. In a practical sense however, it is difficult to distinguish between public good research and research from which a private firm may appropriate benefits.

If the potential beneficiaries of research are few, firms have an incentive to cooperate to carry out research that can benefit them all. One mechanism for doing this is through professional or industry associations. However, when there are many potential beneficiaries, it becomes more difficult to implement cooperative arrangements on a voluntary basis because there is more scope for some beneficiaries to try to free-ride on the outcomes of others' activities. Attempts to free-ride may mean that research with public good characteristics would not be undertaken (IC 1995).

Chapter 3 discusses whether there is a role for government to address the potential market failures raised in this chapter.

3 Improving the environmental performance of commercial buildings

Lack of adoption of ISTPs in the commercial building sector does not necessarily imply a need for government action. However, there are some areas — market failures in particular — where this may be justified. This chapter explores these areas further bearing in mind:

- that government action should be considered in the context of the goals of government;
- the need to consider the potential for government action to improve outcomes;
- that governments should only proceed when the benefits of proposed actions outweigh their associated costs; and
- if there are a several possible beneficial actions to achieve the same goal, the most efficient should be used.

Appendix D lists current government programs relevant to the building sector that focus primarily on energy efficiency.

3.1 Access to appropriate and relevant information

Several groups within the commercial building sector provide information about ISTPs. These include firms that supply ISTPs, consultants, construction and design firms, universities and research centres, and trade associations.

Government may have a role in improving access to appropriate information on which firms make decisions about investing in ISTPs. This could be broadly grouped into two types:

- information relating directly to the ISTPs themselves which includes basic information about what they do and their advantages relative to standard or conventional processes or technologies; and
- information designed to assist firms make decisions about the value of ISTPs in their particular circumstances. This might include providing information or

education about the merits of techniques like life cycle costing relative to simple payback periods.

Availability of information

There was no consensus in submissions to this study regarding the availability of information on ISTPs. For example, the Building Division, Queensland Department of Public Works (sub. 4, p. 8) considered that:

> Information on ISTs [ISTPs] does not seem to be readily available in a way that is holistically useful for buildings. Greater effort is required to gather and integrate information held by different service providers.

Similarly, the Sustainable Energy Industry Association (SEIA) (sub. 17, p. 3) considered that 'Information is a serious barrier to the uptake of energy efficiency in commercial buildings', and that (sub. 17, p. 8):

> There is a need for comprehensive data collection, analysis and definition to develop guidelines for ESD [ecologically sustainable development] so realistic targets can be set, against which actual results can be compared.

In addition to the SEIA, some other submissions also considered that performance data to enable benchmarking was important and lacking:

> The current drawback to adequately evaluating building performance is the general lack of quality performance data against which to benchmark. (Royal Institution of Chartered Surveyors, Queensland Branch, sub. 5, p. 9)

On the other hand, the Department of Architectural and Design Science, University of Sydney (sub. 14, p. 9) felt that information on ISTPs is readily available. It stated:

> There is no shortage of information on ISTs [ISTPs] for commercial buildings. Firms with technology to sell ensure this … [and] … various educational bodies provide courses in energy conservation and management … [but] Development of these programmes has, however, been hampered by withdrawal of Australian Government financial support. Research is also hampered by the intense competition for inadequate funding to the Australian Research Council and other potential funding bodies.

As well, the information that is available may not be of high quality, or may be anecdotal in nature. Professor Geoff Smith (sub. 22, p. 3) argued:

> While the amount of information and case studies in this field is growing rapidly and is important, information alone is not enough. It is useful for stimulating ideas and needs to be kept up to date but potential users need some evaluation. Volume of information is large and varied in quality, with much developmental. Overseas information is often not suited to the Australian context or needs adaptation and even local developments need to be assessed for different climate zones within Australia.

There is an incentive for private firms to provide information on the quality of their products, including energy efficiency information. Private suppliers of ISTPs have an incentive to provide as much information as possible about their products to promote adoption of them and to increase sales. The NSW Sustainable Energy Development Authority (1998) produces an Energy Smart Directory that lists over 200 suppliers of energy efficient services (covering items such as lighting and heating) and energy efficient office equipment.

Suppliers of ISTPs may provide detailed information to design professionals to ensure they are aware of the range of products available. The Australian Council of Building Design Professionals stated that:

> In marketing their products, manufacturers provide such information on their products to architects, engineers, etc. and these building design professionals can then make their own assessment with regard to their experience, on whether to incorporate the product or technology in the design of the project. *The information that is available is not in general terms transmitted to anyone outside this 'design loop' and in many cases may not be easily understood by anyone outside this 'design loop'*. (sub. 16, p. 16)

Users of ISTP information can supplement information obtained through suppliers with information from other independent firms with expertise in this area. Several firms in Australia specialise in providing energy efficiency consultancy services.

Innovative contractual arrangements are also being developed which provide an incentive for the provision of relevant information about ISTPs. Through energy performance contracting, ISTP suppliers provide some capital funding for ISTPs in return for a share of the recurrent energy cost savings. The Sustainable Energy Industry Association outlined the benefits of these developments (sub. 17, p. 4):

> Energy Performance Contracting has been a market response to overcoming these barriers [to adopting ISTPs], in particular, removing the information, risk and evaluation market barriers. NSW DPWS [Department of Public Works and Services] and the Commonwealth Government are both developing standard tender and contract documents in conjunction with AEPCA (Australian Energy Performance Contracting Association).

The Australian Energy Performance Contracting Association should assist to further develop this, and other, innovative arrangements which provide a vehicle for the promotion of ISTPs.

Private firms also supply tools used by building design professionals to design energy efficient buildings. The NSW Government (sub. 25, p. 16) noted that many design tools exist, although there are problems as well:

> Specific-issue stand-alone IST [ISTP] design tools, most of them software based, abound. That is, there are individual packages that do not relate well to other packages.

> Whole-building environmental performance assessment tools using benchmarking and rating processes are much more complex to develop. Australia has very few such tools in current practice however, some are about to be launched, or are in advanced development.

In relation to the ability of the design tools to interact, the CSIRO (sub. 18, p. 12) noted the work of the International Alliance for Interoperability (comprising over 600 companies, with 50 in Australia) in developing standards for the exchange of information between building industry computer programs.

In many cases, industry associations (for example, the Property Council of Australia and the Air Conditioning and Mechanical Contractors' Association) provide and disseminate information to firms about ISTPs. This can be an efficient way for firms to develop and share information that is of particular relevance to their industry. An example of this is the PATHE program, launched by the Housing Industry Association in conjunction with the Commonwealth Government. PATHE is designed to provide information about ISTPs (box 3.1).

Box 3.1 **PATHE (Partnership Advancing the Housing Environment)**

PATHE is an industry initiative designed to enhance the environmental performance of housing in Australia. The Housing Industry Association and the Commonwealth Government (through Environment Australia) are working cooperatively to minimise the environmental impact of the building sector.

The project aims to encourage industry action in three key areas: waste management; energy efficiency; and environmental management practices. It aims to address factors such as industry search costs, consumer perceptions and an overemphasis on minimising up-front costs which may imply that firms are unaware of the environmental and financial benefits of attending to environmental matters.

To address industry 'awareness barriers', PATHE incorporates demonstration projects, industry awards and regular newsletters. Appendix E provides further details.

Source: HIA (sub. 19).

An example of an industry association formed expressly to deal with environmental issues is the Australian Building Energy Council (ABEC). In 1998, the construction industry launched ABEC to represent their interests in relation to the Government's greenhouse strategy. ABEC aims to focus on industry responses to the greenhouse gas issue, promote the industry's view that a mix of voluntary and mandated standards would achieve the best outcomes, and raise awareness in the industry and government on greenhouse gas issues as they relate to the construction sector (ABEC 1999).

Professional associations (such as the Royal Australian Institute of Architects and the Institute of Engineers, Australia) also play an important role in the education of design professionals, who have an important influence on the design of environmentally sustainable buildings. The Australian Council of Building Design Professions (BDP) (sub. 16, p. 16) outlined its roles as:

- show casing best practice projects in association publications and by including such criteria in association award programs
- encouraging debate, review and criticism of projects to increase the level of awareness within the membership and the wider community
- better formal linkages between industry associations and research institutions.

In addition, the council publishes the BDP Environment Design Guide:

> … a subscription service on environmental issues specifically tailored to the needs of Australia's building design professionals. It provides reliable, timely and accessible information; all written with the practitioner in mind. The notes cover the whole range of relevant environmental issues and design solutions and the case studies showcase and critique the very best in Australian environmental design (sub. 16, pp.16–17).

Government also provides information related to ISTPs. (see Appendix D). Generally there has been limited evaluation of the efficiency and effectiveness of government information programs. The International Energy Agency (1991, p. 152) noted this in an international context:

> Even within a single country, those responsible for running energy conservation programs have found it difficult to establish clear cause and effect relationships and attribute a given energy demand reduction to price effects, information efforts, financial support or standards. As a result, where programs are evaluated, the assessment provided tends to be more qualitative than quantitative.

As discussed in chapter 2, demand for ISTPs may be low partly because within the current cost framework energy efficiency is not a priority for many firms. However adequate amounts of information on ISTPs appears to be available from a variety of sources. If demand for ISTPs increases, there are many private and public sector sources of information which should be able to respond to the need for information by decision makers.

3.2 Public good nature of research and development

While there appears to be an active market for the provision of information, it is important to examine the development of information as well.

Research and development of new techniques, methods and technologies for improving energy efficiency is undertaken in a wide range of areas by research institutions, universities and private firms (an example is the Gateway project at the ANU, see box 3.2). The extent to which a firm can use the results of research and development itself, or to which it can commercialise and sell its results, creates an incentive for firms to invest in research and development. Firms will make decisions about investing in ISTP research based on the cost and benefits of undertaking such research. If there is little interest in adopting ISTPs, there will also be little incentive to invest in research and development of ISTPs.

Box 3.2 **The Australian National University Gateway Project**

A proposed new building (the Gateway Project) at the Australian National University, has been designed to showcase cutting edge sustainable design and construction methods. Innovations include:

- maximising the use of local content to minimise energy use through transport and shipping;
- choosing materials which maximise environmentally sustainable development objectives;
- using wind powered electricity generators and photovoltaic cells;
- using water circulated through pipes buried deep in the ground to naturally stabilise the building's internal temperature; and
- various other passive technologies such as prismatic glazing, angular selective skylights and translucent insulation materials.

The building design is open-plan and incorporates public spaces, both designed to maximise the flexibility of the building shell. This should allow the building to adapt to changing needs over time.

Currently, construction is deferred due to a lack of funds. The capital cost of the Gateway Project is about 50 per cent higher than that of a conventional building of the same size.

Source: ANU (1998).

Research and development also has 'public good' aspects. Public goods are characterised by 'spillovers' of knowledge — transfers of knowledge which cannot be prevented and for which there is no payment. It is difficult for a firm to capture the benefits of spillover knowledge. While private benefit from research and development investment may occur, the presence of spillovers generally provides an argument for government to augment private research and development.

Governments in Australia direct significant resources towards research and development, through CSIRO, Cooperative Research Centres, university funding (including the Australian Research Council), Commonwealth and State and

Territory departments, and tax concessions and other incentives for research and development in the private sector. This support includes encouraging research into ISTPs, the performance of commercial buildings and means to improve energy efficiency. CSIRO, for example, has a division devoted to Building, Construction and Engineering, and a Built Environment section.

The Industry Commission (1995) noted that the public sector undertook about 55 per cent of all research and development in 1992-93. Given current levels of government support for research and development, the issue is whether energy efficiency and ISTPs warrant additional government support over and above other areas such as agriculture, industrial research or social research.

While energy efficiency research produces significant public benefits, it is unknown whether the spillovers of this research are likely to be higher than those in other areas. There is therefore no reason to think that the pattern of spillovers of energy efficiency research will be different to research and development in other areas, so that it should receive additional industry specific support.

3.3 Dealing with environmental externalities

If governments are concerned about the environmental impact of energy used in commercial buildings, then the focus of policy should be on energy use, rather than energy efficiency *per se*. The most appropriate and direct way of altering energy use in commercial buildings is to ensure that individual firms account for the external environmental impacts of their consumption of energy.

In Australia, about 85 per cent of electricity is generated using coal which is a highly greenhouse gas intense activity (Allen Consulting and McLennan Magasanik Associates 1999). Greenhouse gas emissions are a significant external cost associated with the use of fossil fuels. There may be a case for government to adjust energy prices so that the price reflects these external costs, thereby ensuring that firms account for them when deciding how much or what type of energy to consume.

Greenhouse gas externalities may be dealt with using several methods, such as a carbon tax or greenhouse gas emissions trading. These mechanisms use prices and markets to address the externality. The advantages of using market based incentives are summarised by Porter and van der Linde:

> Such approaches often allow considerable flexibility, reinforce resource productivity, and also create incentives for ongoing innovation. Mandating outcomes by setting emission levels, while preferable to choosing a particular technology, still fails to provide incentives for continued and ongoing innovation and will tend to freeze a status

> quo until new regulations appear. In contrast, market incentives can encourage the introduction of technologies that exceed current standards (1995, p. 111).

The use of market based mechanisms to incorporate environmental externalities into decision making (through pricing) should improve resource allocation and the efficiency of the economy as a whole. Diesendorf (1996, p. 44) suggests that:

> In the long run, it is important to include the environmental, health and social costs of energy production and use in energy prices. The resulting price increases for fossil fuels and electricity generated from them could be treated as an environmental levy hypothecated for the establishment of energy efficiency and renewable energy.

It should be noted, however, that the merits of hypothecation would need to be assessed on a case by case basis, as it may reduce a government's flexibility in allocating revenue.

Incentive effect of pricing environmental externalities

The main purpose of accounting for externalities in energy prices is to ensure that the price reflects the full cost of energy use to the economy and society. Pricing externalities will increase the price of polluting forms of energy. Future demand for such energy would be expected to decrease, as users cut their consumption or switch to less polluting forms of energy (depending on the size of the price increase). Further, it would spur research and development in alternative energy sources (Metcalf 1994).

The price of energy affects firms' incentives to use energy efficiently. Higher energy prices increase the returns available from adopting ISTPs (and therefore may raise their profile in firms' decision making). By increasing returns, the incentive to adopt them is stronger, just as low prices resulting from recent energy market reform have reduced the incentive to adopt ISTPs (box 3.3). In a recent study, Allen Consulting and McLennan Magasanik Associates (1999, p. 70) found:

> The primary structural barrier [to energy efficiency] identified by almost all participants was that of the price of energy … price signals in the current market environment act as a disincentive to undertake energy efficiency and demand management practices, by both energy companies and consumers.

Box 3.3 **Recent energy market reforms**

The objective of recent energy market reforms has been to improve efficiency in energy supply and use by improving the operation of state and national energy markets. It has mainly been associated with falling energy prices and increased choice for consumers, but may have also had a negative impact on the adoption of ISTPs.

According to Bush et al (1999), recent reform in the electricity generation sector resulted in a sharp fall in wholesale electricity prices in 1996, and prices have remained low. Electricity use in end markets increased markedly in response to strong economic growth and the price reductions that became available to more and more customers.

Lower prices for energy derived from fossil fuels act as a barrier to the use of less greenhouse gas intense fuels, dulling the imperative to find alternative fuels and technologies because coal is abundant, readily available and prices are low. The downward pressure on prices creates fewer incentives for consumers to buy energy efficient appliances or adopt energy efficient practices. This also dulls incentives for firms to invest time and money in research, development or manufacture of ISTPs.

A case study of the impact of falling prices on the adoption of ISTPs was provided by the Sustainable Energy Industry Association (sub. 17, p. 12):

> The Reserve Bank announced in 1998 that it was entering into a long-term lease for office accommodation in Sydney. [The firm] ECS approached the Reserve Bank with sustainable energy alternatives to a conventional lighting system design for incorporation into the tenancy fitout. As initial reactions from the Bank were favourable, ECS prepared detailed proposals for evaluation by the Bank's electrical consultants.
>
> [As a] result of the price competition for market share by … electricity retailers, the Bank was able to negotiate short-term contracts at less than the cost of production: the initial cost of energy was reduced from 9.8 cents per KwHr to 4.194 cents per KwHr with no demand charge, a decrease of 47%.
>
> As a result of the decrease in the cost of electricity, the 3 year simple payback period increased to approximately 5 years and the proposal failed the end-users' financial hurdle …

Previous studies (such as ABARE 1991) have also argued that inappropriate energy pricing by utilities, such as cross-subsidisation and incorrect costing of capital, has distorted electricity use and led to excessive environmental externalities. Such inappropriate pricing should be reduced as competition leads to more commercial pricing polices.

Market based mechanisms

The two main market based approaches for adjusting energy prices to offset the greenhouse gas externality are carbon taxes and emission trading.

A carbon tax sets a fixed price for each unit of fossil fuel, proportionate to its greenhouse gas emissions. This ensures that firms account for the environmental costs of emissions when making decisions about energy consumption levels.

However, while the price of energy would be known (given the tax rate), the actual reduction in emissions is less certain as it depends on the cost of abatement (avoiding greenhouse gas emissions) and how individual firms respond to price signals.

Emission trading involves setting a cap on total greenhouse gas emissions, and allowing firms to trade permits or rights to a certain proportion of the total emissions allowed. This provides flexibility, allowing firms with a lower cost of abatement to reduce emissions more than firms with a high cost of abatement.

Emission trading is generally seen as more economically efficient than a carbon tax. Trading of emission rights allows compliance costs to be minimised, more so than can be achieved under a carbon tax. Under a carbon tax there is no scope for trading emission rights from those with high abatement costs to those with lower abatement costs.

The Australian Cooperative Research Centre for Renewable Energy identifies the need for improved pricing of energy to improve the adoption of ISTPs, and notes mechanisms that may achieve more accurate pricing:

> The relatively low cost of electricity may not be a long term problem, but the pricing of all forms of energy to reflect the total cost (including externalities) would make all forms of energy efficiency more attractive to businesses and domestic energy users. The most appropriate mechanisms to achieve this full-cost pricing are not clear, but would clearly include such things as a carbon tax, a more general 'waste' tax, or somehow charging for the 'cost' of the raw materials (sub. 13, p. 3).

Market based mechanisms not only address environmental problems but, by incorporating previously excluded costs, also improve resource allocation in the economy with all its attendant benefits. The European Commission noted these:

> … it seems that a review of the existing tax … [schemes] is needed for broader economic and employment reasons. The coincidence between this situation and the need to introduce corrective taxes for environmental reasons should be exploited with the view to realising possible synergies. (quoted in Australia Institute, 1999, p. 1)

Improved resource allocation means that resources flow to areas where they are most valued. For example, alternative fuel sources (and alternative energy production technologies) would become relatively more price competitive compared with greenhouse gas intensive energy, and should attract more resources. The Sustainable Energy Industry Association (sub. 17, p. 3) supported this view:

> There are many examples of the failure of energy prices to include externalities and/or being skewed by various government policies. For example, the economic viability of Remote Area Power Supply Systems and Green Power are both radically altered by the failure of various policies to include the cost of externalities. Green Power is a cheaper

> source of electricity when externalities are included. RAPS schemes are cheaper than running electricity cables to remote areas. Solar Hot Water is similarly cheaper when externalities are included. Unfortunately, electricity prices do not reflect the true cost of producing that electricity and therefore the market does not make economically rational decisions.

Nevertheless, there are some difficulties associated with market based mechanisms. It may be difficult to estimate the appropriate rate or level at which to set a tax or cap for a range of reasons, such as difficulties in distinguishing external costs from private costs. Sanstad and Howarth note this practical difficulty:

> Evaluating the empirical magnitude of environmental externalities, however, is a complex, often intractable problem. Simply knowing that prices 'should go up' to reflect these costs is an imprecise guide to policy (1994, p. 814).

Structural adjustment

Higher prices for greenhouse gas intensive energy as a result of emission permits or carbon tax would have distributional implications. Both a carbon tax and emissions trading would favour those parts of the energy production industry with lower greenhouse gas emissions (such as gas) over those with higher emissions (such as coal). This may have significant regional impacts, given the regional concentration of these industries.

The associated rise in the price of energy would also flow on to other industries. Most goods and services are produced using energy, so the impact would be distributed throughout the economy, depending on the level of energy use.

Changes in the prices of energy may also have a distributional impact, mainly because low income households generally spend a greater proportion of their income on energy (for example, for heating). The Australia Institute (1999, pp. xiv–xv) noted measures to compensate those adversely affected by price increases:

> There are concerns that higher energy prices due to the cost of emission permits would disadvantage poorer households … [however] some of the revenue from auctioning emission permits could be ear-marked for compensation, through pension increases and reduced income taxes for low-income earners.

The structural and distributional impacts of pricing externalities needs to be considered, along with other design aspects, when considering the introduction of such a policy.

3.4 Current government initiatives

In addition to broader government policies on greenhouse gas emissions, such as emission trading, two areas of regulation are currently being considered (or implemented) by Australian governments specifically to alter the environmental performance of commercial buildings: energy efficiency labelling and minimum standards for the energy efficiency of buildings

Energy efficiency labelling for commercial buildings

Labelling of buildings has often been suggested as a response to the lack of awareness among consumers of the energy efficiency of buildings and of the benefits that this can bring. Energy efficiency labels are currently required for several types of major electrical appliances in Australia (refrigerators, freezers, air-conditioners, dishwashers, clothes washers and dryers). There are proposals to extend this approach to commercial buildings.

Mandatory energy efficiency labelling has recently been introduced in the ACT for residential housing (see Appendix E). This may provide useful lessons for the application of energy efficiency labelling to the commercial building sector. Each house is unique (unlike an appliance) so a separate assessment must be undertaken as the basis for each label. As many more (unique) assessments are required, administration and enforcement costs are likely to be higher than for standard goods such as household appliances.

Because of the importance of housing purchases for consumers (in terms of cost), it could be expected that consumers would be willing to purchase an energy assessment if it was an issue with which they were concerned. This would be similar to consumers purchasing other expert services to assess various aspects of housing, such as employing a qualified tradesperson to check the structure and foundations of a building which is being considered for purchase.

Similarly, in the commercial building sector, it would be expected that owners and tenants would be thorough in their evaluation of commercial buildings. It is unlikely that firms would neglect to evaluate energy efficiency if they considered it an important feature. Similarly, as each commercial building is unique, there is less scope for economies of scale in the production of energy efficiency information and assessment (compared to electrical appliances or other uniform products).

To the extent that tenants are concerned with energy efficiency, there is an incentive for firms operating buildings to provide information on this issue, possibly in the form of a label. This incentive may be strongest in high quality buildings, which may often be energy efficient because they are leading edge or because they are marketed as ‘green’ buildings.

The amount and quality of information provided through a label can vary enormously. A simple labelling system may be used, such as the NSW commercial building rating scheme, which compares energy use to the size of the building, and provides a one to five star rating. This system is likely to impose few costs on participating firms. However the additional benefit provided by the label is low, as the same information could easily be obtained by any firm wishing to consider the energy requirements of a building. The system, however, does provide a standard measure of energy efficiency in commercial buildings, allowing easy comparisons between buildings.

This may suggest a role for government to provide standards for energy efficiency labelling. As argued by ABARE (1991) a major problem in information provision may be the absence of standard measurement and test procedures, and while there is some incentive for private efforts to provide such information, the presence of some market failures may mean that this does not always occur. The Sustainable Energy Industry Association argued (sub. 17, p. 8):

> There is a lack of data and of credible benchmarked performance comparisons to allow a prospective designer/purchaser/occupant to assess how well a building compares against some baseline.

There may be a role for government to provide a standard benchmark of energy efficiency in commercial buildings, through a voluntary labelling scheme. However, one of the drawbacks of a voluntary code is that it would generally only be used by firms that would follow this course of action already. Firms may see no benefit pursuing a course of action that may well cost them time and money with little or no return.

Minimum standards for the energy efficiency of buildings

The Commonwealth Government, through the Australian Greenhouse Office, is currently working with the building industry to develop minimum energy efficiency standards for potential inclusion in the Building Code of Australia. These will initially be set at a low level, designed to eliminate ‘worst practice’ building designs (see box 3.4 for the development of this policy).

Several submissions to this study supported the use of mandatory standards and legislative requirements to increase the energy efficiency of commercial buildings. For instance:

It is our opinion that unless legislative requirements are incorporated in the Building Code of Australia the majority of buildings will continue to be constructed regardless of energy efficiency considerations (National Electrical and Communications Association, sub. 15, p. 2)

Box 3.4 **Development of policy on minimum energy standards**

The Prime Minister's Greenhouse Statement of 1997 committed the Government to working with industry to develop voluntary minimum energy efficiency standards:

> … we will work with the States, Territories and industry to develop voluntary minimum energy performance standards for new and substantially refurbished commercial buildings.
>
> These initiatives will take us to best practice standards in these important areas. If this voluntary approach does not achieve acceptable progress within 12 months, we will work to implement mandatory standards.

In response, industry formed the Australian Building Energy Council (ABEC) which in 1998 proposed that:

> A suite of activities including a proposed Voluntary Code of Practice will be implemented to "narrow the gap" between "current" and "best practice" in reducing greenhouse gas emissions by the building and construction industry. ABEC will also contribute to the formation of mandated standards aimed to eliminate "worst practice" within the building, construction and energy industries.

The Commonwealth accepted these proposals:

> Following wide consultation between Government and the building industry on 24 March 1999, the Ministerial Council on Greenhouse reached a landmark agreement on a comprehensive strategy aimed at making our homes and commercial buildings more energy efficient.
>
> The two pronged strategy balances the introduction of mandatory minimum energy performance requirements through the Building Code of Australia with encouraging and supporting voluntary best practise initiatives.

Sources: Howard (1997, p. 7), ABEC (1999, p. 9), AGO (1999b), CSIRO (1999).

Like any potential policy action, mandatory standards generate benefits and costs. These should be well understood before deciding to proceed with such a policy. As stated by the Australian Building Codes Board (1998, p. 27):

> The economics of building codes relate to the principle of allocative efficiency — society allocating an optimum level of resources to a given utility (eg safety in buildings) to maximise the net benefit to society. Because resources are limited, society must budget the amount of resources it allocates to building safety. Public and mandatory private expenditure on building safety compete with other social programs like education, public health and transport.

For minimum energy efficiency standards, the benefits would be measured primarily in terms of the energy savings made. These benefits would slowly accumulate over time, as new buildings are constructed or old buildings refurbished.

The imposition of standards is not costless. Any form of minimum standard imposes costs in the form of:

- design costs in establishing the standards;
- compliance costs imposed on firms;
- potential distortionary effects on firm behaviour (for example, some firms may be forced to adopt a higher level of energy efficiency than they consider optimal for their production goals); and
- enforcement costs for governments.

Limited research appears to have been conducted on the effects of building energy efficiency standards. One study (Jaffe and Stavins 1995, p. S-61) examined US data relating to housing for the period 1979 to 1988. Their analysis found little evidence that:

> … building codes made any significant difference to observed building practice in the decade 1979–1988. It is possible that stricter codes (that were more often binding relative to typical practice) might have an effect, but this itself ought to remind proponents of conventional regulatory approaches that while energy taxes will inevitably be effective on the margin, typical command-and-control approaches can actually have little or no effect if they are set below existing standards.

Thus the level at which the standard is set can have a significant influence on the benefits which accrue from it. If standards are set too low they may have little effect on energy consumption in the sector (current ABEC proposals are for low minimum standards). Given the nature of the building code (box 3.5), a low minimum standard may have unintended effects. The building code is a performance based code which contains deemed-to-satisfy provisions which establish that a certain design meets the performance standards. To adopt a solution other than that specified in the deemed-to-satisfy provisions, a firm must incur additional costs to prove its approach meets the specified performance standard.

If minimum standards are set too low, some firms that may otherwise have exceeded the standards, may instead meet the cheaper deemed-to-satisfy solutions, which require little additional work on the behalf of designers or builders. This could work against improving the environmental performance of buildings. This concern was also expressed by the HIA (sub. 19, p. 11) in another context:

> The existing mandated approach to insulation in Victoria has resulted in a dramatic market shift from products which perform, to products which cost the least. Similarly, the piece-meal approach by 177 individual councils in NSW implementing varying energy efficient criteria, from the very onerous to the non-existent, has resulted in a compliant approach by the market, in which the main focus is to minimise costly approval delays, rather than pursue energy efficient initiatives. This lowest common denominator approach has again resulted in products being specified without clear understanding of their ultimate use or benefits.

Box 3.5 **Building Code of Australia**

The building code is a performance based code which sets minimum requirements for new buildings and renovations (with some variation between the States). It does not apply to processes that occur inside buildings or to non-permanent fixtures. The building code covers issues of health and safety, fire standards and general amenities.

The Australian Building Codes Board (with representatives of the Commonwealth, all States and Territories, and industry) oversees the building code. The States and Territories regulate the building industry and refer to the building code (with or without amendments) in state based legislation.

The latest revision of the building code (1996) includes performance requirements that buildings must meet. The most common method of meeting the building code is through the deemed-to-satisfy provisions that are prescriptive and are published with the building code as Australian Standards or as other documents referenced by the building code. They may describe production detail or methods and use of these provisions is deemed-to-satisfy with the performance standards.

If not using a deemed-to-satisfy provision, a firm may use an ‘alternative solution’. This must be assessed to determine whether it achieves either:

- absolute compliance with the relevant performance requirements, or
- at least equivalence with the performance achieved by a relevant deemed-to-satisfy provision.

The use of appropriate assessment methods is required to establish compliance of the ‘alternative solution’ with the relevant performance requirement. An application for a building permit must include one or more appropriate assessment methods to substantiate the use of that alternative solution. One assessment method is to use the ‘expert judgement’ of an individual who has the qualifications and experience to determine whether a building solution complies with the performance requirements.

Sources: BCC (1997), CSIRO (1999).

International experience also has led some authors to question the effectiveness of minimum standards in certain cases:

> In some (though increasingly rare) cases, obsolete codes, standards, specifications, and laws actually prohibit sound and efficient practices. Far more often, standards meant to

> set a floor — like "meet codes" (euphemism for "the worst building you can put up without being sent to jail"), or the British expression "CATNAP" (Cheapest Available Technology Narrowly Avoiding Prosecution) — are misinterpreted as a ceiling or as an economic optimum (Lovins and Lovins 1997).

Given the issues discussed above, there is a need for greater analysis of the potential effects of introducing of minimum energy efficiency standards for commercial buildings.

3.5 Other government approaches

A wide range of alternative, 'second-best', options are available to government to attempt to address the environmental performance of commercial buildings. Some of these are briefly discussed below. While this discussion is not comprehensive, it provides examples of policies that might be possible.

Subsidies for energy efficiency

Subsidies are a common instrument used by government to encourage certain behaviour (for example, subsidies for preventative health care) or forms of production (subsidies for shipbuilding). Subsidies could also be used in the commercial building area to encourage the adoption of ISTPs by:

- subsidising the adoption of ISTP equipment;
- subsidising training or advice/consultancies; and/or
- subsidising energy efficiency audits.

One difficulty with any subsidy is that subsidies can go to firms that would have undertaken the subsidised action anyway.

The Commonwealth Government provided subsidies for energy efficiency audits from 1991 to 1997 through the Enterprise Energy Audit Program (EEAP). An evaluation of the program undertaken by ABARE (1998, pp. 6–7) found that it was difficult to judge the effectiveness of the program:

> … EEAP was, in all likelihood, a cost effective policy and … EEAP audits were worthwhile to the great majority of firms that took part … It should be noted, however, that 'hidden costs', especially those associated with risk, are not incorporated into the evaluation tool used to analyse the program and, to the extent that these costs are important, the value of the program would be overstated.

Provision of benchmarking data

For firms to assess the energy efficiency of their building operations, it can be useful for them to have access to comparable information on the energy efficiency performance of a wide range of commercial buildings. Government could provide assistance with such information.

Industry associations have in the past provided building performance information. The Property Council of Australia (formerly the Building Owners and Managers Association) provided information on building energy consumption and performance targets in an annual energy report until 1995. This was discontinued due to '… cost and lack of interest" (Department of Architecture and Design Science, University of Sydney, sub. 14, p. 6).

Several states undertake benchmarking of their own operations. Energy Efficiency Victoria (sub. 7, p. 2) stated: "Some organisations conduct energy benchmarking studies of their portfolio, conduct energy audits and monitor the energy performance of their buildings". Benchmarking is also undertaken by the NSW Government (NSW Government, sub. 25).

Australian governments are also working together to provide benchmarking information. The South Australian Government (sub. 26, p. 50) pointed out that:

> The Government Real Estate Group (GREG) is a national body which was formed to promote the exchange of information related to government office accommodation. All six States and the two Territories are represented on GREG.
>
> In 1996, at GREG's Annual Conference, it was agreed to nationally benchmark government office accommodation performance in order to assist property managers to improve performance and reduce the cost of office accommodation to government.
>
> Over the past three years, the four benchmarks GREG has chosen to develop and refine [include]:
>
> … Electricity Usage: The MegaJoule usage of electricity per square metre of net lettable area for a selection of owned government office accommodation in the city, metropolitan and country regions for the year ending 30 June …

Government as 'leader'

Australian governments are major property managers. The NSW Government, for example, owns assets and infrastructure to the value of $100 billion, a significant proportion of which is commercial buildings (sub. 25).

Thus government activities in relation to its own portfolio of properties may have a significant impact on the building industry. The Commonwealth Government's objective of reducing energy consumption by Commonwealth agencies, for example, will have an impact on total energy use in commercial buildings.

Further, government may influence the building sector through requirements for its own buildings, using its buying power as a lever. The Master Builders Australia (sub. 10, p. 5) stated:

> Obviously the most meaningful manner in which governments (Commonwealth and State/Territory) can demonstrate a proactive political approach is through the specification and technologies in contracts involving the construction and/or refurbishment of public buildings. Such an approach will encourage designers, consultants, builders and manufacturers to develop strategies conducive to securing this important sector of the market, thereby enabling such products and technologies to be available for incorporation into the private sector.

In NSW, for example, all firms tendering for major government projects must implement an environmental management system — a corporate plan to ensure environmental issues are identified and managed (NSW Government, sub. 25). This could be expected eventually to lead to most large commercial construction firms in NSW having an environmental management system. This would, of course, impose additional costs on businesses which should be considered when evaluating such a program.

Demonstration projects

A more direct form of assistance is for government to provide, or fund, demonstration projects of buildings which are energy efficient and demonstrate various ISTPs.

However, if one of the main barriers to the adoption of ISTPs is that they do not appear to be commercially viable, a non-commercial demonstration project is unlikely to have much impact. In such a case an award system, which identifies commercially energy efficient buildings, may be a better approach.

Government awards for high energy efficiency buildings

Government awards have been suggested as a method for promoting the use of energy efficient buildings in general and of specific ISTPs in particular. Such a program may highlight to firms in the commercial building sector the benefits of energy efficiency and certain ISTPs.

However, industry and professional groups already produce awards for energy efficiency in buildings. For example the PATHE initiative (box 3.1) includes a series of awards for energy efficiency. It would not appear to be necessary for government to replicate an activity already undertaken by the private sector.

Promotion of government policy

There may be a role for government to provide information to consumers and businesses on the policies that have been developed as part of the National Greenhouse Strategy. This is already occurring, to some extent, through the marketing of the Greenhouse Challenge, and the release of discussion papers on tradeable emission permits.

3.6 Comparing approaches

As part of its response to the Kyoto Protocol, the Commonwealth Government is examining various polices to limit the growth of Australia's greenhouse gas emissions, including the potential for domestic greenhouse gas emissions trading. Such a policy would address greenhouse gas externalities at source, by ensuring that the price of energy takes into account the environmental impact of greenhouse gas emissions.

Given that the Government is considering addressing greenhouse gas emissions at their source, there may be no need to mandate minimum energy efficiency standards for buildings, or to pursue other forms of sector specific regulation. Based on research looking at the adoption of energy efficiency enhancing technologies, Verhoef and Nijkamp (1997 p. 23) concluded:

> … a technology standard is in principle counter-productive if optimal energy taxes apply, simply because it need not be optimal — from a social point of view — for all firms to adopt the technology, whereas those firms for which it is socially efficient will face the optimal incentive to adopt already.

Some argue that even with the pricing of greenhouse gas externalities, not all ISTPs will be adopted. As energy prices are generally a minor component of a company's total costs, raising energy prices to reflect greenhouse gas externalities may not dramatically change ISTP adoption:

> Increasing the energy price is not a strategy likely to succeed. If it were doubled it would still be of minor importance in relation to other costs (Department of Architectural and Design Science, University of Sydney, sub. 14, p. 3).

Obviously, the effect on additional adoption of ISTPs will depend on the extent of the price increase. In any case, the objective of government policy in this area should be to address the commitment to reduce the growth of greenhouse gas emissions, not to ensure all known ISTPs are adopted. It is important not to confuse objectives with the instruments used to achieve them. Encouraging the adoption of ISTPs is, after all, only an instrument to achieve environmental objectives, not an end in itself. The commercial building sector may not be the most efficient sector of the economy in which to reduce energy use. Accounting for greenhouse gas externalities allows the market to determine which sectors are best placed to reduce greenhouse gas intensive energy use.

Pricing greenhouse gas externalities at source provides incentives for many different approaches to reducing greenhouse gas emissions, other than increasing ISTP adoption. These include:

- reducing commercial buildings energy use, without changing the efficiency level of the technology used;
- investing in new forests ('carbon sinks') to balance greenhouse gas emissions;
- reducing greenhouse gas emissions by energy generation firms introducing new abatement technology; and
- the wider use of less polluting alternative energy sources (such as fuel cells or wind power) as their relative price falls.

In addition to these potential responses, increased greenhouse gas intensive energy prices should provide an incentive for further adoption of ISTPs. Higher prices due to the pricing of greenhouse gas intensive externalities increases the payback from the introduction of ISTPs, making them more attractive. Further, higher energy prices increases the profile of energy efficiency, and improves the incentives for:

- firms to renegotiate contractual arrangements, such as leases or construction contracts;
- third party suppliers to enter the market for ISTP equipment and advice; and
- additional research into ISTPs.

Some have argued that pricing energy to account for greenhouse gas emissions may increase energy prices significantly, which may in turn pose political problems with implementation. However, it is appropriate that these costs are made transparent and explicit. This is an advantage over a regulatory approach where such costs are not explicit as they are embedded within the cost structures of firms. Consumers and taxpayers are thus less aware of the additional hidden costs imposed by such regulations. As well, pricing energy at source to incorporate externalities then enables the market to determine how to best respond to this price increase. It might be that commercial buildings may not be the best place to make energy reductions.

A further advantage of pricing greenhouse gas externalities is that it flows through to other inputs in the form of embodied energy (see box 1.2). Many participants have raised embodied energy as an important issue when considering the environmental effects of commercial buildings. Pricing greenhouse gas externalities should flow through to embodied energy, as the price of energy would include a component for the environmental effects of that energy. This would be included in any 'downstream' products which incorporate greenhouse gas intensive energy. Relatively more energy intensive products (for example, aluminium) would include a greater proportion of the environmental cost, and thus a higher price, than less energy intense products. Thus, pricing greenhouse gas externalities should automatically account for embodied energy.

Compared with other regulatory approaches, market based mechanisms also offer the advantage of being open and transparent. Command and control regulations can impose significant costs on business and the community that are not necessarily visible because they are incurred within firms. Market based mechanisms make the compliance costs of pursuing a policy goal more visible and explicit.

Regulations designed to control or affect certain aspects of commercial building activity (such as minimum energy efficiency standards) have several drawbacks in addition to the lack of transparency discussed above. They do not provide the flexibility of other abatement methods (such as emissions trading). Further, they impose significant additional compliance costs.

Most significantly however, commercial building regulations *only* affect commercial buildings. Greenhouse gas emissions are an issue for the whole economy. Energy prices which account for greenhouse gas externalities would provide an incentive for all sectors of the economy to contribute to greenhouse gas emission reductions. Thus such pricing can help provide an economywide solution to environmental impacts resulting from greenhouse gas emissions.

4 Conclusions

Significant amounts of energy (and other environmental resources) are used in the construction, operation, maintenance, refurbishment, demolition and disposal of commercial buildings. There are both sound economic and environmental reasons to make efficient use of scarce resources, and to limit damage to the environment.

Many organisations and individuals in Australia consider that insufficient attention is being given to energy efficiency and, more generally, input saving technologies and processes (ISTPs) in commercial buildings. Some argue that there is a range of ISTPs which it would be sensible and profitable for firms to implement. Further, their non-implementation is sometimes believed to imply irrational behaviour or short-sightedness by firms, or the existence of some serious systemic biases against ISTPs.

This study has examined the criteria used by the industry to assess the performance of commercial buildings. In particular, it has focussed on those criteria related to environmental performance, and the underlying reasons for current levels of adoption of ISTPs. The Commission has sought evidence of market failure which might indicate a possible role for government action to enhance performance in this regard.

Firms have many different objectives when selecting, managing, or designing a building, and energy efficiency is only one of these. Firms may demand a building with high quality (if energy inefficient) lighting and air conditioning. Other firms may only be willing to pay for an average or even low quality building, which may also have low energy efficiency.

An analogy may be made with the market for cars. Several energy efficient models of cars are produced, and sell reasonably well. However, many individuals also demand (for various reasons, such as towing caravans or boats) large, relatively fuel inefficient vehicles such as eight cylinder sedans or four-wheel-drive vehicles. At the other end of the market, many consumers purchase cheap second hand vehicles which may not be as efficient as new vehicles, but ‘do the job’.

In some cases, energy efficiency in commercial buildings is important to industry, in particular where energy is a relatively important cost, such as in hotels. Here there is an incentive to improve energy efficiency and reduce energy costs. The firms building, operating and occupying commercial buildings are best placed to decide the extent to which they wish to pursue improvements in energy efficiency and which ISTPs they wish to adopt, for their specific circumstances.

Overall energy efficiency and, more generally, conservation of environmental resources, do not appear to be high priorities for many firms. Energy costs attributed to commercial buildings are a small proportion of most firms' total costs, either at the construction or operational stage. Most firms have a range of other priorities they consider more important, both in terms of management time and investment funds. This will only change if the prices that firms face increase.

There are many reasons why building owners and tenants appear not to be implementing currently available and apparently profitable ISTPs. The report has categorised these into hidden costs, such as those associated with implementing new technology, and risks and uncertainty, such as that surrounding future energy costs, or unknown maintenance costs for new equipment. It is also the case that different ISTPs themselves are not always compatible; for example small windows increase insulation, while large windows increase natural light.

Nevertheless, decisions by firms may conflict with society's broader interests, if significant market failures exist. Governments can certainly have a role in such situations. However, for government action to be successful, clear objectives need to be identified, and the government's ability to affect the situation must be assessed, along with an evaluation of the costs and benefits of such action.

There is the potential for market failure in the provision of information on ISTPs, although the Commission could find little evidence of this. The private sector (through building design specialists, equipment manufacturers and consultants) provides adequate information about performance-enhancing technologies and processes. The government also provides general support for research and development which is also available for ISTPs.

There is one likely area of market failure — environmental externalities resulting from the emission of greenhouse gases. This occurs particularly in the production of electricity derived from fossil fuels, which is the major energy source in the whole life cycle of commercial buildings.

If the objective is protecting the environment, then the focus should be on reducing total greenhouse gas emissions, such as those related to the consumption of fossil fuels, rather than simply increasing energy efficiency in a particular sector such as commercial buildings. This requires examining the *production* of energy as well as the *consumption* of energy.

Governments should consider the adoption of policies to incorporate the effects of environmental externalities where they occur. This can be done through market based mechanisms which price greenhouse gas externalities. These provide a policy response where the actual market failure occurs — in the greenhouse gas intensive energy production market.

Correctly pricing greenhouse gas externalities is considered the most effective and efficient solution. However, it is recognised that there are situations where this solution may not be practical (whether for implementation, political or other reasons). In these cases a range of alternative solutions (sometimes called 'second best'), although neither as effective or efficient, may have the advantage of being quicker and easier to implement.

These alternatives include governments subsidising the adoption of ISTPs, providing public education campaigns, or providing ISTP demonstration projects.

At present, governments are considering energy efficiency labelling and mandatory minimum energy efficiency standards for commercial buildings. Both options may be appropriate in certain circumstances, when their rationale and potential effectiveness and economic efficiency have been carefully analysed.

While initiatives such as information provision and voluntary labelling may help ensure that any existing 'no regrets' actions are undertaken, significantly altering behaviour regarding ISTPs and energy efficiency will be costly.

There are a range of costs and benefits associated with any government action which must be seriously examined before deciding to implement such schemes. It is doubtful whether enough information is currently known about the consumption of energy in the commercial building sector to fully assess the benefits and costs of some proposed actions. Further research in this area is required for a better understanding of the effectiveness and efficiency of options such as labelling and standards before further initiatives are undertaken.

Governments face many demands on their resources. There is an opportunity cost associated with any government action as funds used to pursue one policy goal are then not available for alternative uses (such as health care or education). Further, costs imposed on business through regulations can directly reduce the productivity of those businesses. While there may be difficulties and drawbacks in implementing tradeable emission permits, even greater costs are incurred from using alternative 'second best' actions.

The most appropriate response to greenhouse gas externalities is to use market based mechanisms to ensure that the price of greenhouse gas intensive energy reflects the social cost of its production. The higher price that would result from such an approach would not only provide an incentive for firms to be more efficient in their use of energy, but would also provide an incentive for them to re-examine contractual arrangements such as leases between building owners and tenants. Higher energy prices would also stimulate the provision of additional information on ISTPs, and would encourage further research into ISTPs and alternative, less polluting, energy sources.

Further, these effects would not be confined to the commercial building sector. They would flow through to all sectors of the economy which use energy, of which the building sector is only one part. Pricing greenhouse gas externalities would provide an incentive for all sectors of the economy to reduce energy consumption or switch to less environmentally damaging energy sources.

Similarly, where there are environmental externalities stemming from the use of particular natural resources as inputs (for example, building materials and water), the preferred policy response is to address the externality where it occurs, and adjust prices accordingly. Mandatory technical standards are likely to be too inflexible and inefficient, distorting the future development of the commercial building sector.

APPENDIXES

A Conduct of the study

A.1 Consultative process

While this study was not a public inquiry, as defined in the *Productivity Commission Act 1998*, the Commission carried out a public consultative process to facilitate participation by all interested groups and individuals, and to permit a high degree of transparency and public scrutiny. In undertaking this study, the Commission considered the impact of proposals on the community as a whole rather than their impacts on any particular group or activity.

For this study:

- consultations were held with a range of Commonwealth and State government departments and agencies, as well as firms and industry associations in the building and energy efficiency sectors;
- in June 1999, an issues paper was sent to those who had expressed an interest in participating in the research study, it was also available on the Commission's internet site;
- submissions were sought from interested parties (27 submissions were received);
- a draft report was circulated to three independent referees; and
- a roundtable, to discuss the Commission's preliminary conclusions, was held prior to release of the final report.

A.2 List of participants

Table A.1 **List of submissions**

Participant	*Submission number*
ACADS-BSG	9
Air Conditioning and Mechanical Contractors’ Association of NSW	2
Australian Cooperative Research Centre for Renewable Energy	13
Australian Council of Building Design Professions	16, 20
Building Division, Queensland Department of Public Works	4
Building Research Association of NZ	21
CSIRO Division of Building, Construction and Engineering	18
Department of Architectural and Design Science, University of Sydney	14, 27
Eco Design Foundation	3
Ecological Architects Association	23
Energy Efficiency Victoria	7
Housing Industry Association	19
Langston, Assoc Prof C.	1
Mason, Dr C.	11
Master Builders Australia	10
National Electrical and Communications Association	15
Ness-Chang, D.	8
NSW Government	25
Queensland Master Builders Association	12
Royal Institution of Chartered Surveyors, Queensland Branch	5
SA Government	26
Smith, Professor G.	22
Sustainable Energy Industry Association (Australia)	17
Institute of Engineers, Australia	24
University of Melbourne, Faculties of Engineering and Architecture, Building and Planning	6

Table A.2 **List of visits**

Australian Capital Territory	
Australian Greenhouse Office	
Department of Defence (Defence Estate Organisation)	
Department of Finance and Administration (Australian Property Group)	
Department of Industry, Science and Resources	
Department of Urban Services – Planning and Land Management (ACT government)	
Institute of Engineers, Australia	
Master Builders Australia	
National Capital Properties	
National Library of Australia	
Royal Australian Institute of Architects	
New South Wales	
Department of Public Works and Services	
Intercontinental Hotel	
Property Council of Australia	
Standards Australia	
Sustainable Energy Development Authority	
University of Technology - Sydney	
Victoria	
CSIRO - Division of Building, Construction & Engineering	
Energy Efficiency Victoria	
Lincolne Scott Australia Pty Ltd	
Myer/Grace Bros Department Stores Ltd	

B Commercial building sector

This appendix provides a brief discussion of the characteristics of the commercial building sector.

B.1 What is a commercial building?

A building is a substantial structure designed to provide shelter and space for people and objects. Commercial buildings provide an input into the commercial productive process of a business. The Building Control Commission (1999) defined a commercial building as ‘an office building used for professional or commercial services. A building which is for storage, or display of goods or produce for sale by wholesale’.

The Commission, for the purposes of this study, considers this definition to include buildings used for the production and sale (or provision) of all goods and services, including those provided by governments. Thus, buildings used for retail sales, tourism, education, health and entertainment/recreation purposes are all considered a part of Australia’s commercial building stock.

The purpose of commercial buildings is to provide businesses with a location to facilitate their productive processes. A factory or warehouse may be an input into the production of manufactured goods, while an office building may be an input into the production of professional services, such as legal, accountancy or educational services.

While the Commission is interested in energy and resource flows into, and out of, commercial buildings, it has not considered the resource implications of all contents of these buildings. Capital equipment situated in a building (such as computers) may use considerable amounts of energy but is not considered a part of the commercial building.

B.2 Characteristics of the commercial building sector

The design, construction, operation, and refurbishment or demolition of commercial buildings involves many contractual relationships. These relationships vary in nature and extend for differing time periods. Some of these relationships are clearly defined while others are not.

Different stakeholders in the design, construction, operation, and refurbishment or demolition of a building will bear different kinds of risk, including financial risk. These risks influence decisions about investment in the construction and refurbishment of commercial buildings. Some risk is transferable and its distribution depends on the types of contractual relationships made between the different stakeholders.

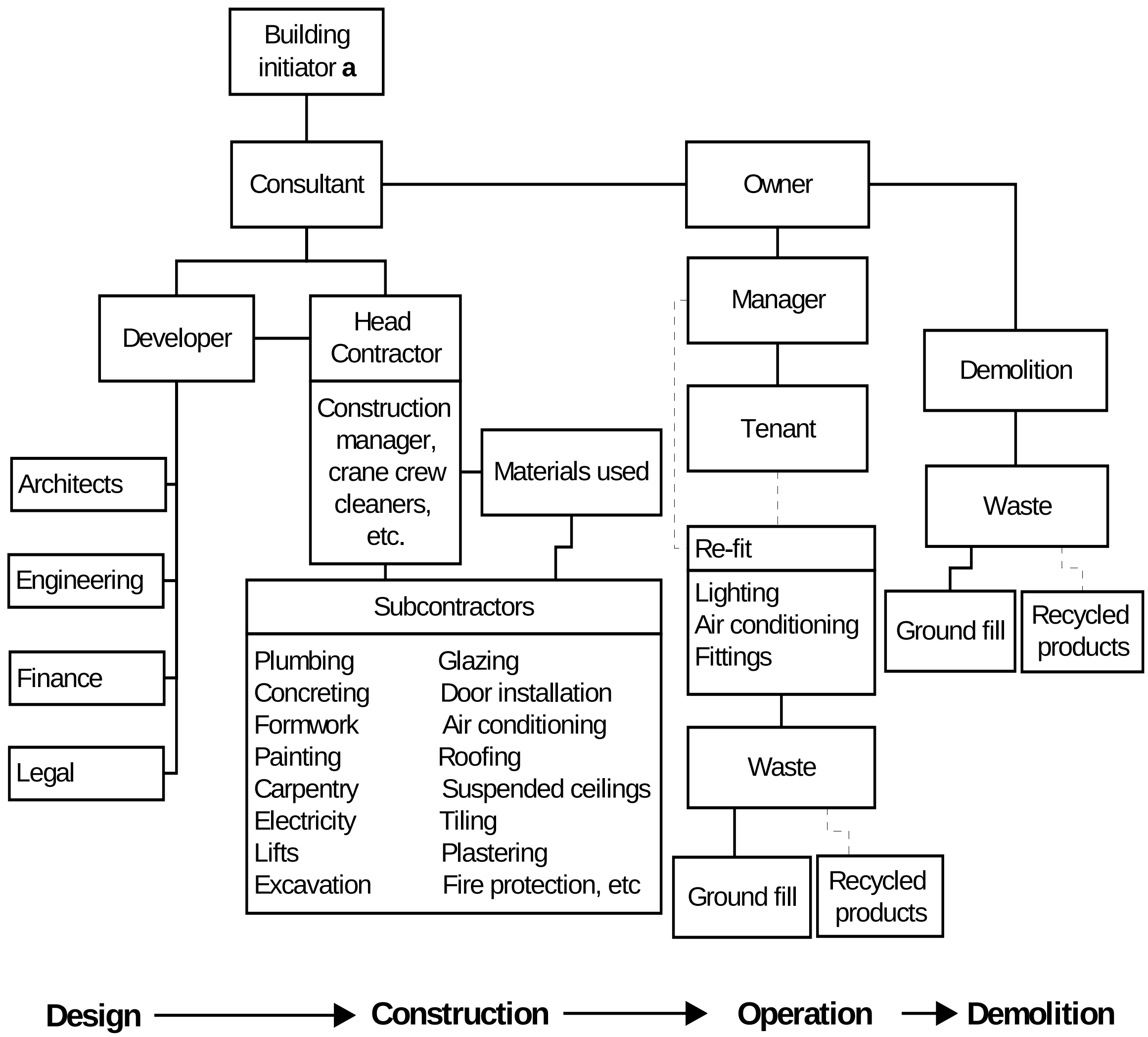
Building construction and the contractual process

A commercial building is typically a one-off design, with final assembly occurring at a specific location. Its design and construction involves a sequence of interdependent tasks that require different types of specialists. The construction phase, for example, combines structural steelwork with plumbing. Figure B.1 illustrates the process of design, construction, operation and demolition.

Initiators of large capital city building projects tend to be institutional investors or governments. Typically, management of the construction work is delegated to a 'head contractor', who usually employs only a small workforce (such as a crane crew and cleaners) on site for project-wide duties. Most of the construction work is sub-let to specialist subcontractors. However, a variety of approaches are used to bring together the many specialist contractors required for a large building project. Box B.1 outlines a range of contractual relationships between clients and contractors.

On completion of construction, the owner receives the building which, if not sold, may be either occupied by the owner or, more commonly, leased. The relationship between the owner/manager and tenant will depend on their contractual arrangement which is usually defined by a lease contract. The owner may also outsource the management and maintenance of the building to a consultant who has specialist skills in managing commercial buildings.

Figure B.1 **Stylised representation of the phases of a commercial building**



[a] A consultant may represent the building initiator when the initiator lacks the technical expertise to coordinate a large building project.

Sources: Based on Industry Commission (1991a); Productivity Commission (1999a); Rawlinsons (1998).

Box B.1 Relationships between clients and contractors

On a typical large building project, the client relies on a team of specialist contractors to design and erect a building. The role of each contractor and its relationship to the client depends on the type of contractual system used.

Under a **traditional tender**, the client appoints a project design team that produces comprehensive documentation for the project. Tenders, usually lump sum, are then sought from builders. The site is subsequently handed over to the successful tenderer and the client's agent administers its contract. Most of the construction work is typically sub-let by the builder to specialist subcontractors.

A **design and construct** contract involves a team of contractors submitting a design and, in most cases, quoting a maximum price. The client's agents (architects and engineers) specify the design brief in general terms and evaluate design proposals.

Under a **construction management** contract, the client usually appoints a project manager and a consultancy team to produce the initial schematic design. A building contractor is then appointed as a construction manager to assist with design considerations and to organise the building process. The client makes contracts with the specialist subcontractors who do the construction work, and the client is responsible for making payments to subcontractors and suppliers. The construction manager therefore has no direct commercial interest in the subcontractors' work, so is not subject to the contractual risks of a traditional tender.

Under a **competitive negotiation** contract the client appoints a team of consultants to prepare a design up to preliminary drawings. Tenders are then called from builders for the cost of preliminaries, completion time, and a percentage for margins and off-site overheads (based on the unknown value of work). The successful tenderer joins the consultancy team to prepare final design documentation and erect the building, often using subcontractors. This is essentially a fast tracking system. The successful tenderer is installed on site and commences work before formal design documentation is completed, in the hope that this will lead to faster completion.

With a **cost plus** contract, the client selects a builder on the basis of a tendered fee payable in excess of costs incurred. This fee is a percentage of cost or a lump sum.

Alliance contracting is a relatively new concept intended to ensure the client and its contractors operate as an integrated team. The client agrees to reimburse a contractor's costs on the understanding that it has full access to the contractor cost records. A 'no disputes clause' is used to reinforce the alliance objective.

Source: Productivity Commission (1999a).

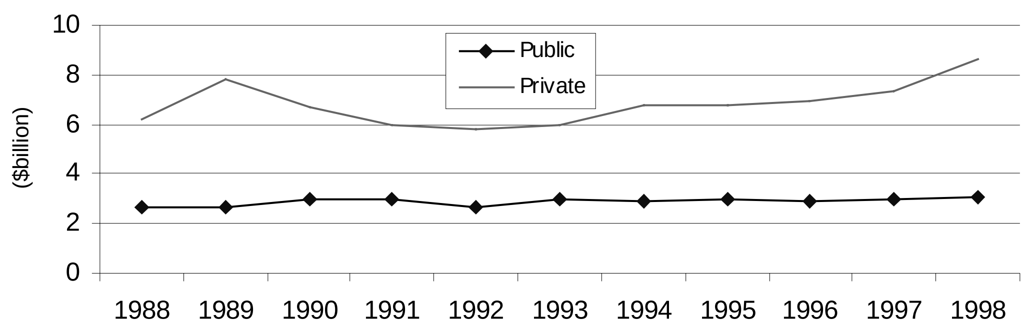
Size and nature of the commercial building sector

The commercial building sector contributes to the Australian economy in two main ways. First, construction activity associated with the supply and refurbishment of commercial buildings is a major source of employment and major contributor to economic output. Second, commercial buildings provide business with a location to carry out productive activities. The Department of Industry, Science and Resources (1999) estimates that 95 per cent of the Australian workforce operates within the built environment, generating 90 per cent of Australia's annual gross domestic product.

No data is available on the stock of commercial buildings in Australia. Commercial construction expenditure consists of both private and public expenditure. Construction for the public sector consists primarily of schools and hospitals, while construction for the private sector centres on office and retail construction and other more commercially orientated industry sectors (ERDC 1996). As a result, public sector commercial construction activity is considerably less affected by the business cycle than is private sector construction activity (figure B.2).

Figure B.2 **Quarterly real non-residential construction activity**

At average 1989-90 prices



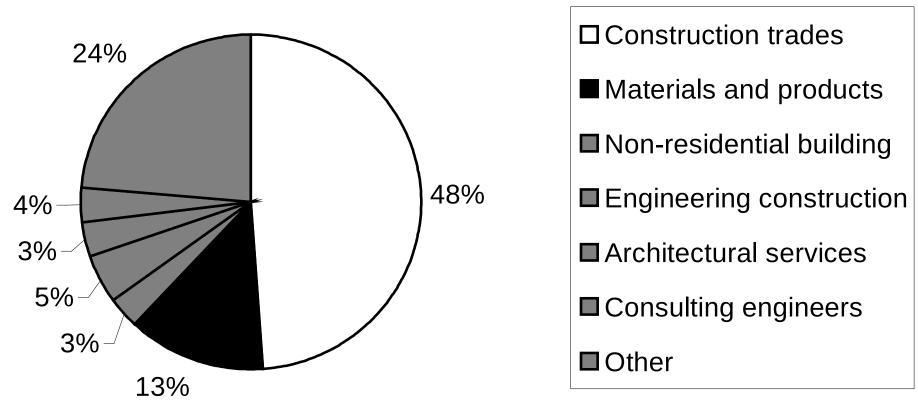
Data source: ABS (cat. No. 8752.0, 1999).

The construction industry is a major contributor to Australia's economy. The ABS (1999) estimated that during 1997-98, building and construction activity (commercial and residential) contributed an estimated 6.7 per cent of Australia's gross domestic product. Further, commercial construction accounted for an estimated 29 per cent of total construction activity in that year.

Contribution to employment

The construction sector is a major employer within the Australian economy. In 1997-98, total employment directly related to the construction industry was estimated at 597 100, or 7.1 per cent of the workforce (ABS 1999). However, the construction industry uses resources and management expertise from outside the industry: the inclusion of client services and machinery and building products suppliers gives a total employment in the sector of 729 400 persons in 1996-97 (DISR 1999). Figure B.3 provides a breakdown of employment among the various sub-sectors.

Figure B.3 **Building and construction employment by sub-sector, 1997-98**



Data source: ABS (1999).

Industry sub-sectors

The construction sector brings together many activities across the economy. These include those associated with the building and construction trades which undertake both residential and non-residential work (for example, bricklaying and roofing), building materials and products (for example, windows and steel), non-residential building (comprising non-residential building trade and management specialists), architectural services and engineering services (for example, structural design). Box B.2 highlights the differences within, and between, each of the main building and construction sub-sectors.

Box B.2 Various elements of the commercial building industry 1996-97

Building and construction trades

The building and construction trades sub-sector is characterised by a large number of small enterprises. Of the 158 000 enterprises engaged in building and construction activities, only 35 per cent employed more than two people. Industry concentration is low.

Building materials and products

This sub-sector consists of large scale manufacturers producing products that account for 25 per cent of all the material inputs into the building sector. Some of Australia's largest companies compete in this sector. Industry concentration is extremely high and increasing.

Non-residential buildings

Firms involved in this sector are, on average, larger than those involved in general building and construction activity. Market concentration in the sector is low, on average, but increases substantially depending on the size and type of project undertaken. The top five companies accounted for 15.9 per cent of all construction carried out in 1996-97.

Architectural services

A total of 4600 firms make up the architectural services sub-sector. Each firm employs, on average, five people. Industry concentration is low, with the top five firms accounting for 7.3 per cent of all work undertaken in 1996-97.

Engineering services

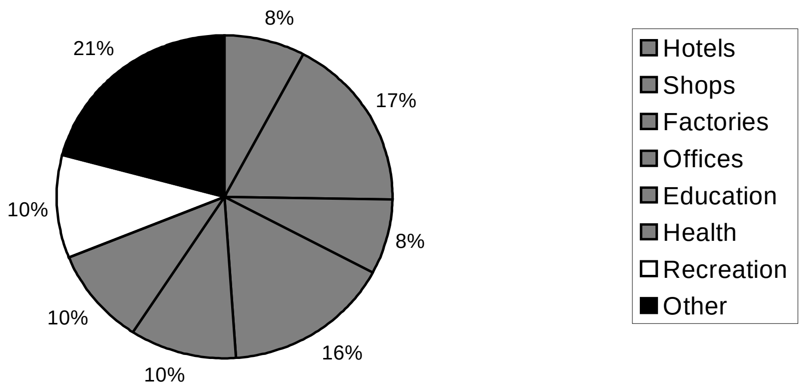
Non-residential construction accounts for around 35 per cent of all work undertaken by the engineering sub-sector. This sub-sector is made up of around 4600 firms, with moderate to high industry concentration. In 1996-97, thirty one per cent of all work was undertaken by just five firms.

Sources: EA (1999); DISR (1999).

Australia's building stock

Commercial buildings facilitate a large variety of business activities thus the industry comprises a wide range of different types of commercial building. No data is available on the total stock of commercial buildings in Australia. In terms of the share of the total value of commercial building work, the five most important areas in 1997-98 were shops, offices, other business premises, educational buildings, and entertainment and recreation facilities (figure B.4).

Figure B.4 **Commercial building work share of value, 1997-98**



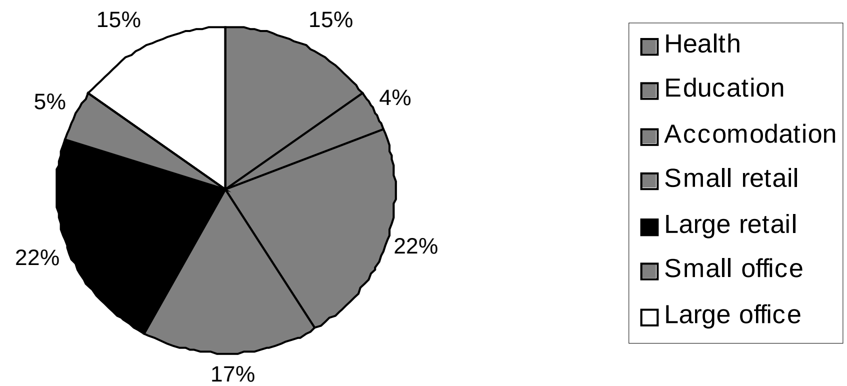
Data source: ABS (cat. No. 8752.0, 1999).

Refurbishment and renovation

Refurbishment and renovation activity can have major implications for resource use in buildings. Buildings have long physical and economic lives, and outside of demolition and the construction of a new building, refurbishment represents the major opportunity to improve the quality and performance of buildings.

The engineering components of a building (air conditioning, communications and so on) generally have a shorter economic life than the commercial building shell. Refurbishment to change these components and adapt the building shell to suit changing needs over time occurs often. For example, over 75 per cent of commercial building work undertaken during 1994-95 included some renovation. As a result, most of Australia's commercial building stock will have had some renovation by 2000 (ERDC 1996). Figure B.5 indicates renovation activity, by building type, forecast to occur within Australia by 2007.

Figure B.5 **Forecast building renovation activity to 2007**



Data source: BIS Shrapnel (1992).

Quality

A ranking system is commonly used within Australia to classify commercial buildings according to their 'quality' (table B.1).

Table B.1 **Office 'quality' within Australia**

Capital city	*A grade (%)*	*B, C and D grades (%)*
Sydney	32	58
Melbourne	25	53
Brisbane	35	58
Adelaide	32	68
Perth	40	45

Source: PCA/Colliers Jardine (1999).

While 'A-grade' office stock is not necessarily classified with respect to resource efficiency, some attributes of these buildings may reflect the adoption of input saving technologies and processes. For example, 'A-grade' buildings may include zone controlled air conditioning.

C Performance of buildings

This appendix highlights some of the stakeholders involved in the life cycle of a commercial building and outlines how the industry assesses building performance. It focuses on indicators of environmental performance for these buildings and on the tradeoffs between environmental performance and other aspects of performance.

C.1 Different perspectives of performance

Various stakeholders are involved in the various life cycle phases of a commercial building — design and construction, operation and maintenance, and refurbishment or demolition. The varying objectives of different stakeholders, with different types of involvement, means that the notion of adequate building performance varies according to the stakeholder involved. For this reason, stakeholders will not necessarily be interested in, or collect, the same sets of performance information.

Initiators provide the impetus for the creation of a commercial building. They create the initial demand and are involved in arranging finances. Initiators may establish a project for investment purposes or for their own use. Typically initiators include developers, large organisations that occupy commercial buildings (such as government departments or retailers), and finance and investment firms (box C.1).

Constructors perform the physical task of constructing the commercial building. Their job is usually defined through contracts with designers and initiators, and their objective is clear — perform the construction task, as defined by the contract, as efficiently as possible to maximise return. Constructors typically employ specialist sub-contractors to undertake various aspects of the project. Sub-contractors often have similar objectives to the constructor or head builder.

An investor/owner of a commercial building, in contrast to an owner/occupier, holds a commercial building primarily as an income producing asset. The primary concern of the building owner is to maximise the income stream generated by the building, while minimising the outgoing costs of holding the property. An owner may self-manage a commercial building, or contract these tasks to a specialist firm.

Box C.1 Stakeholder perspectives of performance

The National Electrical and Communications Association (NECA) noted that different stakeholders have different motives for their involvement in the development of new or refurbished buildings. NECA identified these stakeholders and their perspectives.

The owner/occupier usually requires a building with low recurrent costs. For this stakeholder, whole-of-life costs are driven by recurrent expenditure and this is relatively more important than the capital costs of establishing the building. These buildings are typically designed, constructed and fitted out for the owner's purpose and often include hospitals, defence establishments and some corporate head offices.

The non-occupying owner is not particularly interested in whole-of-life costs (such as energy and resource expenditures for the building's operation over time) because the tenant is generally responsible for all outgoings under a commercial lease agreement. Non-occupying owners typically include retail trusts and superannuation funds.

The speculative developer constructs a commercial building to sell to either an owner/occupier or a non-occupying owner. There is no incentive for the speculative developer to include ISTPs unless they reduce the capital cost of the building or increase the prospect of selling the completed building. According to NECA, speculative development is common in the commercial building sector.

Source: National Electrical and Communications Association (sub. 15, p. 3).

Building managers arrange and facilitate the operation of a commercial building, undertaking tasks such as satisfying tenant requirements, organising ongoing maintenance, and managing building safety and security.

Tenants lease or rent space in commercial buildings. The primary objective for a tenant is to have a space that facilitates the efficient operation of the tenant's business. However, the objectives of tenants can vary significantly according to the nature of their contractual arrangements with the building owner. Relative to the total life cycle of a commercial building, most commercial leases are for short periods. Thus tenants generally have a shorter time horizon than a building owner:

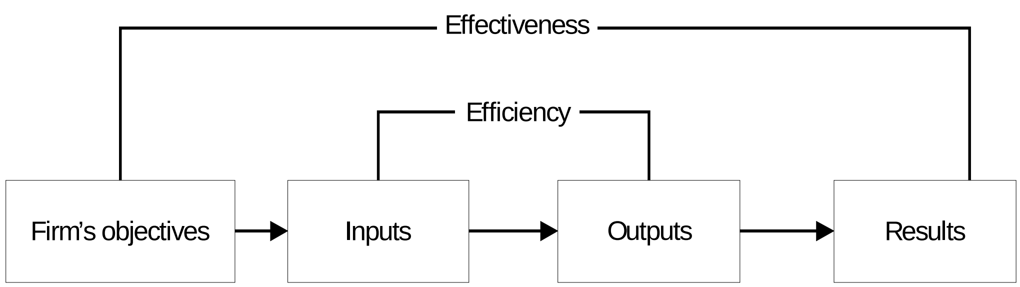
> … the tenant will have a much shorter time perspective than the building owner. Owners typically look at a building life cycle of 15 to 25 years while a tenant will be concerned with time periods of typically 3 to 5 years. (Sustainable Energy Industry Association, sub. 17, p. 4)

C.2 Measuring performance

Performance measures or indicators are used throughout government and the private sector. They can be used to focus on different aspects of goods and services, such as their inputs, the outputs (the goods and services themselves) and the outcomes (the consequences of the goods and services) (figure C.1).

Ultimately the purpose of a commercial building is to provide a stream of services to the users, owners and managers of that building. A good performance measurement system should provide information on the efficiency and effectiveness of those services. For example, outgoings per square metre may be a measure of efficiency, while tenant satisfaction may be a measure of effectiveness.

Figure C.1 **Generic performance measurement framework**



Data source: Based on DOF (1994).

A wide range of information is important for measuring the performance of a commercial building, particularly given stakeholders' diverse notions of appropriate performance. Industry participants often seek performance information for measures such as:

- up-front costs;
- capacity use;
- location;
- staff and/or customer comfort;
- aesthetic appeal (image);
- staff productivity;
- environmental aspects and energy efficiency;
- health and safety;
- waste minimisation efforts; and
- ease of upgrade/alteration.

The International Standards Organisation has set a standard that identifies the main factors to be considered in assessing a building's performance (box C.2).

Box C.2 ISO 6241-1984 — Performance standards in buildings

International Standard ISO 6341-1984 (E) provides the general principles for drafting performance standards for buildings. It identifies the main factors to be considered, particularly in relation to user requirements.

	Category	*Examples*
1	Stability requirements	Mechanical resistance to static and dynamic actions, both individually and in combination. Resistance to impacts, intentional and unintentional abuse, accidental actions. Cyclic (fatigue) effects.
2	Fire safety requirements	Risks of outbreak of fire and of spread of fire. Physiological effects of smoke and heat. Alarm time (detection and alarm systems). Evacuation time (escape routes). Survival time (fire compartmentation).
3	Safety in use requirements	Safety in respect of aggressive agents (protection against explosions, burning, sharp points and edges, moving mechanisms, electrocution, radioactivity, inhalation or contact with poisonous substances, infection). Safety during movements and circulation (limitation of floor slipperiness, unobstructed passage, guard rails, etc.). Security against human or animal intrusion.
4	Tightness requirements	Water tightness (rain, groundwater, drinking water, waste water, etc.). Air and gas tightness. Snow and dust tightness.
5	Hydrothermal requirements	Control of air temperature, thermal radiation, air velocity and relative humidity (limitation of variation in time and in space, response of control). Control of condensation.
6	Air purity requirements	Ventilation. Control of odours.
7	Acoustical requirements	Control of external and internal noise (continuous and intermittent). Intelligibility of sound. Reverberation time.
8	Visual requirements	Natural and artificial lighting (required illuminance, freedom from glare, luminance contrast and stability). Sunlight (insolation). Possibility of darkness. Aspect of spaces and surfaces (colour, texture, regularity, flatness, verticality, horizontality, perpendicularity, etc.). Visual contact, internally and with the external world (links and barriers for privacy, freedom from optical distortion).
9	Tactile requirements	Surface properties, roughness, dryness, warmth, suppleness. Freedom from discharges of static electricity.
10	Dynamic requirements	Limitation of whole body accelerations and vibrations (transient and continuous). Pedestrian comfort in windy areas. Ease of movement (slope of ramps, pitch of staircases). Manoeuvrability (operation of doors, windows, controls on equipment, etc.).
11	Hygiene requirements	Facilities for human body care and cleaning. Water supply. Cleanability. Evacuation of waste water, waste materials and smoke. Limitation of emission of contaminants.
12	Requirements for the suitability of spaces for specific uses	Number, size, geometry, subdivision and interrelation of spaces. Services and equipment. Furnishability, flexibility.
13	Durability requirements	Retention of performance over required service life subject to regular maintenance.
14	Economic requirements	Capital, running and maintenance costs. Demolition costs.

Source: ISO (1984).

Many organisations use, as a minimum, the Property Council of Australia's standard performance measures (table C.1).

Table C.1 **Property Council of Australia benchmarks for commercial buildings**

Property council metrics	
Strategic	Vacancy rate on portfolio
	Return on investment
	Vacancy rate of building
	Lease expiry profile
	Internal building management cost ($\$/m^2$)
	External building management cost ($\$/m^2$)
	Occupant satisfaction
	Ratio of net to gross leases as % of total leases
	Income, capital and total returns
	Portfolio risk
	Portfolio yield
	Property risk
	Property yield
Operational	Capital value per m^2
	Capital expenditure per m^2
	Capital expenditure as % of capital value
	Operating costs per m^2
	Energy costs per m^2
	Turnover per m^2 by retailing type
	Maintenance cost per m^2
	Ratio of lettable area to total area
	Fitout costs as % of total capital costs
	Rental income per m^2
	Outgoings recovery per m^2
	Rental growth
	Net income per m^2
	Rental arrears as % income
	Ratio of outgoings to gross income
	Churn rate
	Staff density per m^2
	Total occupancy costs per employee

Source: CSIRO Division of Building, Construction and Engineering (sub. 8, p. 8).

In contrast, table C.2 contains a sample of the performance measures used by the Queensland Department of Public Works (an owner/occupier) to assess the performance of its commercial buildings. Those likely to affect environmental performance of the building are marked with an asterix.

Table C.2 **Performance indicators used by Queensland Department of Public Works**

1. *Location/site*
   - 1.1 Proximity to business district/client base
   - 1.2 Site independence and expansion potential
   - 1.3 Car parking
   - 1.4 Public transport
   - 1.5 Public transport access
   - 1.6 Landscaping
   - 1.7 Site compatibility/utilisation
2. *Structural adaptability*
   - 2.1 Structural constraint
   - 2.2 High load zones
   - 2.3 Thermal and acoustic performance *
   - 2.4 Heritage status
3. *Image*
   - 3.1 Building grade (BOMA or similar)
   - 3.2 Design of entry and public spaces
   - 3.3 Materials quality *
   - 3.4 Amenities
4. *Non-discriminatory*
   - 4.1 Non-discriminatory building access
   - 4.2 Disabled parking facilities
   - 4.3 Disabled toilets
   - 4.4 Non-discriminatory lift facilities
   - 4.5 Non-discriminatory building circulation
   - 4.6 Non-discriminatory emergency systems
5. *Planning adaptability*
   - 5.1 Floor plate size
   - 5.2 Regular floor plan
   - 5.3 Column density
   - 5.4 Floor plate depth *
   - 5.5 Spatial subdivision potential *
   - 5.6 Module integration (structure/mullion/ceiling)
6. *Internal work*
   - 6.1 Air conditioning plant capacity environment *
   - 6.2 Air-handling, decentralisation *
   - 6.3 Zone control *
   - 6.4 After-hours operation
   - 6.5 User control (temperature, airflow, etc.) *
   - 6.6 Acoustic levels *
   - 6.7 Lighting quality *
   - 6.8 Lighting control *
   - 6.9 Emergency lighting
7. *Electrical power*
   - 7.1 Main feed capacity
   - 7.2 Primary distribution and capacity of switchboards
   - 7.3 Secondary distribution system
   - 7.4 Power stabilisation
   - 7.5 Un-interruptable power supply
   - 7.6 Standby power provision
   - 7.7 Individual tenancy metering *
8. *Vertical transportation*
   - 8.1 Number and capacity of lifts
   - 8.2 Waiting times
   - 8.3 Priority access/lockout capability
   - 8.4 Ride quality/floor levelling
   - 8.5 Dedicated goods lift provision
   - 8.6 Escalator provision
9. *Telecoms/ IT infrastructure*
   - 9.1 Supply capacity
   - 9.2 Equipment provision and situation
   - 9.3 Backbone cabling system
   - 9.4 Horizontal cabling system
   - 9.5 Ability to relocate equipment
10. *Security*
    - 10.1 Personnel interception at entries
    - 10.2 Electronic surveillance/monitoring/alarms
    - 10.3 After-hours building access control
    - 10.4 Car-park access control
11. *Fire control*
    - 11.1 Fire control systems

Note: A 1–5 rating system is used for each assessment criterion and levels of functionality are identified for each category. Measures likely to affect the environmental performance of the building are marked with an asterix.

Source: Building Division, Queensland Department of Public Works (sub. 4, pp. 4–5).

For those stakeholders involved in constructing the building, performance measures focus on production issues rather than ongoing operation of the building. However, specific indicators may still cover a wide range of areas. A Building Research Centre (1997) survey found that contractors regularly measure aspects such as:

- performance against scheduled time, cost and labour use;
- waste levels and number of defects;
- re-work;
- non-conformance; and
- client satisfaction.

Indicators used to measure building performance from a tenant's or manager's perspective (more broadly, a users' perspective) are typically broader and reflect a more diverse range of objectives, such as operational functions like ongoing maintenance and service, and comfort and functionality. The US Public Building Service, for example, uses indicators reflecting ongoing maintenance and tenant satisfaction to assess overall building performance (box C.3).

Box C.3 **Performance measures used by the US Public Building Service**

Building operations (cleaning, maintenance and utilities)

Construction cost

— Construction satisfaction

— Countermeasures installed

Cycle time for leases

— Develop new financial reports

— Energy consumption

Funds from operations

— Gains/losses

— Income and return on investment

— Increase federal enrolment in child care program

Leasing costs

— Leasing satisfaction services, gains/losses

Space alterations, guarantee discounts

— Value of sales to fair market value

Major repairs and alterations/new construction on budget

Major repairs and alterations/new construction on schedule

— Market share in alterations

— Market share in realty services

— Number of federal employees in telework program

Overall tenant satisfaction

— Per cent child care accredited

Per cent of gross potential income

— Per cent of buildings in compliance with 'Uniform Federal Accessibility Standards'

Property disposal

Protection costs

— Quality culture

— Satisfaction with reimbursable work authorisations

Source: GSA (1999)

Environmental performance

Environmental performance is only one aspect of performance that may be of interest to stakeholders; moreover, its significance will vary depending on the stakeholder involved. Firms are motivated to improve environmental performance for a number of reasons (see chapter 2), including savings in energy and other inputs that translate into cost reductions for the firm.

Environmental performance can be measured at a detailed level — where each individual component is assessed — or at a more aggregate level — where, for example, all lighting systems or all air conditioning systems are assessed. At the most broad level, the total energy efficiency of a building can be assessed by modelling the many aspects of a commercial building to derive an estimate of total building energy consumption.

Box C.4 lists energy efficiency benchmarking programs currently available in Australia. These programs focus on generating information about the energy efficiency performance of commercial buildings. Performance information for the building may then be compared to an established standard or best practice benchmark to assess a particular building's relative performance level.

Box C.4 **Energy efficiency rating models for commercial buildings**

The main building energy estimation programs available in Australia are:

- BUNYIP — developed by CSIRO;
- BEAVER/ESP — originally developed in the United States but an Australian version is available;
- E-20 — developed by Carrier Air Conditioning, an equipment supplier in the United States;
- GBTool — an environmental performance assessment framework developed internationally by Green Building Challenge, with an Australian version to be available in mid 2000;
- TRACE — developed by Trane Air Conditioning, an equipment supplier in the United States; and
- DOE2 — a program developed by the US Department of Energy with use support provided by the University of NSW.

A greenhouse energy rating system for non-residential buildings has also been recently developed by the Sustainable Energy Development Authority in NSW. This benchmarking tool will give buildings an energy rating level from one to five depending on their efficiency.

Sources: NSW Government (sub. 25); CSIRO (sub. 18).

Internationally, performance benchmarking for the energy efficiency of commercial buildings is further advanced. An example is the Energy Star program run by the US Environmental Protection Agency. This program was originally designed for residential buildings but has been extended to include office buildings. Box C.5 illustrates the type of information collected for this benchmarking exercise.

Box C.5 US Energy Star — energy efficiency ratings of office buildings

To assess the energy efficiency of office buildings, the Energy Star program requires performance information for the building under three broad areas:

1. Physical attributes:
   - location; and
   - area of office space, computer room space and parking space.
2. Operating characteristics:
   - number of occupants;
   - weekly hours; and
   - number of personal computers.
3. Energy consumption:
   - use of electricity, natural gas, steam, oil, chilled water and propane; and
   - monthly billing dates.

This information is assessed against performance benchmarks to determine an overall building rating. An indoor environment evaluation is also undertaken to ensure that the building is operating as expected. The following areas are rated a ‘pass’ or ‘fail’:

- proper control of indoor air pollutants;
- adequate outside air ventilation;
- provision of interior thermal conditions; and
- adequate illumination.

Sources: EPA (1999); US DOE (1998).

3.3 Tradeoffs in assessing building performance

It is clear from the preceding discussion that building owners and users consider a wide range of factors when assessing the performance of a commercial building. The Building Division of the Queensland Department of Public Works (sub. 4, p. 7) noted that:

> Generally, other factors, such as space availability, location, configuration and functionality override energy efficiency considerations for existing buildings.

This view is not unusual; environmental aspects of building performance are often a minor consideration compared to other aspects of performance. Other performance indicators, such as security or location, often reflect higher order objectives and represent the key criteria against which stakeholders assess the overall performance of their commercial buildings. The Department of Architectural and Design Science, University of Sydney (sub. 14, p. 5) said: ‘Location, location, location. Importance cannot be overestimated’.

Similarly, other factors that contribute to a corporation’s ‘prestige’ value also seem to have a high priority. A number of submissions to the study emphasised these points. For example, the Office Building Functionality Assessment System used by the Queensland Department of Public Works contains assessment criteria relating to image. In terms of the ‘design of entry and public space’, a building must display the following to achieve a rating of ‘excellent’ (sub. 4, p. 20):

> Distinctive, impressive and well-designed entrance(s); ‘impressive’ main foyer (e.g., generous area and volume, well planned and with best quality furnishings); well-planned and spacious lift lobbies (all floors).

In contrast, submissions note that little performance information on energy efficiency is even collected. The Department of Architectural and Design Science, University of Sydney (sub. 4, p. 3) stated:

> As far as can be established nobody is keeping systematic performance records or indicators for commercial buildings in New South Wales.
>
> The Property Council gave up preparing its very useful annual report on energy use in office buildings in 1995 because of cost and lack of demand. As far as can be ascertained no other building type such as hospitals, shopping centres, police stations, court houses to name a few, has been studied by anyone. The Property Council has also abandoned its broad grading scheme for quality of office buildings because of objections from members who considered that periodic re-grading tended to reduce their property values. It is understood that the Facility Managers’ Association does no systematic benchmarking.

A recent study by the International Building Owners and Managers Association and the Urban Land Institute asked US and Canadian tenants about their satisfaction with commercial buildings. Table C.3 shows the importance that tenants attached to various aspects of commercial buildings. At the top of the list are costs and key amenities, such as air temperature and the quality of building management. ‘Environmentally friendly building systems’ and ‘cost of after-hour heating/cooling’ rate about halfway through the list, slightly above ‘elevator service speed’.

Table C.3 **Importance of, and satisfaction with building features, amenities and services**

	Important	*Satisfied*
	%	%
Rental rates (including pass-throughs/escalations)	99	88
Comfortable temperature	99	74
Indoor air quality	99	81
Acoustics/noise control	99	83
Building management's ability to meet your needs	99	89
Quality of building maintenance work	99	89
Effectiveness of communications with building management	99	86
Appearance of building	98	93
Operating expenses	98	87
Appearance of grounds/landscaping	98	92
Appearance of entry lobby (style/finishes)	97	89
Buildingwide security systems after hours	97	85
Appearance of common areas other than lobby	97	84
Power capacity	97	93
Tenant control of temperature	96	65
Image and prestige of the building	95	92
On-site parking	94	80
Tenant improvement allowance	93	83
Security/controlled access	93	90
Proximity to restrooms	93	95
On-site building management staff	93	90
Flexible suite layout (for example, easily reconfigured)	92	87
Cost of parking	91	75
Environmentally friendly building systems and materials	90	89
Cost of after-hours heating/cooling	89	79
Elevator service speed	88	72
On-site security guard	88	85
Buildingwide security systems during work day	88	85
Proximity to business services	87	98
Proximity to elevators	84	98
Proximity to where employees live	81	95
Proximity to restaurants/retail/personal services	81	94
Disabled access	78	92
Covered parking	77	77
Proximity to clients	76	98
Food service	75	71
Tenant mix	73	92
Outside signage for your organisation	71	80
Banking/ATM	70	79
Proximity to public transportation	69	95
Convenience retail stores	64	81
Outside loading docks	53	82
Fitness center	53	58
Child-care facility	44	48
Concierge	41	77
Operable windows	40	61
Shared videoconference facility	38	60
Shared teleconference facility	34	64
Shared business services (for example, data and word processing)	29	78
Roof-loading capacity	23	90

Notes: The numbers in the first column represent the percentage of respondents to whom a particular feature is important. 99 per cent thought the first eight features were important while 90 percent thought the first 25 were important. The second column indicates tenants' satisfaction with the features. Although nearly all tenants thought a comfortable temperature was important, only about three-quarters were satisfied with the temperature in their office space.

Source: BOMA/ULI (1999).

D Government programs

All levels of government in Australia deliver programs that aim to influence the environmental performance of commercial buildings in relation to energy consumption. They range from providing information, promoting partnerships between government and business and setting mandatory requirements. This appendix summarises these programs for New South Wales, Victoria, Queensland, Western Australia, South Australia, the ACT, and the Commonwealth.

Some of these programs relate to residential buildings but are included here as they may provide a guide to developments in the commercial building sector.

Local governments, through their planning laws, may also mandate some requirements for building standards that could relate to environmental performance. However, given their diversity, these requirements are not listed here.

Table D.1 **Programs relevant to building performance — New South Wales**

Program	*Nature of program*	*Relevance to building performance*
Construction Policy Steering Committee		
• Environmental management systems guidelines	Provides a systematic approach to management of the environmental impact of the construction industry.	All NSW government projects that go to tender require an environmental management plan.
Department of the Environment		
• Government Energy Management Policy	Establishes a framework for reducing greenhouse gas emissions across the public sector.	Promotes best practice in energy management to reduce energy use in government buildings.
Environment Protection Authority		
• Waste Reduction and Purchasing Policy	Agencies are required to plan and implement a strategy to avoid waste. The plan focuses on paper, office equipment, landscaping and construction materials.	Focuses attention on waste issues through a building's lifecycle.
Department of Works and Services		
• Total Asset Management Manual and Guidelines	Provides a systematic approach to resource allocation and physical asset management including attention to life cycle analysis, sustainable development and indicators of building performance.	Guidelines institutionalise a framework which may affect how government buildings in NSW use inputs.

(Continued on next page)

Table D.1 (continued)

Program	*Nature of program*	*Relevance to building performance*
Sustainable Energy Development Authority (SEDA)		
• Commercial Building Greenhouse Rating Scheme	A voluntary ratings program which aims to give star ratings to commercial buildings.	Increases commercial consumer demand for energy efficient design and operation.
• Energy Smart Business	Partnerships between NSW government and medium to large businesses.	Partnerships designed to increase the uptake of energy efficient design features, systems and operating features.
• Energy Smart Homes Industry Partnership	Partnership with NSW building companies.	Partner builders commit to building energy efficient homes, with SEDA's assistance.
• Community Housing Energy Program	Retrofit program for low income housing.	To increase efficiency of low income homes, saving tenants money and reducing greenhouse gas emissions.
• Building Integrated Photovoltaic Program	Rebates for building-integrated solar power systems.	Increase penetration of photovoltaic systems and reduce costs through economies of scale
• Energy performance contracting for government agencies	Cost savings through improvements in energy efficiency are used to pay contractors.	Aims to reduce energy use in government operations.

Table D.2 **Programs relevant to building performance — Victoria**

Program	*Nature of program*	*Relevance to building performance*
Energy Efficiency Victoria		
• Energy Smart Commercial Building Program	Aims to promote energy efficient commercial building design and construction practices.	Aims to reduce energy use in commercial buildings.
• 1ST Rate Housing Energy Rating Software	Software package to allow new homes to be assessed for energy efficiency at the design stage.	Seeks to reduce average energy use in the Victorian housing stock.
• Mandated insulation in new houses	Homes constructed after 1990 must meet minimum performance standards in relation to insulation.	Aims to reduce average energy use in the Victorian housing stock.

Table D.3 **Programs relevant to building performance — Queensland**

Program	*Nature of program*	*Relevance to building performance*
Department of Mines and Energy		
• Solar hot water rebate scheme	Provides rebates for the installation or replacement of solar hot water heaters.	Aims to reduce greenhouse gas emissions associated with hot water systems.
• energyWise	Provides advice on energy efficiency to homes, schools and businesses.	Aims to increase understanding and to offer advice on energy efficient design and construction.
Department of Public Works		
• Office Building Functionality Assessment System	Assesses government buildings against the functional needs of government.	Aims to ensure that building upgrades and refurbishments meet the needs of organisations.

Table D.4 Programs relevant to building performance — Western Australia

Program	Nature of program	Relevance to building performance
Office of Energy		
• WA Energy Efficiency Awards	Annual awards offered in six categories, including one for commercial building projects that incorporate energy efficient features.	Designed to promote energy efficiency in commercial buildings.
• Home energy line	Provides advice on energy saving within the residential sector.	Aims to promote energy efficient practices in housing.
• House Energy Rating Scheme	Allows houses to be compared with each other in terms of their heating and cooling needs.	Aims to promote the design of more energy efficient housing.
• Financing Efficient Energy Use (FEEU)	Provides grants to government agencies for energy audits and energy efficient capital upgrades.	Seeks to reduce energy use in WA government operations.

Table D.5 Programs relevant to building performance — South Australia

Program	Nature of program	Relevance to building performance
Department of Administrative and Information Services		
• Energy Management Guidelines	Assists energy consultants and government agencies develop energy saving strategies.	Seeks to reduce energy use in government operations.
• Asset Performance Review Process	Identifies and collects data to assess the relative performance of an agency's facilities in terms of its service delivery objectives.	Includes performance measures on the efficiency and effectiveness of the physical environment of a building.
• Strategic Asset Management Information System	Designed to match agency assets to business service goals and to optimise performance throughout the useful life of the asset.	Seeks to reduce the life cycle cost of public assets including buildings.
Office of Energy Policy		
• Greenhouse Gas Target Program	Aims to increase information available to the general community about energy efficiency.	Seeks to improve energy efficiency in the community, including the energy efficiency of buildings.
• Small Business Energy Saver Kit	Aims to increase information available to business in regards to energy efficiency.	Seeks to improve energy efficiency of business, including the energy efficiency of buildings.

Table D.6 Programs relevant to building performance — ACT

Program	Nature of program	Relevance to building performance
Department of Urban Services		
• ACT House Energy Rating Scheme	Requires all houses in the ACT to carry a 'star' rating indicating energy efficiency potential.	Aims to reduce average energy use in the ACT housing stock.

Table D.7 **Programs relevant to building performance — Commonwealth**

Program	*Nature of program*	*Relevance to building performance*
Australian Greenhouse Office		
• National Greenhouse Strategy	A strategic framework for Australia's greenhouse response.	The framework for government action in various areas includes the building sector.
• Community Partnerships - Cities for Climate Protection	Involves the local community in reducing greenhouse gas emissions through local government initiatives.	Some local government initiatives aim to reduce greenhouse gas emissions attributable to commercial premises.
• Minimum energy performance standards for certain electrical equipment	Minimum energy performance standards for items such as refrigeration and electric motors.	Certain equipment used in commercial buildings will be required to be more energy efficient.
CSIRO Building Construction and Engineering Division		
• On-going research into building construction and engineering	Research is aimed at, amongst other things, improving the performance of buildings.	Provides an information and consulting role to industry. Developments include software applications such as 'BUNYIP' and research into airconditioning and building materials.
Department of Finance and Administration		
• Commonwealth Procurement Guidelines	Clarifies requirements for Commonwealth procurement activity.	Agencies should take into account relevant environmental legislation or government objectives.
Department of Industry, Science & Resources		
• Greenhouse Challenge	A cooperative effort between industry and government to reduce greenhouse gas emissions.	Australian Building Energy Council and the Housing Industry Association have established programs in response to the National Greenhouse Strategy.
• Energy efficient codes and standards	A joint program with between Commonwealth, State and Territory Governments to encourage the manufacture and purchase of energy efficient appliances and commercial and industrial equipment.	Program will develop energy efficiency codes and standards for new and substantially refurbished housing and commercial buildings.
• Energy Efficiency Best Practice Program	A cooperative effort between government and industry associations to stimulate energy efficiency and to benchmark energy performance.	Aims to promote energy efficiency.
• Government Energy Management Group (GEMP)	A secretariat facilitating the exchange of information and expertise between State and Territory Governments.	Aims to improve energy efficiency in government operations — including buildings.
• Technology Diffusion Program	Program aimed at providing access to leading edge technologies for Australian industry.	May be used for access to ISTPs.

(Continued on next page)

Table D.7 (continued)

Program	*Nature of program*	*Relevance to building performance*
Department of Defence		
• Defence Energy Efficiency Program	Aims to cut energy use across all Defence facilities by 15 per cent by 2003. Defence consumes nearly half of all energy consumed by the Commonwealth Government.	Included components aimed at reducing energy consumption in Defence owned or operated facilities.
Government wide policies		
• Whole of government energy efficiency program	All newly constructed buildings, whether Commonwealth owned or leased, must meet minimum energy performance standards.	Aims to reduce energy use in government operations.
• Wastewise construction program	Ministerial representatives on ANZECC (Commonwealth and all State and Territory Governments) made a commitment to reduce waste to landfill and to set recycling targets.	Addresses issues of construction and demolition waste from the commercial construction industry.

E Case studies

The Commission has chosen the following case studies to document some of the many objectives that stakeholders pursue in relation to commercial buildings, and to highlight recent developments in building efficiency in Australia:

- facility management and the new central document storage facility at the National Library of Australia;
- the Housing Industry Association's PATHE (Partnership Advancing the Housing Environment) project;
- the ACT housing energy rating scheme (ACTHERS); and
- energy management at Myer-Grace Bros.

Issues arising from the case studies are summarised at the end of this appendix.

E.1 National Library of Australia facility management and the new document storage facility

National Library of Australia facility management

This case study demonstrates the benefits that can be gained by investment in well targeted input saving technologies and processes (ISTPs) and how savings in inputs can be the result of objectives unrelated to the efficient use of inputs.

Background

The Library has responsibility for maintaining and providing access to a national collection of library materials. It currently has a collection of over four million items, housed within some 200 kilometres of shelving. The collection is growing at a rate of five kilometres of shelving per year, or around 100 000 items.

In 1996, the National Library of Australia appointed a new manager to their building management section. From the outset, the manager was keen to ensure that the library used all its resources, including energy resources, as efficiently as possible. To achieve this goal, the manager had three main objectives:

- to improve facilities management while keeping within an existing budgetary framework;
- to guarantee that taxpayers' money is used as efficiently as possible; and
- to initiate more environmentally friendly management techniques at the library.

Main components of the initiative

When the manager of the Building Management Section was appointed, building services were little changed from their initial specifications of 30 years ago. Much of the plant and equipment at the library was performing to standards that were well below current industry best practice. The boilers, for example, had been designed with a capacity over 300 per cent above the building's current requirements.

To design improvements to the building's performance, the library sought to identify, first, the original design criteria and use patterns of the building and, second, the current occupational uses of the building. These were then compared and used to identify ways to optimise the building's performance.

Building management decided it would initially concentrate on reducing the building's energy use in zones that could give the largest and easiest savings. The initial changes to facility management focussed on areas that had the potential to generate income that could then be used to finance investment in areas that required a significant financial commitment. Some of the initial changes to the building included:

- installation of timer controls on air conditioner plants;
- replacement of 30 year old boilers with highly efficient hot water generators;
- installation of maximum current limiters on air conditioning chillers;
- disconnection of redundant computer equipment;
- staged replacement of 30 year old air conditioning plant along with the installation of direct digital controls, funded through energy savings; and
- staged installation of building management software to closely monitor and control the new air conditioning plant.

Outcomes

Energy consumption over the past three years has dropped from a peak of around 54 300 gigajoules (1996-97) to just under 31 400 gigajoules (1998-99). This represents a saving in energy costs of around $500 000 per year.

All ISTPs adopted to date are fully funded from these savings with some funds left over to undertake further efficiency improvements.

Document storage facility of the National Library of Australia

Background

In 1996, the National Library of Australia called for tenders for a new library storage facility in Canberra to complement its storage capacity.

The primary aim of the new library storage facility was to provide safe and accessible storage for the library's growing collection of books and other material. However, the building design's impact on the environmental performance of the building was also considered. The required thermal characteristics and heat flow through the structure, while primarily aimed at creating a suitable environment for the long term storage of books, also affects the building energy efficiency.

The library's collection is stored in 'closed stacks' and is not accessible to readers. On request, staff retrieve the required items, with the customer service objective of a maximum of two hours from request to delivery at the reading rooms. The library services approximately 600 000 requests of this type per year. Inter-library loans account for another 100 000 requests.

Main components of the initiative

In the call for tenders for the new facility, many of the required specifications of the building were performance based. The successful developer could use any design to meet the level of performance required.

A steering committee was formed to provide details of user requirements for the facility. A functional specification was prepared from this information, setting out the required characteristics of the building. The library prepared most of the contract documentation 'in house', but consulting engineers specified certain aspects of the building's performance, such as calculations of desired thermal characteristics.

After consideration of the competing tenders, the library chose DECOIN to build the new storage facility. DECOIN's concept design was developed to incorporate a number of innovative construction methods which provide both a stable internal building environment and the promise of reduced running costs. The facility was constructed on a two way post tensioned concrete slab, using cold room technology in both the walls and roof. This consists of an expanded polystyrene core sandwiched between pre-colour coated sheet steel.

Outcomes

As a result of the tendering specifications and process, the Library's new storage facility offers substantial reductions in energy use compared with more traditional buildings. For instance, the use of cold room technology allows the building to perform within agreed temperature and relative humidity specifications with a minimum of heating, cooling and ventilation. The specific air lock arrangement allows for the retention of the stable storage environment during frequent vehicular access. The costs in terms of staff and management time and so on to create the design specifications has not been recorded.

E.2 PATHE (Partnership Advancing the Housing Environment)

Information about ISTPs is important to the future uptake of technologies and processes that both act to minimise input use, create financial savings to firms, and minimise environmental impacts. This case study illustrates an industry effort to raise awareness of the benefits of ISTPs. While mainly focused on residential buildings, many builders are involved in both residential and commercial construction and lessons learned in one sector can be applied to the other sector.

Background

The Housing Industry Association in cooperation with Environment Australia, the Australian Greenhouse Office and Greening Australia, developed the PATHE project to enhance the environmental performance of residential buildings. This initiative concentrates on three main areas of environmental impact:

- waste management;
- energy efficiency; and

- environmental management practices.

The Housing Industry Association is a representative body of over 30 000 members across Australia. Membership comprises small builders, trade contractors and developers involved in the building industry. According to the association:

> PATHE's approach is broader than energy efficiency, focusing on the full spectrum of environmental issues. This integrated approach yields important synergies in reducing the 'environmental footprint' of a typical Australian building (sub. 19, p. 2).

This approach to environmental management is highlighted by the PATHE initiative's consistency with the aims and objectives of both the National Greenhouse Strategy and the WasteWise construction program.

Aim

The aims of the PATHE project are to promote technologies, including design and practices, that can improve the environmental performance of buildings. The initiative is based on the assumption that the major barrier to increasing efficiency in buildings is a lack of awareness of the benefits — both environmental and financial. These 'awareness barriers' (HIA, sub. 19) include:

- consumer perceptions;
- industry search costs;
- lack of knowledge of the impacts of different ways of operating a building; and
- overemphasis on minimising up-front costs against whole of life and running costs.

The project has an emphasis on demonstrating the sound economic basis of many ISTPs and on eliminating or reducing many current 'awareness barriers'. Once the benefits of ISTPs are realised within the housing industry, the association contends that 'these increases in efficiency will be relentlessly pursued in one of Australia's most competitive industries' (HIA, sub. 19, p. 3).

Main components of the initiative

The main PATHE programs are:

- the national PATHE GreenSmart Awards, recognising ‘leading edge’ practitioners in eight key area of environmental building performance including a National Energy Efficiency Award;
- a national series of information events and training programs aimed at increasing industry awareness of energy efficiency and environmental issues;
- information guides advising the industry of practical means of improving the energy efficiency, waste management and stormwater management of their buildings and building practices;
- the development of PATHE GreenSmart Building Software, which allows both builders and designers to demonstrate the environmental performance of different building designs to home buyers;
- a national code of environmental practice within the industry;
- a demonstration project — the GreenSmart Millennium Village — which consists of display homes specifically built to highlight the benefits, both to builders and home buyers, of environmentally sensitive buildings; and
- implementation of a program called ReLeaf, which aims to engage leading edge builders and developers in mitigating the greenhouse emissions associated with their buildings and practices.

Furthermore, the housing industry, through the association, will work with government to produce educational material for consumers that promotes GreenSmart outcomes.

The association has established performance indicators to gauge the impact of the PATHE initiative. Indicators are based on key PATHE objectives over three years. The PATHE Steering Committee (comprising members from the association, Environment Australia, Greening Australia and industry leaders) will implement these objectives.

An annual reporting framework developed by the steering committee will gauge performance against these objectives. Not only will this framework cover performance of the key PATHE initiatives: it will also provide the necessary reporting for government programs, including the WasteWise and Greenhouse Challenge Programs. The steering committee will review the PATHE project after its third year to gauge the effectiveness of all the individual initiatives.

E.3 ACT Housing Energy Rating Scheme (ACTHERS)

This case study highlights one method of regulating a standard for energy efficiency. While this is applied to residential buildings in the ACT, its application to commercial buildings is currently being considered by government.

Background

ACTHERS is a home energy rating system which uses a star rating system to gauge the potential energy efficiency of new and existing residential dwellings in the ACT. The 'star' rating system is used extensively in relation to energy efficiency. For example, on fridges and washing machines, and on computers compliant with the US energy star scheme.

ACTHERS is part of the ACT's Greenhouse Response Strategy which encompasses a number of government programs and actions. ACTHERS aims to:

> … encourage an awareness in both the community and building industry of the benefits of energy efficiency, and to demonstrate the Government's commitment to the National Ecologically Sustainable Development and Greenhouse Strategies. (Department of Urban Services 1996, p. 2)

The use of ACTHERS became mandatory on 1 July 1995 for all houses planned for construction. With the legislative backing of the *Energy Efficiency Rating (Sale of Premises) Act* 1997, this scheme was extended, on 31 March 1999, to include all residential property for sale in the ACT. It is the only compulsory residential house rating scheme operating in Australia.

The implementation of ACTHERS represents a commitment by the ACT government to implement the Nationwide House Energy Rating Scheme (NatHERS).

Main components of the initiative

This scheme requires almost all homes built after 1 July 1995 to comply with the ACT's minimum energy performance standard for residential property. Homes built in the ACT after this date must achieve at least a four star rating out of a possible five. Homes deemed to perform below this standard will not progress to the final approval stage unless it can be demonstrated that: it would be impossible to comply (because of site characteristics); novel construction techniques preclude a reliable assessment; or it would be uneconomic to meet the minimum standard.

The second aspect of the scheme applies to any advertisement for sale of residential property in the ACT. Advertisements must contain a statement of the energy efficiency rating obtained. Ratings are obtained from registered assessors trained in the use of the ACTHERS' assessment program. They concentrate on four main factors: air leakage; insulation; other design features; and windows (including orientation). The vendor, before entering into a contract for sale, must also provide a prospective purchaser with a copy of an energy efficiency rating statement for the premises. Failure to do so, or publication of false or misleading energy ratings, may result in a penalty.

ACTHERS assessment software is based on that used by NatHERS. NatHERS uses a modified energy assessment computer software package (CHEETAH) developed by CSIRO.

Both NatHERS and ACTHERS use performance based assessment. That is, instead of specifying required building structures and fitouts, they specify required energy efficiency targets. Residents are free to choose any design or combination of technologies to meet the standards. Any property that passes the specified overall efficiency threshold is deemed to comply. A similar approach, linked to the Building Code of Australia, was advocated for commercial buildings by Associate Professor Langston (sub. 1). Associate Professor Langston suggested extension of the concept of operational energy to also include embodied energy.

E.4 Energy management at Myer-Grace Bros

Savings in energy inputs can be a result of processes and management expertise internal to a firm (as illustrated in case study F.1). However, in many cases, firms do not have the required expertise to undertake such action. This case study details a cooperative effort between a firm and a specialist contractor that has resulted in substantial changes to the firm's internal management of one input — energy.

Background

In 1996, Myer-Grace Bros instigated an energy management program in its Australia-wide retail operations. The two main objectives were:

- to treat energy as a cost that could be minimised; and
- to initiate a program that would produce environmental benefits.

Myer-Grace Bros commissioned energy management consultants Lincolne Scott to undertake energy audits in all 75 of its Australian sites to identify potential ISTPs and to design and implement an energy saving program.

Main components of the initiative

The ongoing energy efficiency program is divided into four phases to be implemented over a number of years:

- initial auditing of stores, collection of data and initiation of non-capital energy saving (1996);
- ongoing monitoring and reporting of energy consumption and implementation of further energy-saving ISTPs over a three year period (ongoing);
- implementation of capital intensive ISTPs such as lighting controls, air conditioning and changes to building design (ongoing); and
- introduction of energy efficiency planning in the construction and refurbishment of new and existing buildings (ongoing).

In order to ensure that any recommendations resulting from the initiative would not be financially onerous, three basic rules were followed:

- energy efficiency must be easy to achieve;
- it must be achievable within existing maintenance budgets; and
- measures should not involve excess capital outlay.

From the outset, Myer-Grace Bros and Lincolne Scott were keen to ensure that energy efficient solutions were integrated into day-to-day management. In contrast, previous measures were seen to rely on technical solutions. Myer-Grace Bros wanted energy use to be addressed as a management problem, not purely a technical issue.

A simple and effective reporting framework was designed after extensive consultation between Lincolne Scott and Myer-Grace Bros. This involves a remote energy monitoring system that reports to Lincolne Scott’s offices. From this data, company-wide energy consumption, individual store consumption and excess energy use can be reported to both senior management and those charged with the day-to-day operation of the stores. Myer-Grace Bros also distributes posters and information bulletins on energy efficiency, and provides energy efficiency awards for staff.

Ongoing communication between Myer-Grace Bros and Lincolne Scott has allowed both parties to identify further solutions that will drive energy efficiency in the longer term. The online building management system, for example, has been developed using an open protocol (where no firm owns the programming and other companies can use it) allowing Myer-Grace Bros to source new components under a competitive regime.

Both parties attribute a large part of the success of this program to their close working relationship.

Outcomes

In the initial audit, potential annual savings of $5.5 million were identified, representing 16 per cent of the company's total annual expenditure on energy. Further savings are expected as the process continues.

E.6 Issues arising from the case studies

As demonstrated by the chosen case studies, companies and organisations pursue measures that act to reduce the intensity of input use for a number of reasons. Companies generally act to reduce the cost of their operations while governments may instigate education campaigns or other programs where they perceive a case of market failure that warrants government action.

The case studies raise several issues relating to why, and how, action may be taken:

- the importance to energy efficiency of a commitment by both building management and the owners to improving building performance;
- the use of performance objectives and performance based contacting and ongoing monitoring to drive innovation in building design and management;
- the possibility of achieving savings without significant expenditure on capital upgrades;
- the continuing role for industry to provide information on energy efficiency; and
- the importance of institutionalising energy efficiency within management practices.

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