Australia's approach to energy efficiency and the building code

Mr Stephen Berry, Dr Tony Marker and Mr Philip Harrington, Australian Greenhouse Office

1. SYNOPSIS

Australia is developing a comprehensive program of voluntary and mandatory measures to address building energy efficiency and greenhouse gas emissions.

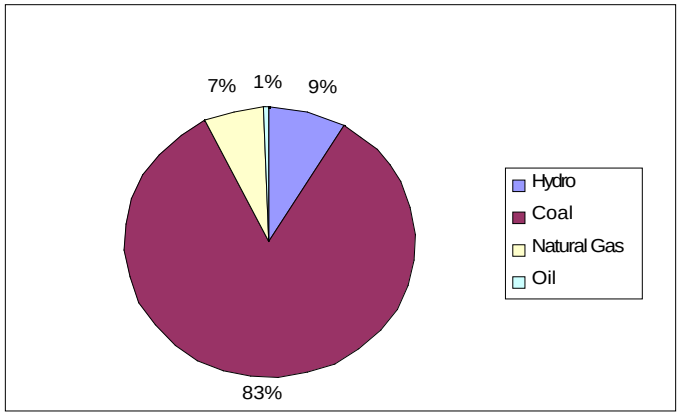
2. ABSTRACT

The energy and greenhouse efficiency of buildings in Australia has been subject to considerable debate and action over the last ten years. In March 1999, the Australian Government announced it had reached agreement with the building industry to reduce the energy consumption and related greenhouse gas emissions from the operation of buildings.
This paper outlines the research into the energy and greenhouse performance of Australian buildings that lead to the agreement between Government and industry and the action plans designed to achieve the greenhouse abatement.
Voluntary best practice initiatives and consumer demand strategies, integral to this holistic program, are noted, as are details of the partnership approach taken by the Australian Government.
The paper concludes with details of the building code change process underway in Australia, and the research into existing prescriptive building energy requirements that has influenced the performance approach adopted.

3. AUSTRALIA'S ENERGY & GREENHOUSE SITUATION

Australia is a strongly carbon based economy, with extensive coal and natural gas reserves, and a small but rapidly depleting oil reserve.
The share of fuels consumed in 1998 was approximately 45 per cent coal, 33 per cent petroleum, 17 per cent natural gas, and only 5 per cent biomass. Australia has large uranium reserves but no nuclear power generation.
Australia is the driest continent on Earth and there is limited potential for hydro power generation. Hydro contributes only 8.7 per cent to the total electricity generation across Australia, although its contribution is significant in regions such as Tasmania.

Figure 1. Electricity Generation by Fuel Type 1998/99

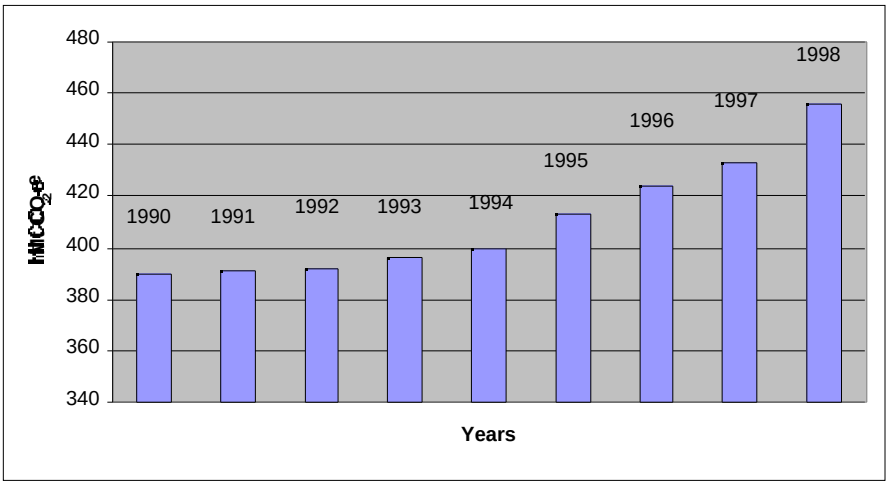


Electricity Australia 2000, 2000, Electricity Supply Association of Australia, Canberra

The potential for solar and wind generation across Australia is almost limitless but these technologies are yet to be exploited in any significant way.

Electricity generation is dominated by large coal fuelled power stations, with a resultant high greenhouse intensity of electricity.
Total greenhouse gas emissions produced in Australia are large by international standards, and in 1999 it was reported that Australia was the largest greenhouse polluter per capita in the world.
The Australian Greenhouse Office is responsible for analysing and quantifying emissions according to methodologies agreed by the international Panel on Climate Change, and publishing the results in *Australia's National Greenhouse Gas Inventory*.
As can be seen in the figure below, Australia's emissions have steadily grown, reflecting high rates of population and economic growth.

Figure 2. Australian Net Greenhouse Emissions 1990-1998



National Greenhouse Gas Inventory 1998, 2000, Australian Greenhouse Office, Commonwealth of Australia

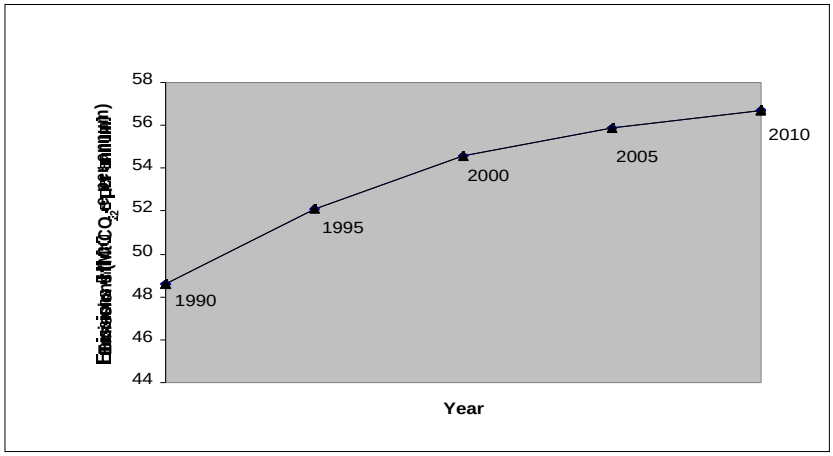
4. AUSTRALIAN BUILDING RELATED GREENHOUSE

As would be expected from a scenario of cheap energy and a particularly mild climate, Australian buildings have traditionally been wasteful of energy and thermally inefficient.
The Australian climate ranges from cool temperate to tropical zones, with almost all large cities within the very mild temperate band. No large urban areas are subject to regular annual snow falls or daytime maximums below zero degrees Celsius. Most urban areas cling to the coastline, further moderating regional climatic conditions.
The Australian Greenhouse Office, with the co-operation of the building industry, commissioned studies into the operational energy and greenhouse performance of Australia's residential and commercial building sectors.
Because of the state of scientific consensus on the application of life cycle analysis and insufficient building product embodied energy data, the baseline studies focussed on emissions caused by the operation of buildings rather than those embodied in materials. Therefore the quantification of environmental impacts in these baseline studies, although representing the significant percentage of impacts, is less than that resulting from a full lifecycle assessment method.
These studies titled *Australian Residential Building Sector Greenhouse Gas Emissions 1990-2010 and Australian Commercial Building Sector Greenhouse Gas Emissions 1990-2010* were published by the Australian Greenhouse Office in 1999.
Additional research into the performance of new residential buildings in the State of Victoria was commissioned by the Australian Greenhouse Office and released in 2000. This study titled *Impact of Minimum Energy Performance Requirements for Class 1 Buildings in Victoria* examined the energy and greenhouse performance of a representative sample of actual house plans approved for construction in 1990 and made comparisons with a similar representative sample of plans from 1999.
Together these reports form the most comprehensive energy and greenhouse data of Australian buildings ever produced, and provide an insight into the performance of both the aggregate stock and contemporary buildings.

Residential Buildings

In the residential sector the mix is predominantly detached housing, on relatively large blocks of land, geographically spread out across suburban sprawl.
The Australian residential sector has traditionally been dominated by single storey detached housing, although this trend is changing as the popularity of inner urban apartment living increases in the major metropolitan areas. The residential baseline study found that by 1997 the stock was 70 per cent detached and 30 per cent non-detached.
The residential building stock model developed in the residential baseline study revealed that brick veneer (outer brick single leaf wall covering lightweight frame) represented 39 per cent of Australian homes by 1997, lightweight construction 33.5 per cent, and cavity brick/heavy weight construction 27.5 per cent. This pattern is rapidly changing, by 1999, around 85 per cent of new construction was brick veneer, with cavity brick construction falling to a much smaller percentage of the market.
The methodology applied in the residential baseline study was to reconcile top down and bottom up energy consumption and apply known energy source greenhouse intensities. For example, for residential buildings a stock model was developed from census data, sales data, industry records and energy performance measurements. This model was then compared with total sectoral energy consumption information.
The results indicate that buildings are responsible for a large and growing slice of Australia's greenhouse emissions. In fact the energy used in buildings accounts for almost 27 per cent of all energy related greenhouse gas emissions in Australia.
In the residential baseline study, total greenhouse emissions in 1990 were estimated to be 48.6 MT of CO_2 equivalent, and the business-as-usual projection including existing building law measures for 2010 was estimated to be 56.7 MT of CO_2.

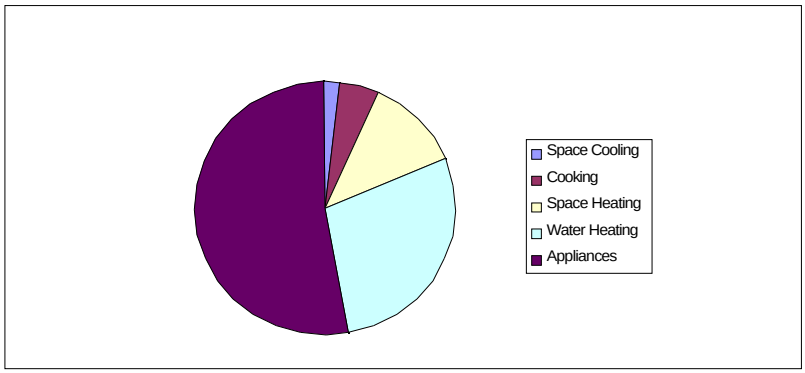
Figure 3. Residential Building Greenhouse 1990-2010



Australian Residential Building Sector Greenhouse Gas Emissions 1990-2010, 1999, Australian Greenhouse Office

This equates to a 17 per cent increase in greenhouse emissions, well above Australia's Kyoto target limiting growth to 8 per cent above 1990 emissions. This increase would be greater if existing building law measures and minimum energy performance standards (MEPS) for appliances were not taken into account.
Due to the high greenhouse intensity of electricity, the largest block of emissions by end use were electrical appliances and equipment. Of this block refrigeration is the largest energy consumer, although the growth in standby energy load is notably high.
Other causes of emissions by end use were hot water at 28 per cent and heating and cooling at 14 per cent. Cooking was only responsible for about 5 per cent of total end use emissions.

Figure 4. Residential Greenhouse Emission Share by End Use 1998



Australian Residential Building Sector Greenhouse Gas Emissions 1990-2010, 1999, Australian Greenhouse Office

These average emissions by end use hide changes in the way buildings are being used. The number and use of electrical appliances and equipment is growing quickly, but simultaneously their efficiency is improving and overall emissions from this group are not growing significantly.

The projection of heating and cooling emissions for the residential sector, although arguably significant in its own right, does not fully spell out the extent of need to address greenhouse emissions through building regulation.

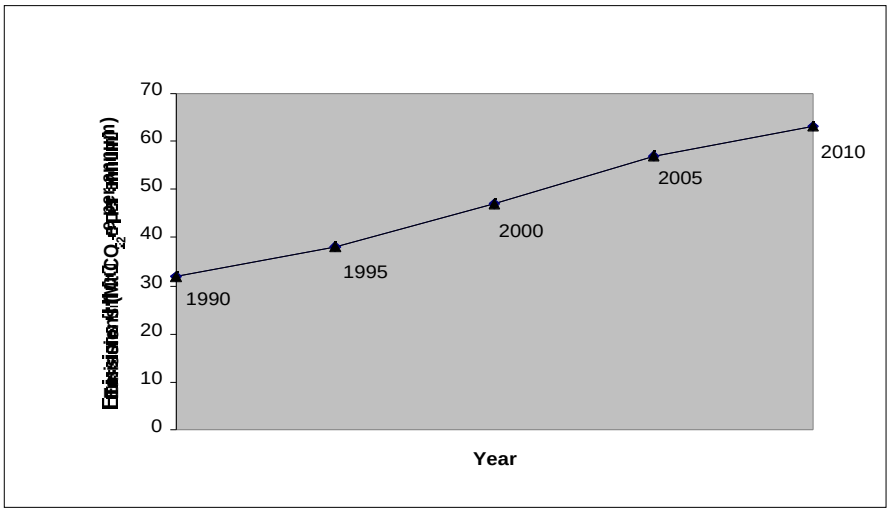
When building shell related heating and cooling emissions are isolated, business-as-usual projections with existing building law measures to 2010 are estimated to be 54 per cent higher than in 1990. The residential baseline study projected new buildings to be 39 per cent larger by floor area in 2010, and when combined with increases in comfort demanded by residents, heating and cooling emissions are expected to grow quickly.

When you consider the long useful life of our housing stock, it is clear that any improvements in thermal efficiency of the building shell will have long term benefits.

Commercial Buildings

The baseline study of greenhouse emissions from commercial and public buildings indicates even larger growth than that of the residential sector. Total business-as-usual greenhouse emissions are predicted to increase by 95 per cent from 1990 to 2010, from 32.2 Mt to 62.8Mt.

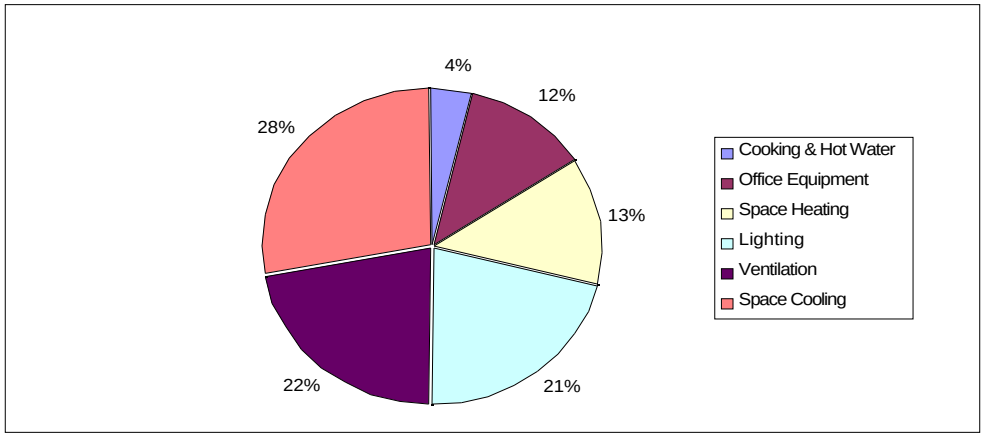
Figure 5. Commercial Building Greenhouse 1990-2010



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

The baseline study found that cooling, air handling, and lighting were responsible for around 71 per cent of greenhouse gas emissions in 1990, and are responsible for the majority of predicted emission increases to 2010.

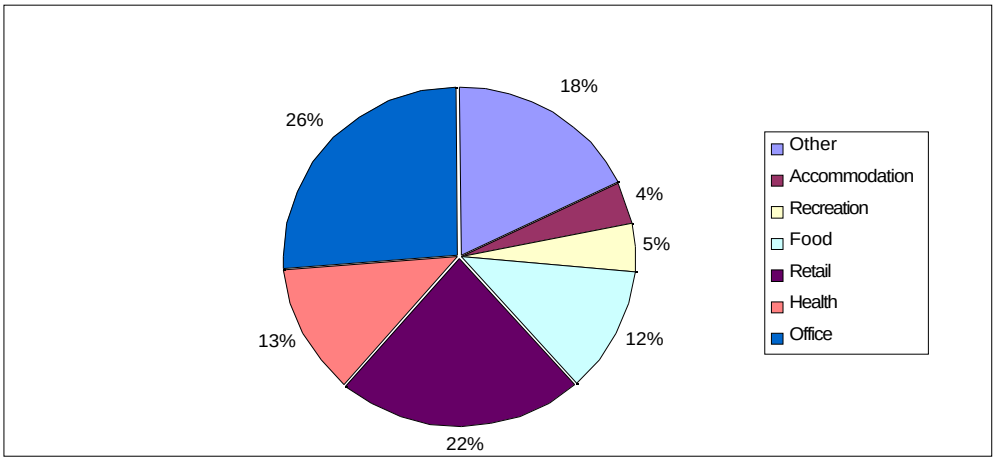
Figure 6. Commercial Greenhouse Emission Share by End Use 1998



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

The commercial building sector baseline study found that office buildings and retail were the two largest emitters by building type, causing nearly half of total sectoral emissions.

Figure 7. Commercial Greenhouse Share by Building Type 1990



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

Results from the residential and commercial building sector baseline reports provide a clear indication of the size and scope of the challenge in front of the building industry to reduce greenhouse gas emissions.

5. ENERGY EFFICIENCY POLICY FOR BUILDINGS

Energy efficiency policy, in a land of abundant and cheap energy, has not traditionally had a high profile. During the oil crisis of the 1970's the issue was debated and as a result infrastructure expanded for alternative carbon based fuel types such natural gas.

As Australia, at that time, still produced much of its oil needs, energy efficiency policy remained a secondary concern. This changed during the late 1980's and 1990's when the link between energy use and environmental concerns grew.

In 1990 the Australian Government responded to the *1988 Toronto Convention on the Changing Atmosphere* by holding a National Forum on Energy Efficiency in Buildings.

In 1991 the Building Regulation Review Task Force proposed the development of a “Model Code for Energy Efficiency in Buildings” for both housing and commercial buildings. The project to develop the Building

Energy Code of Australia (BECA) grew from this report and involved all jurisdictions through the Australia and New Zealand Minerals and Energy Council (ANZMEC).
BECA was abandoned in 1996 after a torturous process lasting 5 years. Among the reasons for the failure of this project was the strategy to develop an energy code separate from the primary building performance regulatory tool, the Building Code of Australia.
From the work undertaken by BECA it became clear that regulation of building energy efficiency must be applied through the existing regulatory framework.

6. PRIME MINISTER'S GREENHOUSE STATEMENT 1997

In 1997, in the lead up to Kyoto, the greenhouse statement by the Prime Minister, Mr John Howard, titled *Safeguarding the Future*, mapped out the Commonwealth Government's action plan to address Australia's contribution to global climate change. The most significant component of this package was the formation of a national agency on greenhouse matters.
The Australian Greenhouse Office (AGO) was established in April 1998, bringing together programs from three Commonwealth departments, forming the world's first national government greenhouse agency.
The AGO is responsible for the co-ordination of domestic climate change policy and the delivery of key greenhouse response programs in the *National Greenhouse Strategy*. The AGO works with industry and government partners to take immediate action in reducing emissions, to improve the knowledge base on Australia's production of emissions, and to promote ecologically sustainable energy.
The AGO is based in Canberra, the National capital and seat of government, and has just over one hundred and fifty staff committed to numerous programs directed at quantifying and reducing greenhouse gas emissions.
From an initial package totalling AUS$180 million, the AGO budget was supplemented in 2000 with further AUS$800 million greenhouse abatement package of which around half was earmarked to develop a fledgling renewable energy industry.
The scope of programs now includes actions for the transport sector, alternative fuels development, electricity generation efficiency standards, energy market reform, emission trading research, renewable energy technology commercialisation, community and corporate engagement programs, mandatory minimum energy performance and disclosure requirements for appliances and industrial equipment, and programs for the building sector.

7. INDUSTRY RESPONSE

Safeguarding the Future identified the building sector as a key industry in the reduction of greenhouse gas emissions, and gave the building industry twelve months to develop an industry driven strategy for greenhouse change, otherwise Australian governments would regulate energy performance levels.
The Australian Greenhouse Office worked closely with key building industry representative organisations to develop a plan with the goal of changing the behaviour of building industry members towards the design, construction and use of energy efficient buildings.
Following two national building energy forums held in 1998, the Australian Building Energy Council (ABEC) was created as a peak body for building industry views on energy and greenhouse issues.
ABEC, on behalf of the building industry, responded to the Prime Minister's statement in late 1998, calling for a two pronged approach of government support to encourage best practice in building design, construction and operation, plus the elimination of worst energy performance practice by the addition of minimum energy efficiency requirements into the Building Code of Australia.
In March 1999, the Commonwealth Government's Ministerial Council on Greenhouse announced that it had reached a landmark agreement with the building industry on a comprehensive strategy aimed at making Australian buildings more energy efficient, and therefore reduce their contribution to Australia's greenhouse gas emissions.

8. VOLUNTARY PROGRAMS

The Australian Government together with the building industry has developed programs to create awareness of the impact of industry members and their products on the environment, has provided tools such as guide books and computer software, and has sponsored education and training programs.
The AGO has funded the documentation and promotion of excellence in energy efficient design, and is leading by example by requiring that all Government Agencies report on, and reduce their greenhouse impacts.

Many of the programs are also designed to prepare the building industry for mandatory energy performance requirements.

The strength of the voluntary program is the broad reach across industry participants, from builders to designers to owners to facility managers to building users, with many industry representative groups actively involved.

The most important principle of the voluntary program is that all initiatives are designed by industry and implemented by industry.

Key programs funded by the Commonwealth Government include the Housing Industry Association's Partnership Advancing the Housing Environment (PATHE), the Window Energy Rating Scheme (WERS), Master Builders Australia's Building Environment Dividends Program (BEDS), and the residential consumer and technical guide project titled *Your Home.*

The PATHE project has raised the awareness of builders to the need for improved environmental performance of their construction techniques and products, provided nation-wide training and showcased excellence in environmentally sensitive housing.

WERS has provided consumers and industry professionals with an easy to understand star rating system describing the impact of window products on the thermal performance of houses.

The small and medium sized commercial building sector is being trained in the science of energy performance under the BEDS program. The Master Builders Australia project provides the tools to deliver, and marketing assistance to sell, energy efficient buildings within a market that has traditionally focussed on price alone.

The most ambitious project to date is the *Your Home* suite of consumer and technical guides. This projects aims to create demand for environmentally sustainable homes through the distribution of a glossy full colour consumer booklet, whilst delivering the technical knowhow through the accompanying technical manual for builders and design professionals. The supporting and integrated education and training program has been developed with the major industry representative organisations to ensure that their members can meet the demand for better housing.

9. MANDATORY PROGRAMS

The Commonwealth Government, although lacking in jurisdictional responsibility for mandating performance requirements, is managing on behalf of the Australian and New Zealand Mineral and Energy Council (ANZMEC), a program of setting minimum energy performance standards (MEPS) for appliances, industrial equipment and buildings. The Australian Greenhouse Office is responsible for developing the national MEPS program.

A similar program of mandatory energy performance disclosure is also managed by the AGO for ANZMEC. Already many household appliances are required to display energy performance labels, and mandatory disclosure of house energy performance is also under investigation.

In 1999 the Australian Greenhouse Office funded a scoping study to determine whether it is possible to incorporate minimum energy performance requirements for both residential and non-residential buildings into the Building Code of Australia.

This study concluded that the Building Code of Australia can be amended to set minimum energy efficiency levels in new buildings, which will result in meaningful reductions in greenhouse gas emissions in the building sector compared to the business as usual case, and that progress toward the incorporation of minimum energy performance requirements into the Building Code of Australia should only take place with consensus agreement from all key stakeholders.

10. RATING TOOLS

For residential buildings, an important historical landmark has been the development of the Nation-wide House Energy Rating Scheme (NatHERS) with the involvement of all jurisdictions through ANZMEC.

A NatHERS house energy performance star rating is formed from the assessment of the energy required to maintain human thermal comfort levels as determined by thermal modelling software.

As a tool for evaluating the energy efficiency of residential building shells under Australian conditions, NatHERS has become the industry standard, although its total influence has been limited until recently due to a generally slow uptake by the building design industry.

The NatHERS star rating system is based on zero stars equivalent to zero thermal performance and 10 stars equivalent to no supplementary heating and cooling required to maintain human comfort. The average Australian home built in 1990 had a NatHERS performance of approximately 1 star. 5 stars NatHERS is

considered a good but not exceptional thermal performance standard for Australian homes. Less than one per cent of Australian homes meet the 5 star standard.
The development of rating tools for non-residential buildings for Australian conditions has lagged that of residential tools. The Sustainable Energy Development Authority of New South Wales has developed a voluntary greenhouse rating tool to assess the operational greenhouse performance of commercial office buildings, which other State Governments have adopted.

11. REGIONAL BUILDING ENERGY CODES

Although the national section of the Building Code of Australia has never referenced an energy performance standard, some State and Local Governments have required minimum performance levels.

Victoria

In March 1991, the State of Victoria took the first step towards marrying energy efficiency with building law by introducing mandatory minimum insulation requirements for ceilings, walls and floors in residential buildings.
Buildings were also deemed to satisfy these minimum insulation regulations if the building shell achieved a 4 star rating by a recognised house energy rating tool such as NatHERS.
In August 1996, after considering research funded by the National Association of Forest Industries, the minimum insulation regulations were reduced for buildings with timber floors, and the deemed to satisfy requirement reduced to a 3 star rating.
In 2000, with the support of the Victorian State Government, the Australian Greenhouse Office funded a study to determine the impact of minimum insulation performance requirements. The results of this study are discussed later in this paper.

Australian Capital Territory

The Australian Capital Territory Government took energy efficiency even further by making the rating of new housing compulsory from 1 July 1995, and most importantly legislated the minimum acceptable rating as four stars from 1 May 1996.
Consequently, the ACT now has a fully implemented performance evaluation protocol and Minimum Energy Performance Standards for new housing.
ACT's House Energy Rating Scheme is based on NatHERS, a move designed to ensure that the ACT building industry would be well placed to offer services across State borders.
In fact the building industry was consulted during all stages of the program's development, leading to a joint industry and government steering committee being established to oversee its successful implementation.
The ACT Government has reaffirmed its commitment to improving the energy efficiency of housing by introducing mandatory disclosure of energy performance on sale of residential property from April 1999.
In 2000, with the support of the ACT Government, the Australian Greenhouse Office funded a study to determine the impact of mandatory energy performance disclosure. The results of this study are discussed later in this paper.

New South Wales

In 1997 the New South Wales Government through the Sustainable Energy Development Authority (SEDA) announced the voluntary Energy Smart Homes Program.
The Energy Smart Homes Program is designed to assist local government to adopt and implement a model energy efficiency policy.
Under this program the building envelope must have a minimum of 3.5 stars on NatHERS or an equivalent rating tool, dwellings should be designed so artificial lighting is unnecessary during daylight hours, and the hot water system must meet a Greenhouse score of 3.5 or greater.
By 25 September 1998 around 50 per cent of all residential building approvals in New South Wales were located in Councils committed to the Energy Smart Homes Program.

12. PRESCRIPTIVE REGULATION EFFECTIVENESS

Regional responses to building energy codes have favoured two distinct strategies: (a) prescribing building practice by requiring minimum insulation levels; and (b) setting a performance level that must be met using a NatHERS family software tool.

The introduction in 1991 of regulations under the Building Control Act (Vic) to require compliance with specified minimum R-values of insulation for roof or ceiling, external walls and ground floor for all houses, is an excellent example of regulators attempting to solve an energy efficiency problem by a single prescribed technology.

In fact there is an alternative path to the specified minimum R values of insulation, approval is also given if a design achieves a NatHERS rating of at least 3 star using a nominated software tool. In practice, almost all residential building approvals in Victoria have been based on compliance with minimum insulation requirements.

In 2000, the Australian Greenhouse Office, with support from the Victorian Government, commissioned a study into the impact of this regulation on the energy and greenhouse performance of houses.

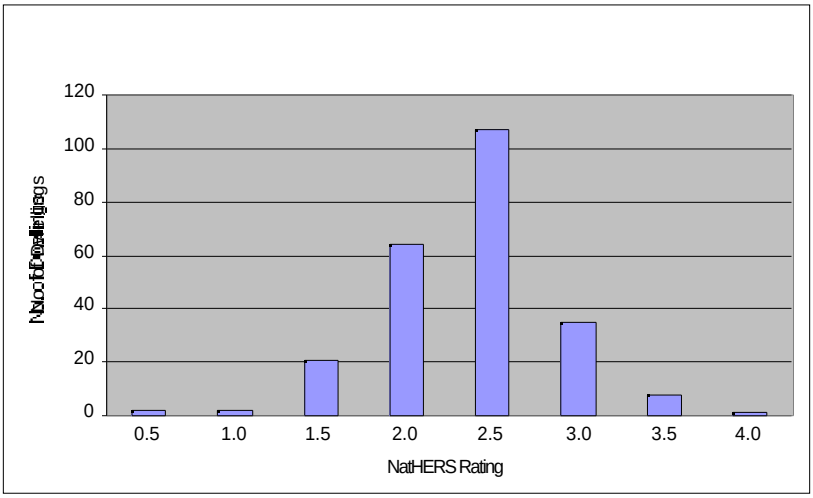
The results were startling and demonstrate that building energy efficiency is a complex problem and can not be controlled in most cases by the application of just one energy saving technology such as insulation.

The study, titled *Impact of Minimum Energy Performance Requirements for Class 1 Buildings in Victoria* examined a representative sample of 110 actual house plans approved for construction in 1990 and made comparisons with a similar representative sample of 240 plans from 1999. This meant that houses before and after the introduction of the energy efficiency regulation could be analysed and compared.

This modelling established that without regulations, houses built between 1990 and 2000 would have had an average thermal performance equivalent to less than NatHERS 1 star rating. With current regulations, the post 1991 housing stock was found to have an average performance level of 2.2 stars.

Despite the introduction of mandatory minimum insulation requirements, the 1999 sample showed that a substantial number of poorly performing houses were produced. Across the total 1999 housing sample, more than 80 percent failed to meet the alternative 3 star performance requirement, with some only achieving 1 star or less.

Figure 8. Thermal Efficiency Distribution by NatHERS Rating, 1999 Sample



Impact of Minimum Energy Performance Requirements for Class 1 Buildings in Victoria, 2000, Australian Greenhouse Office

Improvements in average thermal efficiency since the introduction of regulations have been modest: Since 1991/92 there has been a total of only 6 per cent improvement in building shell thermal efficiency (in terms of energy per unit of floor area). This weak trend levelled off to practically zero over the last few years of the study. Due to the increasing average floor area per house, measured at 25 per cent between 1990 and 1999, total energy consumption per house actually increased significantly over the period. Apart from improvements gained as a result of mandatory insulation regulations, improvements in building shell thermal efficiency in other areas of building design were found to be almost non-existent.

Based on criteria established in the report for assessing solar passive design, only 7 houses out of the 240 sampled in 1999 were found to meet the criteria, and is considered representative of current building practice in Victoria. This demonstrates that passive solar design practices are not applied to any significant extent in Victoria by the building industry.

With the regulation focussing attention on insulation, the study found that there have been no noticeable change in the uptake of high performance glazing, adoption of passive solar design, optimal orientation or change in building shell construction methods. In fact Australia has one of the lowest rates of uptake of high performance glazing in the developed world.

The introduction of thermal performance requirements for the building shells of Victorian houses has, to a limited respect, reduced energy consumption and greenhouse gas emissions compared with business as usual projections.

The prescriptive insulation code has delivered residential buildings with a state average rating of NatHERS 2.2 stars, although the performance goal was 3 stars. This achieved performance standard is well behind world's best practice, and due to its consideration of only one energy saving technology, has permitted buildings with less than 1 star rating to be constructed.

13. FEASIBILITY STUDY

As a result of the study into the impact of minimum insulation requirements in Victoria, the Australian Greenhouse Office together with the Australian Building Codes Board commissioned a study to establish the best approach to regulating energy performance in housing through the Building Code of Australia.

The Building Code of Australia is a performance document, meaning elemental performance levels are not numerically prescribed and building design professionals can use alternative conformance paths to prove that their solution meets the qualitative performance requirement. This system allows greater design freedom and encourages innovation although can lead to conformance checking complexity.

Within the Building Code of Australia framework is a series of acceptable construction practice prescriptions, based on commonly used construction systems. Construction to these prescriptions is deemed to satisfy the performance requirement.

The Feasibility Study found that the acceptable construction practice recipes should be climate specific, in no less than 6 climatic zones, and should cover as a minimum:

- Minimum insulation levels for ceilings or roofs, walls, floors and windows;
- Specified permanent shading of windows and/or walls;
- Maximum window to floor ratios or minimum coefficients for solar gain;
- Specified ventilation opening to floor area ratios for designs utilising natural ventilation as the primary means of comfort control; and,
- Weather stripping and dampers to control infiltration.

It is also likely that individual State Governments will legislate for a NatHERS style computer modelling performance level to be deemed to satisfy the qualitative performance requirement.

14. BUILDING CODE ENERGY EFFICIENCY PROGRAM

In July 2000 the Australian Government reached agreement with the Australian Building Codes Board over funding for the building code changes.

Since this agreement a Steering Committee, two Technical Committees and numerous Working Groups have been established to develop sections of the new code. In all cases the committees comprise representatives of government, industry and independent technical experts.

The building code change program is characterised by consensus decision making based on rigorous research and cost effectiveness testing.

Earlier in 2001, the Australian Greenhouse Office together with the Australian Building Codes Board commissioned a study to determine what performance level and which sets of prescriptive energy efficient requirements can be determined to be cost effective for houses in each climate zone. This research will help inform industry experts and is expected to help build consensus on the appropriate minimum energy performance level for Australian housing.

Similar analysis is being considered for commercial and public buildings or the sub systems that directly affect energy performance.

The code change program is expected to be completed by 2004, although sections of the code are expected to be released as soon as 2002.

15. CONCLUSION

To summarise, this paper has described the path taken so far by the Australian Government in its quest to reduce the impact of Australian buildings on the global climate.
Extensive research into the impact buildings have on the emission of greenhouse gases in Australia has led to concerted effort by industry and governments to deliver change.
The research has found that amending the building code to incorporate minimum energy performance standards will result in significant greenhouse gas abatement but will not result in the widespread adoption of best practice.
Studies into the potential for abatement have refocused attention toward a more holistic approach which includes educating and training industry members, and providing them with the tools to deliver best energy practice in the design, construction and operation of buildings.
The strategy of government and industry working in partnership to facilitate the improvement of building energy performance has enabled the fast tracking of abatement actions.
A program of parallel regulatory and voluntary projects, reinforced by the creation of demand for better performing buildings, has been widely accepted and celebrated within the building industry.
Although the program is still in its infancy, the dramatic increase in the construction and marketing of energy efficient homes is a clear indicator of industry and consumer awareness of the benefits of better buildings.
A more detailed assessment of the program's success is planned in future years.

16. REFERENCES

Australian Greenhouse Office, 2000, *National Greenhouse Gas Inventory 1998*, Australian Greenhouse Office, Commonwealth of Australia

CSIRO, 1999, *Scoping Study of Minimum Energy Performance Requirements for Incorporation into the Building Code of Australia*, Australian Greenhouse Office, Commonwealth of Australia

CSIRO, 2000, *Feasibility Study - A National Approach to Energy Efficiency Measures in Houses*, Australian Greenhouse Office, Commonwealth of Australia

Energy Efficient Strategies, 1999, *Australian Residential Building Sector Greenhouse Gas Emissions 1990-2010*, Australian Greenhouse Office, Commonwealth of Australia

Energy Efficient Strategies, 2000, *Impact of Minimum Energy Performance Requirements for Class 1 Buildings in Victoria*, Australian Greenhouse Office, Commonwealth of Australia

EMET, 1999, *Australian Commercial Building Sector Greenhouse Gas Emissions 1990-2010*, Australian Greenhouse Office, Commonwealth of Australia

Electricity Supply Association of Australia, *Electricity Australia 2000*, 2000, Electricity Supply Association of Australia, Canberra