Energy Efficiency Inquiry
Productivity Commission
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Australian
Business Council
for Sustainable
Energy

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Dear Commissioners

Productivity Commission Inquiry into Energy Efficiency Draft Report

Email: energy@pc.gov.au

The Australian Business Council for Sustainable Energy (BCSE) is an independent member-based industry association representing the broader sustainable energy industry in Australia. The BCSE has more than 280 organisations as members, ranging from installers and designers of renewable energy systems to large renewable energy and gas-fired power project developers and equipment manufacturers, distributed energy, and both energy retailers and energy service providers.

The BCSE is extremely disappointed with the Draft Report as it is not a balanced assessment of the body of evidence on government intervention to increase energy efficiency. Our view is that the draft report needs to be completely rewritten. The report, and the press release that accompanied it, make some very bold and potentially damaging assertions that require greater substantiation than the report currently provides. The Productivity Commission is in a position of considerable responsibility and influence and therefore it must be very careful in the claims and statements it makes to ensure they are subjected to a high standard of proof. Instead we have a report that suggests and infers energy efficiency measures are not cost-effective but provides little or no demonstrable proof that this is the case. The report is full of statements that repeatedly claim energy efficiency measures ***may*** not be cost-effective and that they ***may*** be regressive – which when repeated over and over again leave the impression that they definitely are regressive and definitely aren't cost effective. We could equally say that we ***may*** win Tattslotto but without a detailed quantitative analysis of the claim we aren't particularly better informed. Selective use of the body of research in this area to identify ***potential*** faults is not good enough to justify scrapping or delaying programs that detailed study and analysis indicates are very worthwhile. And which governments have spent years developing through transparent processes involving extensive stakeholder consultation.

The Report appears to the BCSE to be an attempt at a damning indictment of government intervention on energy efficiency rather than a dispassionate, independent evaluation of broad body of evidence and issues in this area. It's as if the Commissioners have taken on the role of the prosecutor in a court case rather than the judge. This is not what the Commission has been asked to do. At the very least the Commission needs to make it clear in its report that many of its statements are not so much definitive findings based on a detailed analysis of the evidence so much as cautionary views on regulatory interventions.

Also the report provides a completely inadequate discussion of the role of energy efficiency in achieving greenhouse abatement and how price elasticity of demand for energy poses particular challenges in solely relying on price signals to achieve lowest cost greenhouse abatement. We are not suggesting that Government should intervene to improve energy efficiency solely to save people money, we are advocating it because it is a relatively painless way of realising greenhouse abatement that the electorate is likely to readily accept because it will not negatively impact on their utility. While

the BCSE is also a strong advocate of the need to impose a price on greenhouse emissions, we see energy efficiency as a complementary and important additional measure, because it gets around the problem of low price elasticity of demand for energy and it will assist in lowering the financial impact on energy users of increased prices for energy from decarbonising energy sources.

No one is suggesting that analysis and initiatives surrounding energy efficiency policy measures are perfect, and there is certainly a need for more research and evaluations to be undertaken. But to suggest that efficiency interventions need to be unilaterally halted is entirely unreasonable considering they all require regulatory impact statements that must pass an assessment by the Office of Regulatory Review. And regulatory impact statements to date show considerable positive financial returns. This does not rule out refinement over time in light of policy evaluations and experience but the Productivity Commission will need to provide more definitive analysis demonstrating a net negative outcome to justify wholesale delay. Delay which the current evidence indicates is likely to have considerable costs. Many of the products currently regulated or that will be regulated have lives of decades. In addition to this long lifetime their energy use will produce carbon dioxide emissions year upon year with atmospheric lifetimes of 100 years. Retrofitting these products and buildings post manufacture to improve their efficiency will cost far more than building in the efficiency features during initial manufacture. The Productivity Commission fails to give due consideration to the costs of delay. One of the findings from the 2005 Avoiding Dangerous Climate Change Conference held in Exeter, UK was that a 20 year delay of action could result in required rates of emission reductions 3-7 times greater than that required for a more immediate response to the same temperature target[1]. We have already been discussing, debating and delaying mandatory energy efficiency measures since the mid-1980's.

Also further delay and watering down of standards is only likely to undermine national consistency. Jurisdictions have already grown impatient with the unnecessarily slow, timid progress of national efficiency initiatives and have chosen to go it alone with more progressive energy efficiency standards. In many cases this has actually broken the deadlock on national initiatives, with other jurisdictions rapidly following in the initial jurisdiction's path.

The Draft Report has demonstrated that the Inquiry's terms of reference are totally inadequate. The BCSE urges the Commission to propose to government that the present inquiry be terminated and that a new one be established with more comprehensive terms of reference that consider wider issues beyond just private benefit.

Our detailed submission is provided overleaf along with 2 attachments.

Yours sincerely

Original signed by

Ric Brazzale
Executive Director

ATTACHED:
Detailed submission
Critique of CATO Institute Study
Examination of Productivity Commission Criticisms of Building Efficiency Regulation

[1] Report of the Steering Committee 3 Feb 2005, International Symposium on the Stabilisation of Greenhouse Gases, Hadley Centre, Met Office, Exeter, UK 1-3 February 2005,

Australian Business Council for Sustainable Energy

Detailed Submission on the Productivity Commission Inquiry into Energy Efficiency Draft Report

May 2005

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Energy efficiency is a poorly targeted greenhouse abatement measure

"Some energy efficiency measures may not be privately cost-effective, and yet may generate net public benefit because of their environmental outcomes" Those measures may prove to be sound public policy, but they should also be considered against other means of achieving the environmental objectives more directly." Media release

"In considering policy responses to market failures…..the principle of targeting the objective as directly as possible is fundamental"

While we agree with the Productivity Commission that the key method to address greenhouse emissions is to put in direct controls that would essentially place a price on emissions such as emissions trading, we believe the Productivity Commission's discussion of the issues is too simplistic.

The Productivity Commission may think there are some unspecified, unaccounted for costs missing from assessments of energy efficiency potential, nonetheless those involved in this field have identified and continue to identify substantial opportunities for cost-effective improvements in energy efficiency. If we accept these assessments are correct, these areas offer tremendous potential for achieving greenhouse abatement at very low cost and in fact a positive financial return. According to the 2001 Third Assessment Report of the Intergovernmental Panel on Climate Change, which stands as the most comprehensive and authoritative peer-reviewed statement on abatement options:

"Hundreds of technologies and measures exist that can improve the energy efficiency of appliances and equipment as well as building structures in all regions of the world. It is estimated that CO2 emissions from residential buildings in 2010 can be reduced by 325MtC in developed countries and the EIT region at costs ranging from -US$250 to -US$150/tC and by 125MtC in developing countries at costs of -US$250 to US$50/tC. Similarly, CO2 emissions from commercial buildings in 2010 can be reduced by 185MtC in industrialized countries and the EIT region at costs ranging from -US$400 to -US$250/tC and by 80MtC in developing countries at costs ranging from -US$400 to US$0/tC. These savings represent almost 30% of buildings CO2 emissions in 2010 and 2020 compared to a central scenario"

And:

"Energy efficiency improvement is the main emission reduction option in industry. Especially in industrialized countries much has been done already to improve energy efficiency, but options for further reductions remain. 300 - 500MtC/yr and 700 -1,100MtC/yr can be reduced by 2010 and 2020, respectively, as compared to a scenario like SRES B2. The larger part of these options has net negative costs."

So the challenge confronting policy makers wishing to reduce greenhouse emissions at the lowest possible cost is how to capture this no regrets abatement when it is already in people's private interest to undertake these options. Clearly there are other elements at play that are hindering the effect of price signals, otherwise these options would be taken up anyway. Simply imposing a price on greenhouse emissions, while it may further improve the attractiveness of these investments, is probably not going to capture close to the full extent of these abatement opportunities. Consequently a sound greenhouse policy focussed on achieving abatement at the lowest possible cost requires measures additional to something such as emissions trading. This could take the form of information schemes and MEPS, but it could also involve a financial transfer scheme that sought to alter incentive and pricing structures to address the split incentive problem and poor decision making processes of consumers so that they saw the financial implications of product's energy consumption in the purchase price.

Furthermore, by improving the energy efficiency of the economy, abatement from decarbonising energy sources (replacing conventional coal with natural gas and renewables) imposes less of an

impact on the economy through its likely increase in the cost of a unit of energy. Thus realising an abatement target becomes less disruptive for society.

In conclusion, policies targeting energy efficiency as a means to reduce greenhouse emissions are not a poorly targeted policy mechanism.

Inefficient levels of energy efficiency investment is largely due to information failures and should be solved through information provision, not regulation

"Many existing policies and programs do not address market failures, but rather impose mandatory measures where government agencies have concluded that householders and firms have consistently made 'wrong' decisions, even after they have been provided with the relevant information"

"In developing appropriate energy efficiency programs, the Commission argues in favour of information and more light-handed regulatory approaches." – press release

We agree that in an ideal world the energy efficiency information failure would be addressed through an information scheme alone. We also believe that governments should be doing far more in terms of information provision. For example they should be placing prominent information guides in the light globe section of the supermarket to explain the advantages of compact fluorescent light globes over incandescents and halogen downlights, and the circumstances in which it is most appropriate to use which lighting technology. Another area where information provision is inadequate is the ACT home energy rating scheme. Housing energy disclosure is a good idea, the problem is that the ACT scheme is insufficiently promoted, does not provide a comprehensive rating of a house's likely energy use because it does not include fixed equipment, and the manner in which the rating is presented in real estate advertisements is easily confused amongst all the other acronyms that dominate such adverts.

In an ideal world energy labels would actually be lifetime cost price tags, consumers would see not just the cost of purchasing the equipment but also the lifetime operating cost (appropriately discounted). Unfortunately, much as the Productivity Commission would like to imagine we live in an ideal world, we don't. There are a number of practical difficulties with information provision as a means of realising cost-effective energy efficiency that would then provide low cost greenhouse abatement. The Draft Report actually mentions some of the practical difficulties but doesn't adequately recognise their significant implications for adoption of policy measures:

"The first labelling scheme in the United States (Energy Guide) was ignored by many consumers because it had too much information and was difficult to interpret" (Draft report p.114)

and:

"seal of approval labels are usually better understood by consumers than information disclosure labels. While seal of approval labels may be oversimplified and judgmental, experience has shown that the proportion of informed consumers who are willing and able to use technical information effectively is low. Also, consumers often confuse disclosure labels as a seal-of-approval thus defeating the label's purpose. In surveys, consumers have repeatedly complained about their difficulty in understanding…the energy guide." (Draft Report p.114)

The Australian Energy Rating label learnt much from the experiences above and their own market research and consequently produced a particularly simple label that emphasised stars as the measure of performance. Stars are not a particularly informative piece of information about the relative cost-effectiveness of one product versus another, but people find it easy to understand and hence find it useful. However, it would probably be more useful if consumers had a label that gave them lifetime cost. But there are quite a few variables at play in determining lifetime cost – electricity tariffs, patterns of use, voltage fluctuations of supply, lifetime of the product, how well it is maintained and the

environment in which it is operated. If a label was to be provided that attempted to capture this we'd end up with the same situation as the US Energy Guide – the label would be ignored as too difficult to understand. If cost information were provided on a simplified basis there is the potential for consumers to become quite irate when their product costs more to operate than specified in the label, which doesn't invalidate the relative efficiency of that product versus its alternatives, but could be due to inappropriate operation of the appliance.

Instead the government takes the hard work out of this issue for consumers by undertaking studies, exposed to considerable stakeholder scrutiny, to examine whether efficiency standards adopted overseas can be cost-effectively implemented in Australia (with reference to relevant and material factors such as electricity tariffs and patterns of use). While Australia has adopted or is about to adopt many minimum standards implemented overseas, it is important to note that it has not adopted them where they are not applicable to our patterns of appliance use. For example washing machine MEPS in place overseas has not been adopted in Australia because we use washing machines differently, with most Australians washing clothes in cold water (unlike the United States) which uses a fraction of the energy involved in hot water washing. Also Australia has not adopted MEPS for clothes dryers because our temperate climate and ample yards means we use them far less frequently than in northern hemisphere countries.

Consumer and producer sovereignty should not be overridden lightly

"In developing appropriate energy efficiency programs, the Commission argues in favour of information and more light-handed regulatory approaches." – press release

"The Commission considers that voluntary agreement programs can be effective policy tools for promoting energy efficiency improvements as a means of achieving greenhouse abatement objectives."

"Consumer and producer sovereignty should not be overridden lightly"

The Draft Report does not acknowledge the two decades of history surrounding energy efficiency initiatives that very clearly illustrate that the current mandatory regulatory measures have not been introduced lightly and without regard to alternatives. The Commission consistently puts the view that government intervention to promote energy efficiency improvement is likely to be costly, and to introduce additional distortions to markets, so it should be avoided unless all other options have been exhausted. The Commission's lack of involvement in this field is reflected in this stance, as there is substantial evidence on the historical record to show that strenuous efforts have been used to pursue less intrusive approaches. Either those approaches have failed, or not unusually, industry have indicated to government that voluntary initiatives are unlikely to be effective. The following provides some examples of this.

<u>Building industry regulation</u>

In 1976, an all-party Victorian Parliamentary Inquiry recommended that mandatory insulation regulations should be introduced for new Victorian homes. In 1979, this became policy of the Hamer government. In 1982, mandatory insulation was also a policy position of the incoming Cain government. Again, in 1986, an all party Committee recommended introduction of mandatory energy efficiency requirements for new homes. However, regulations were not introduced in Victoria until March 1991, as a range of alternative strategies were explored.

For several years around 1980, there was a tax deduction for installation of home insulation, but this was removed by the Hawke government. Through the 1980s and 1990s, governments around Australia pursued a wide range of information and education programs of both builders and consumers regarding building energy efficiency. One example of this was the industry-driven 'Five Star Design Rating' scheme of the 1980s, launched by then Prime Minister Bob Hawke: this failed to capture

significant market share. In the 1990s, the Victorian government strongly pursued information and incentive schemes for builders, using early versions of the FirstRate energy rating software. While this built a useful base of market leaders, it failed to capture mainstream support.

In his *Safeguarding the Future* statement in 1997, the Prime Minister issued a challenge to the Australian building industry: deliver energy efficiency improvement using voluntary mechanisms in the next year, or be regulated. The industry made a number of attempts, with the Australian Building Energy Council (funded to a significant extent by the Australian Greenhouse Office) and programs within industry associations. Eventually, the building industry admitted that it would accept regulation, as it had been unable to make significant progress. This process led to the AGO-ABCB agreement of 2000.

A key factor in the building industry's acceptance of regulation as a legitimate path forward was the widely held view within the industry that it was very difficult to create strong marketing advantages using energy efficiency. The industry view was therefore that regulation would create a 'level playing field' where everyone had similar compliance issues, but the industry leaders could gain advantage by delivering energy efficiency more cheaply than their competitors.

In practice, many in the building industry were also aware that regulation would underpin introduction of new and improved products (such as thermally improved aluminium windows) and help reduce the prices of products that improve energy efficiency through economies of scale, removal of 'luxury' price premiums, and optimisation of design.

The key point is that the building energy regulations are the outcome of a long process in which a wide range of less intrusive alternatives have been thoroughly tried. The Commission is therefore simply out of step with both industry and government when it challenges this approach. Of course there is a case to improve the effectiveness and efficiency of regulatory frameworks, but this is occurring over time under strong pressure from all parties.

Appliance energy standards (MEPS)

Appliance energy labelling was government policy in both New South Wales and Victoria from 1979. This built upon the labelling programs introduced in the USA and Canada as a response to the OPEC oil crisis, as well as responding to electricity supply capacity concerns and recognition (based on consumer tests) that there was significant variation in performance across the range of products on the market.

The rationale underpinning mandatory energy labelling was the recognition (based on market research) that consumers did not trust energy performance claims made by individual manufacturers, as well as recognition that standard test procedures and forms of presentation of information were important for consumer response. Even this level of government intrusion was a concern to the appliance industry, with many claims regarding potential adverse impacts being made in the lead-up to introduction of energy labelling. Industry's fears were not fulfilled, and instead they found that energy labelling provided another significant marketing opportunity. Despite the claims by many engineers in the industry that no more than 15% efficiency improvement was possible, performance improved rapidly.

At the same time, manufacturers who tried to 'short-change' customers on other important features in order to improve their energy rating found that this did not work. For example, some clothes dryer manufacturers extended drying time to improve their energy ratings: customers were unimpressed, so other strategies for efficiency improvement were pursued. The fact that the thickness of insulation has not increased significantly in new MEPS compliant refrigerators that use 70% less energy than mid 1980s products reflects manufacturers' judgement that this is a feature consumers value. So they have maintained this while finding other methods of cutting energy consumption. In the near future,

manufacturers will use ‘evacuated panel’ insulation to upgrade insulation performance while maintaining thin cabinet walls, as is already being done in some overseas appliances.

The rationale for MEPS emerged from two directions. First, by 1990, the USA had demonstrated that MEPS could drive cost-effective technological innovation and market transformation. The USEPA had a strong technical program in which high efficiency prototypes were developed and computer simulation models used to show manufacturers what was possible.

Second, it had become clear that energy labels did not influence some significant market segments, and that those customers were worse off as a result of the market failure. For example, some bar refrigerators used several hundred kilowatt-hours per year more than competitors priced within a few dollars: the lifecycle cost for individuals favoured the more efficient options but the focus of some buyers such as motel owners and low income households was on saving s few dollars upfront. Efforts were made to develop energy labels for electric hot water services, but the industry was uninterested: it was already culturally focused on MEPS through the existing Australian Standard. In some other areas, such as lighting, it was recognised that MEPS that harmonised Australian standards with those of Europe or other major markets would help Australian industry compete in increasingly open international markets, and would reduce the cost of utilising technological developments from those markets in Australian product.

In most parts of the appliance industry today, the value of MEPS is rarely debated. The big issues relate to the timing, stringency and testing requirements rather than the principle. Industry leaders have been known to encourage government to accelerate introduction and increase the stringency of MEPS.

A recent example of the efforts that have gone into avoiding MEPS is the effort to reduce standby power consumption. In 2000, a detailed study found standby power comprised almost 12% of residential sector electricity. Since 2002, the Australian government has carried out regular annual measurements of standby power. NAEEEC, the body representing all Australian governments, carried out awareness raising activities, and became active in the International Energy Agency voluntary ‘One Watt’ program that aimed to coordinate international efforts to reduce standby power usage. Further, the voluntary USEPA ‘Green Star’ label was adopted for use in Australia to focus attention on improving standby power use. The Australian Consumers Association was encouraged to include information in its test reports on the standby power consumption of appliances, which it still does. Despite all these efforts, recent surveys have shown that standby power consumption of new appliances, after a small improvement from 2001, is no longer improving[2]. ‘Active’ standby is increasing, and there is a very wide range of performance – not related to price. At the same time, international technological developments have led to a situation where the cost of the components required to reduce standby power consumption is now very low.

NAEEEC has recently announced that it will introduce MEPS on standby power of a range of products by 2010, with several producers arguing that a voluntary scheme would fail to deliver results. This could hardly be described as precipitate action. Nor does it over-ride either consumer or producer sovereignty.

[2] NAEEEC (2004) *Appliance Standby Power Consumption Store Survey 2004-2005 Interim Report* December (www.energyrating.gov.au)

Having to regulate is a sign that an intervention is not in an individual's private interest therefore energy efficiency regulations could not possibly be in individual's private interest

"Firms and households generally do implement energy efficiency improvements that are cost-effective for them – very few would deliberately waste energy." Media release

"Many existing policies and programs do not address market failures, but rather impose mandatory measures where government agencies have concluded that householders and firms have consistently made 'wrong' decisions, even after they have been provided with the relevant information. Many of these may be quite effective in increasing energy efficiency and/or reducing emissions of greenhouse gases, but they are unlikely to be privately cost effective for producers and consumers." P. XXVII

"Mandatory measures – such as minimum performance standards – override consumer and producer sovereignty, and are inconsistent with the proposition that the energy efficiency improvements they promote are privately cost effective."

This belief that regulation can't possibly be in the person's interest who's regulated infects the whole of the Report's findings and would have to be the most "debatable" assumption of this whole process in respect to energy efficiency. We wonder what the Commissioners' attitude is on the private cost-effectiveness of drink driving laws, compulsory seat belts, speed limits and controls on smoking. The story of human behaviour is one where we regularly make decisions based on immediate gratification or to avoid minor immediate inconveniences without full regard to the consequences. Human beings do not typically apply NPV calculations on their purchases with due consideration to the range of possible alternatives. Decisions that imply discount rates of 30% when the cost of capital is far lower indicate a serious flaw in decision making processes when the extra incremental cost is only a small percentage of the overall purchase price. Capital constraints are hardly an adequate explanation when housing efficiency measures typically add around $2000 to a house that will cost $200,000 or where the cost of the more efficient fridge (which in all other respects appears identical to the consumer) is only an extra $30 over a purchase price of $400. If all this meant was that some people unnecessarily lost a few dollars there would be little need to be concerned, but it has serious societal implications due to greenhouse emissions associated with energy use.

The fundamental issue the Productivity Commission has failed to grasp surrounds the concept of energy as a small and unmanaged cost that is consequently wasted. It's much like the 5 or 20 cents you commonly see lying on the ground, its small change that you can afford to live without. Yes energy is a small proportion of individuals' and firms' overall costs, and yes people choose to focus their attention on other matters. But does this mean there are not energy efficiency opportunities where it would be worth the extra cost? According to the Draft Report the answer is no because there would be costs associated with people diverting their attention from other matters. Yes people have difficulty and an unwillingness to spend the time understanding the energy implications of their decisions – but government intervention is able to cost-effectively assist in this regard. The Government is able to act as an aggregator that can do the thinking involved in determining where these 5 and 20 cent coins are lying around and because it's thinking effort involves not just one individual but rather thousands the rewards of the thinking are worth the effort – to the private benefit of individuals and also for the benefit of society through greenhouse abatement. Also the government could overcome this problem through re-orienting incentive structures so that those who build, sell or install energy consuming equipment care about their overall life-time cost and not just initial capital cost. These people are more likely to do something about the energy efficiency of equipment if they benefit from it, because they are dealing with hundreds and thousands of these products and it is their core focus of activity.

Studies of the energy efficiency gap are overestimates and energy efficiency regulations are not justified

"Some regulations limit consumer and producer choice, solely because of the product's energy efficiency – for example minimum standards for electrical appliances. But in many cases it is unclear that the benefits justify such intrusive measures" - Media release

"The Commission has reservations about the use of minimum standards…And they do not appear to result in cost-effective options for individual producers and consumers."

To state that energy efficiency regulations are not justified when there are several Office of Regulatory Review approved regulatory impact statements available to say they are, necessitates some substantial substantiation. The Draft Report does not make a sufficiently strong case to support such a significant claim. It seems the primary supporting argument behind this claim is that, *"Benefit –cost analyses of such proposals have tended to use unrealistically low discount rates (around 5 per cent) that bear little resemblance to the rates that firms and consumers appear to apply (often in the 10 to 20 per cent range or higher)"*. But all appliance and equipment efficiency measures were analysed according to a 10% discount rate which still gave a significantly positive benefit to cost ratio of $2.4 to $1[3].

On the issue of Building Code regulations for commercial buildings, the RIS applies a discount rate of 7% which is comparable with risk-weighted rates of return in commercial property sector and comes up with an astoundingly positive benefit to cost ratio of $4.2 to $1. If the Productivity Commission wishes to claim that these regulations are not justified they need to do a bit more than just argue about discount rates.

The Draft Report also states that energy efficiency analyses to date are based on "debatable assumptions". One assumption it raises as debatable is how some firms use paybacks while others use NPV – so what? If NFEE analysis is converted to an NPV instead of a payback measure does this result in the estimates becoming dramatically lower? From an impressionistic reading of the Draft Report you would believe this to be the case, but a four year payback on measures with a ten year life works out to 15% annual return. Considering energy efficiency measures are typically low risk this is a very attractive rate of return. On page 91 the report states, "EMET (2004) consultants relied heavily on debatable assumptions regarding the performance of existing technology, costs of implementing the improvements and the potential energy savings (boxes 6.3 and 6.4)". Box 6.3 then lists the assumptions and box 6.4 is nowhere to be found. The Productivity Commission needs to be better explain "debatable" assumptions and the implications of them. Almost any economic modelling exercise will make assumptions which could be debated, but the issue is how likely are those assumptions to hold true and what are the implications for net benefit from varying those assumptions. The Productivity Commission provides no quantitative analysis on this and we are left with the impression that the existence of "debatable" assumptions mean an energy efficiency gap is not likely to hold at all. But where is the firm evidence that this is the case? The only study the Draft Report references to support the proposition that energy efficiency interventions result in a net negative outcome is an article by Ronald Sutherland published in a right-wing lobby group's magazine – hardly a reliable source and an article dominated by many "debatable assumptions" of its own as illustrated in the attachment, *Critique of CATO Institute Study*.

Also the Productivity Commission fails to give any consideration to the fact that the final NFEE estimate of the energy efficiency potential was actually a simple halving of what was actually found to be the energy efficiency potential. This halving was not because of any particular concern with the

[3] George Wilkenfeld and Associates (2003) National Appliance and Equipment Energy Efficiency Program Projected Impacts 2000-2020 – When you can measure it you know something about it, Australian Greenhouse Office, available from: http://www.energyrating.gov.au/library/details200302-projectimpacts.html

competency of the analysis or debatable assumptions, but simply just to be conservative. In spite of this halving it still found substantial potential for energy efficiency with private benefit. Where does the Draft report make allowances for this extremely conservative measure that could lead to a substantial understatement of the potential energy efficiency gap?

In terms of regulations of residential housing the Draft Report makes extensive use of work by Terry Williamson which we believe is subject to some serious issues. We have attached a detailed review of the Williamson work which we expect will lead to substantial revisions of discussion on residential building regulation (*Examination of Productivity Commission Criticisms of Building Efficiency Regulation*).

Also the Commission's report needs to note that there are a number of examples of where the energy efficiency regulatory impact statements understate benefits and overstate costs. Some examples include lack of any incorporation of avoided energy generation and network augmentation costs for many RISes, no dollar value attached to greenhouse emission savings, the failure to incorporate a reduction in costs of upgraded efficiency due to learning effects and economies of scale, and the lack of any benefit attributed to improved comfort of occupants in energy efficient homes or improved functional attributes associated with efficient appliances (e.g. longer lifetime).

As an example of how current RISes may overstate costs is a Lawrence Berkeley National Laboratory study which found that:

"Real prices of major appliances, such as refrigerators, dishwashers, heating and cooling equipment, have been falling since the late 1970s despite increases in appliance efficiency and other quality variables. This paper demonstrates that historic increases in efficiency over time, including those resulting from minimum efficiency standards, incur a smaller price increase than were expected by Department of Energy (DOE) forecasts made in conjunction with standards. This effect can be explained by technological innovation, which lowers the cost of efficiency, and by market changes contributing to lower markups and economies of scale in production of higher efficiency units.

The paper reaches four principal conclusions about appliance trends and retail price setting:

> *1. For the past several decades, the retail price of appliances has been steadily falling while efficiency has been increasing.*
> *2. Past retail price predictions made by DOE analyses of efficiency standards, which assume constant prices over time, have tended to overestimate retail prices.*
> *3. The average incremental price to increase appliance efficiency has declined over time. DOE technical support documents have typically overestimated this incremental price and retail prices.*
> *4. Changes in retail markups and economies of scale in production of more efficient appliances may also have contributed to declines in the price of more efficient appliances."*[4]

[4] Larry Dale, Camille Antinori, Michael McNeil and James E. McMahon (2002)
Retrospective Evaluation of Declining Prices for Energy Efficient Appliances in Proceedings of the ACEEE 2002 Summer Study on Energy Efficiency in Buildings, August 18-23, American Council for an Energy-Efficient Economy.

Energy efficiency requirements are regressive for low income earners

"MEPS may also have adverse distributional effects"

"the Building Code….may have adverse distributional effects"

Low income earners typically are unable to afford their own home and landlords have little incentive to improve the energy efficiency and thermal performance of their houses because they don't pay the energy bills and renters have little bargaining power. By mandating better energy efficiency for homes, governments are overcoming a split incentive problem where landlords are unprepared to improve the efficiency of homes where the benefit is received by the renter. Building efficiency regulation will consequently help low income earners who are the people least able to afford high energy bills, and enable them to live in more comfortable houses that are cooler in summer and warmer in winter. Expecting these two parties to initiate a discussion surrounding capital improvements to improve the energy efficiency of a home in exchange for higher rent is unlikely to occur (even if it is in their financial interests) because of the low awareness of energy efficiency issues due to low energy costs.

For those who are able to afford their own homes, improved energy efficiency increases their capacity to pay back their loan because they have to spend less on energy expenses. This has been recognised by a number of loan providers, for example Bendigo Bank offers a 'Green Loan' for energy efficiency dwellings which has a lower interest rate than its standard residential variable rate. What is astounding is that the Draft Report notes these innovative financial products but then ignores this, repeating throughout the document that efficiency requirements have adverse distributional effects.

In terms of electrical appliances which are fixed such as water heaters and room heaters, the conclusions about the renter-landlord split incentive still apply. In terms of other electrical equipment, the Productivity Commission fails to mention that in many cases MEPS drives innovation and economies of scale in energy efficiency attributes whereby manufacturers find ways they can produce the more energy efficient products at prices similar to those prevailing before the efficiency standard. Not to mention the fact that in most cases MEPS will remove products that leave low income earners worse off and which market research indicate will only increase the price of appliances by a few dollars on average.

There is a need for reforms to electricity pricing to properly reflect costs of use

"without a price mechanism to moderate demand during periods of congestion and high wholesale prices for electricity, many consumers have little or no incentive to conserve electricity or invest in energy efficiency, or reschedule their use to off-peak times. The result is overinvestment in infrastructure needed to meet the needs of the community for those relatively few hours in the year when demand peaks, and an undue dependence on nonprice means of rationing demand"

The BCSE agrees with the Productivity Commission contention that electricity prices need to reformed to better reflect cost impacts of use. We also believe the Commission should suggest the potential for government to restructure the way the market operates so that monopoly network operators have to compete with demand management service providers and distributed generation solutions as alternatives to network augmentation. Also network costs should not only be borne by users but also generators so they are given a price signal to indicate appropriate locations for generation in light of network infrastructure costs.

American Council for an Energy-Efficient Economy
WASHINGTON, DC

CRITIQUE OF THE CATO INSTITUTE STUDY
THE HIGH COSTS OF FEDERAL ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL APPLIANCES
BY RONALD SUTHERLAND

Steven Nadel
March 2004

The CATO study *The High Costs of Federal Energy Efficiency Standards* was written by a longstanding critic of the appliance standards program and the author's bias is evident. More importantly, the paper contains several serious errors and also many half-truths. In this short paper, I elaborate on a few of these.

The CATO paper purports to demonstrate several conclusions. These conclusions, and a critique of these conclusions, are as follows.

CATO: Calculations by Lawrence Berkeley National Laboratory (LBNL) of the costs and benefits of standards rely on an underestimation of energy efficiency gains that would occur absent government mandates.

Response: CATO mostly relies on arguments about and limited analyses of 1960s through 1980s data, before federal standards took effect.' In the 1960s, efficiency improvements were driven fully by market forces-there were no standards. In the 1970s and 1980s, efficiency improvements were driven by a mix of market forces, utility energy efficiency programs, and standards in California and other leading states. The CATO study (and the Newell, Jaffe, and Stavins 1998 report that underlies it) ignores standards established by California and other states, despite the fact that according to CATO's data, refrigerator energy use declined 200 kWh/unit (nearly 20%) in 1987, the year a new California efficiency standard took effect. For other products, state standards (and the generally modest initial federal standards that primarily took effect in 1990) had a smaller effect. It is possible that for some of the early product standards, the LBNL analyses may have modestly overestimated benefits. However, much of the savings from standards is occurring from standards set in the 1990s. According to data on home appliance energy use from Table 2 in Sutherland's paper, appliance energy use was generally stagnant during the 1990s, not showing efficiency improvements in the absence of standards as Sutherland asserts. According to Sutherland's data, the years with significant changes in appliance efficiency include a drop in refrigerator energy use of 161 kWh (20%) in 1993, a drop in refrigerator energy use of 138 kWh (20%) in 2001, a drop in freezer energy use of 137 kWh (23%) in 1993, and more modest drops in room air conditioner energy use in 2000/2001 (a reduction of 25 kWh/unit) and freezer energy use in 2001 (a reduction of 34 kWh). All of these changes took place in the year standards took effect! Absent these

' The primary source for the CATO paper was a 1998 paper by Newell, Jaffe, and Stavins that analyzes data on room air conditioners over the 1958-1993 period, data on central air conditioners over the 1967-1988 period, and data on water heaters over the 1962-1993 period (Newell, Richard, Adam Jaffe, and Robert Stavins, 1998, *The Induced Innovation Hypothesis and Energy-Saving Technological Change,* Discussion Paper 98-12, Washington, D.C.: Resources for the Future).

standard-induced changes, efficiency was stagnant in the 1990s, hardly evidence that half of the efficiency gains attributable to standards are market induced as Sutherland claims but inadequately supports. Sutherland also ignores data for central air conditioners and furnaces that show large efficiency gains in 1992 when standards took effect (e.g., approximately 9% reductions in central air conditioner and furnace energy use), but otherwise efficiency levels have scarcely changed.

CATO: LBNL also uses an unrealistically low consumer discount rate to calculate the value of future energy savings.

Response: LBNL generally uses a real discount rate of 7%, which is based on the weighted average consumer cost of capital (e.g., a mix of savings, home equity loans, and credit card purchases). Sutherland recommends a discount rate of 21-28% based on empirical studies showing that these values are implicitly assumed by consumers when they make purchases. Arguments for use of implicit discount rates have been made by some economists and business interests for more than a decade and rest on the assumption that markets are functioning properly. However, perfect markets exist only in textbooks and thus use of implicit discount rates has been repeatedly rejected by DOE and the federal courts. As the Federal Court of Appeals said in a 1985 decision:

> [T]he fact that consumers demand short payback periods was itself a major cause of the market failure that Congress hoped to correct. DOE cannot logically reject design options because consumers would not in the absence of standards buy appliances including those design options, when the entire point of a mandatory program was to change consumer behavior.[2]

The court then went on to reject DOE's use of a 10% discount rate, let alone a rate of more than 20% as Sutherland proposes.

CATO: Correction of these errors will actually lead to a conclusion that the program will cost consumers a net $46-55 billion through 2050.

Response: This argument assumes that benefits are reduced by 50% relative to the LBNL estimates, that costs are not reduced at all, and that implicit discount rates of 21-28% are used. However, the assumption that benefits are reduced but costs are not reduced is an outright error. If Sutherland assumes that the market accounts for half of the benefit, the market will also account for half of the costs (if not more than half of the costs, since efficiency standards tend to make efficient products commodity products, driving down costs relative to the pre-standard marketplace [3]). As noted above, Sutherland's 50% discount on LBNL's calculated benefits is wishful thinking on his part, and the use of implicit discount rates is contrary to the law. Still, if we want to be extremely conservative, we could reduce the LBNL savings estimates by 20% (and also reduce costs by 20% as discussed above), and use a 14% real discount rate (double what DOE assumes and essentially assuming that all appliance purchases are paid by credit card and the credit card is never paid up), then we could figure that according to Sutherland's Table 3, the net present value of appliance standards is about

[2] 768 F.2d 1355, 247 U.S.App.D.C. 340, U.S. Court of Appeals, District of Columbia Circuit, 1985, "NRDC v. Herrington."

[3] For a discussion of this issue, see Nadel, Steven, 2002, "Appliance and Equipment Efficiency Standards," *Annual Review of Energy 27,* Palo Alto, Calif.: Annual Reviews.

$26 billion-a respectable outcome, particularly given the conservative assumptions used. Furthermore, if we're talking about correcting the LBNL analysis, recent studies have shown that the actual costs of standards have been significantly lower than what LBNL and DOE estimated when the standards were set, [4] which increases net benefits significantly (e.g., if costs are overestimated by 50%, net benefits with the conservative assumptions discussed above increase to $73 billion).

CATO: The program's costs are borne disproportionately by low-income households.

Response: This argument is predicated on the assumption that low-income households have higher discount rates than higher-income households. However, in making the claim that low-income households are hit particularly hard by the modestly higher costs of more efficient appliances, Sutherland ignores two critical points. First, the majority of low-income households rent, and hence it is often the landlords who purchase the appliances and not the tenants.' Second, if low-income people buy appliances, they often buy on the used appliance market, where costs are reduced since equipment is partly depreciated. Given these factors, it is a rare low-income household who will be hurt by efficient appliances, but instead many gain because appliance standards reduce the cost of the more efficient appliances relative to having no standards, and eventually these more efficient appliances trickle down to even the poorest of households. As a result, most of the organizations that work with low-income households generally support strong appliance standards.[6]

[4] See, for example, ACEEE, 2002, "ACEEE Comments on *Draft Engineering Analysis, Furnaces and Boilers Rulemaking,"* submitted to DOE Oct. 14, Washington, D.C.: American Council for an Energy-Efficient Economy.

[5] According to the 1995 American Housing Survey in the United States, 60% of households below the poverty line rent. U.S. Census Bureau, 1998, *Statistical Abstract of the US.: 1998,* Washington, D.C.: U.S. Government Printing Office.

[6] See, for example Harak, Charles, 2001, "Letter of Sept. 6 to DOE re: Energy Efficiency Standards for Central Air Conditioners and Heat Pumps," Boston, Mass.: National Consumer Law Center.

Examination of Productivity Commission Criticisms of Building Efficiency Regulation

1 Introduction

The Productivity Commission's (PC) draft report into energy efficiency raises serious questions regarding the validity of the simulation methodology used for the purpose of demonstrating compliance with building regulation:

DRAFT FINDING 7.2

Energy efficiency standards for residential buildings are based on computer simulation models — such as the Nationwide House Energy Rating Scheme energy-rating software — that exclude many of the determinants of a building's actual energy efficiency.

DRAFT FINDING 7.3

A ranking of residential buildings by star rating (using energy-rating software such as Nationwide House Energy Rating Scheme) may be very different from a subsequent ranking based on actual energy consumption or efficiency.

These findings lead the Commission to conclude that all further changes to building codes should be delayed till 'ex post' evaluation of current standards demonstrates that the current standards are sufficiently effective. (Draft Recommendation 7.3, page 156).

These concerns originate with the analysis presented by one submission to the Inquiry by Dr. Terry Williamson, Dean of Architecture at Adelaide University, for example:

" … the Commission is concerned that the analytical basis for these regulations (computer simulation of energy loads within buildings in each climate zone) may be flawed. It therefore considers existing standards should be fully evaluated before new more stringent energy efficiency standards for residential or other buildings are introduced."[1]

[1] Overview p. XXXVII

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and,

"… Dr. Terry Williamson submitted results from past research and case studies which suggest that the science of building energy efficiency is far from understood … If Dr. Williamson's observations are correct, the simulated energy performance may not be an indicator of energy efficiency."[2]

"Dr. Williamson suggests that building energy efficiency standards could distort the housing market in favour of designs that rate highly ... [with the result that] more cost effective improvements in energy efficiency may be overlooked in favour of those that are rated highly by the software."[3]

The PC quotes Williamson directly:

"There is little or no evidence to show that efficiency standards … will be in any way effective"[4] and his description of his case study results:

"Despite each of these houses having energy consumption results well below the 'average' house in the location, based on star rating results, none could now be built because they do not achieve the required rating criteria."[5]

Because this submission has been so influential on the PC draft findings it is important to evaluate the claims of the submission to see whether the evidence it presents supports the PC's conclusions.

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[2] P 145

[3] P 148

[4] P 148

[5] P 147

2 Evaluation of Williamson's own research

Attached to the submission are a range of case studies and papers presenting evidence that there is little relationship between real building performance and the energy rating. This analysis will focus on two of these papers:

"**NATHERS: SCIENCE AND NON-SCIENCE",** and

"Perceived and prescribed environmental performance of award winning houses"

2.1 NATHERS: SCIENCE AND NON-SCIENCE

This paper presents the results of a study which compared actual energy bills with the NatHERS simulated energy load of 31 houses. Actual energy consumption and energy loads predicted by NatHERS show virtually no correlation. The paper concludes that because there is no correlation between simulated load and energy consumption a regulation based on simulated energy load can not be effective in reducing household energy consumption:

> "The results presented in this paper now indicate that the commonly held purpose of NatHERS, that higher Star Ratings will mean reduced household energy consumption and greenhouse gas emissions, could not be corroborated." [6].

It seems that Williamson either misunderstands or chooses to ignore the real commonly held purpose of NatHERS which is:

> "The intention of NatHERS is that the five star house should use less energy *than it otherwise would have* given that the occupants would have heated and cooled that house in the same way regardless of the rating."[7]

It is misleading to compare energy consumption with simulated loads without correcting for appliance efficiency and variable aspects of user behaviour such as areas heated and cooled, thermostat settings, and hours of use. Without this correction one could be comparing an inefficient

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[6] Williamson, submission 28 to Productivity Commission, 2005 p 50

[7] Isaacs, Ballinger and Pears, 2001 p 4

house heated for a few hours a day with an efficient house heated for most of the day and come to the conclusion that the inefficient house is better.

Given the variability that can occur in heating and cooling energy use the truly surprising finding in Williamson's paper is that with minor adjustment the relationship between the rated energy load and actual consumption was found to be so strong. If appliance efficiency is used to adjust the NatHERS load predictions the energy performance shows a far better correlation with NatHERS results:

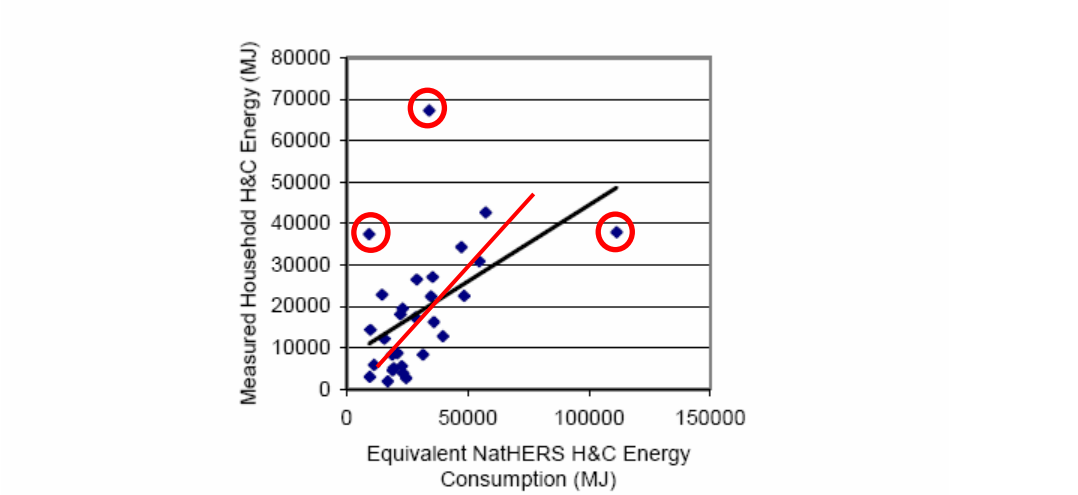


Figure 7: Equivalent NatHERS Energy Consumption vs Actual Energy Consumption
Note: N=31, R^2=0.185, p<0.05

Indeed, if it was valid to remove the circled outliers the correlation would be even stronger. This suggests that a lower heating and cooling load predicted by NatHERS **WILL** lead to a reduction in actual consumption. Williamson's own research does not support his conclusions that the use of ratings to improve building fabric efficiency would not save energy. Rather the paper shows that the impact of improvements will not be directly proportional to actual consumption because the efficiency of the heating and/or cooling appliance is not included.

Adjusting simulated loads to allow for appliance efficiency would significantly diminish the ability of the rating to influence cooling energy use because the efficiency of typical heaters is 2 to 4 times worse air conditioners. This would effectively cripple the ability of the rating to influence cooling energy loads at a time when the loads caused by residential air conditioning are causing problems with electricity supply all over Australia.

Finally the exclusion of appliance efficiency from the rating is presented as some sort of careless oversight, when in fact it was a deliberate decision.

The reasons for this decision are outlined in the paper which responded to Williamson's findings (Isaacs, Ballinger and Pears, 2001). This is shown in Appendix A.

2.2 Perceived and prescribed environmental performance of award winning houses

This paper and the case studies shown in Williamson's submission to the Commission (pp 26-30) provide examples of houses which in Williamson's opinion have achieved low energy consumption (compared to average houses) and a high degree of occupant satisfaction with thermal comfort and yet do not receive a high star rating. The paper concludes that because such houses which have met the intention of the regulation i.e. a low energy use "would not be allowed to be built" by the BCA that the rating methodology is flawed. It recommends that the rating technique should be amended to allow the intended occupants to enter their own comfort preferences (and presumably other factors such as time of use, areas heated and cooled etc.) and that houses with no mechanical heating or cooling installed which are intended to be open to the outside be assessed on a different basis.

2.2.1 General Comments

Houses should be designed to meet the needs of future occupants

Simply because a house meets the comfort requirements of the specific individual(s) it was designed for does not mean that it will meet the requirements of future occupants. It is extraordinarily rare for a house to be occupied by the same people for the entire life of the house and even if this were the case these preferences may change e.g. the elderly and very young are known to have less tolerance to extreme temperatures. The results of monitoring presented in the paper show that these houses spend a substantial amount of time outside the ASHRAE comfort zone. Subsequent occupants may find they need to consume far more energy to maintain comfort.

Most new houses are not designed for specific individuals but are purchased from either from a range of builders' plans or a 'spec' house which has already been constructed. The buyer chooses the house that meets their needs on a range of criteria that will often not involve any thought of thermal comfort or energy efficiency. The suggested change to

the rating methodology would only be relevant for a small proportion of new houses.

Application of regulatory requirements would benefit these houses

To say that these houses could not be constructed is a misleading statement. These houses could be constructed, but would require some modification. As Williamson's own research suggests that a lower simulated load would lead to lower actual consumption these modifications would benefit the current occupants in terms of even lower energy consumption or improved comfort. Future occupants with more stringent comfort requirements would benefit through significant reductions in energy bills.

The same conclusions may not apply to the next generation of NatHERS rating tools

The findings of this paper apply to the NatHERS rating software. As a result of feedback from industry, particularly in regard to the rating failing to take into account the physiological cooling effect of air movement, a new rating tool called AccuRate has been developed and will soon be available for use. Regulatory trials have already begun in some states.

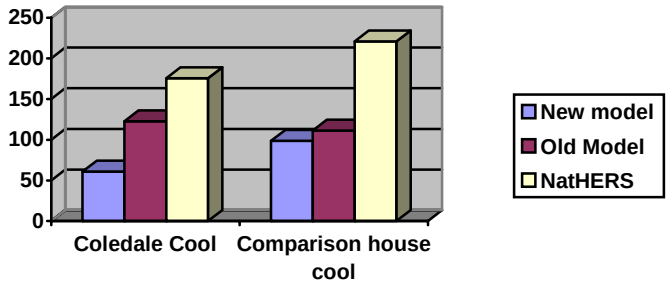
In each of the three case studies reported in the paper the house fails to achieve an acceptable rating at least in part because cooling energy load is predicted to substantial when the occupants found no artificial cooling was necessary. Each house contains specific design features to enhance ventilation in summer to avoid the need for artificial cooling.

AccuRate predicts substantially reduced cooling loads. In part this is caused by modification to the assumed user behaviour pattern. This change has recalibrated the cooling thermostat setting to match Auliciems' neutral temperature. The paper was critical of NatHERS for not using these temperatures. Furthermore users are assumed to wait until internal temperatures are 2.5^{o}C above the neutrality temperature before commencing cooling. This behaviour is consistent with Williamson's research as presented in "Context Relevance in Thermal Comfort"[8]. In addition the software has been modified to predict air flows through houses when windows are opened and will not invoke cooling if this air

[8] Williamson and Riordan, presented to the ANZAScA conference 1993

movement makes the house 'feel' comfortable even if air temperatures are beyond the comfort zone.

Research undertaken by the author for the AGO compares the cooling load predictions of AccuRate and NatHERS for a well ventilated house which has entire walls of window which fold away to promote ventilation and a standard spec house which has small windows with limited openable areas.. The chart below shows one aspect of the findings:



The two houses are simulated in Sydney. Three cases are presented:

1. NatHERS predicted cooling load,
2. AccuRate predicted cooling load using the NatHERS model for estimating air exchange when windows are opened, and
3. AccuRate predicted cooling load using the new model for estimating air exchange when windows are opened.

The chart shows that AccuRate predicts a significant reduction in energy load even when the old method for estimating air exchange is used. It shows that the new model shows that cooling load does not change significantly for the spec house but is halved in the house which has been specifically designed to promote ventilation in summer. Given these new findings it may well be that if assessed using AccuRate these buildings would receive a far more favourable rating. In this case the conclusion of the paper and case studies as presented by Williamson would no longer be relevant.

2.2.2 Specific comments on Kawanda Muna case study

This house has been the subject of a paper by a colleague of Dr. Williamson's as Adelaide University, Veronica Soebarto in a paper entitled: A LOW-ENERGY HOUSE AND A LOW RATING: WHAT IS THE PROBLEM?.

In this paper it is explained that the owners have modified the house to reduce heat losses through the windows by applying a shrink wrap film to the window frames to, in effect, create double glazing, have installed weather strips to reduce air leakage and add external shading to reduce heat gains in summer. This would add in the region of one to two stars to the rating. It suggests that the performance of the house DID NOT initially meet the expectations of the owners. Furthermore, simulations using an alternative package showed the house to be "warm and uncomfortable (based on the standardised human comfort range)". Soebarto explains that "the occupants did not seem to feel that the house was warm as they were mostly out of the house during summer days", but suggests "If the house was occupied all the time, however, the occupants may have had a different perception and the blinds may have been used to reduce the heat gain."

No cooling is used in the house and heating is provided mainly through a wood fire. Based on estimates of wood consumption by the owner the annual energy use for heating is found to be 16.5 GJ. Occupants report that they heat only at night. By contrast NatHERS predicted 39 GJ heating per year.[9] Given that occupants heat only at night it is reasonable to halve the energy use predicted by NatHERS due to the reduced number of hours of heating. In this case NatHERS appears to have predicted the heating load successfully once occupant use is accounted for.

Finally, the building contains a number of features that can not be modelled using NatHERS such as earth bermed walls and Trombe walls. It is therefore outside the scope of application of the rating tool. In this case compliance would need to be determined according to meeting Deemed to Satisfy prescriptive regulations or by expert opinion and a rating tool would not be used. It is therefore misleading to suggest this house could not be built under the BCA requirements.

The evaluation provided seems to lead to the opposite conclusion to the paper's title:

[9] It is unclear whether this energy use was predicted before or after the occupant improvements described above.

- Heating energy use is surprisingly well estimated given the reduced occupancy and the additional features which would reduce energy use but could not be modelled,
- Other simulation packages and the owners own experience seem to suggest the house is not comfortable in summer, and
- The modifications made to the house by the owners suggest it was not energy efficient as originally constructed.

2.3 Conclusion

Williamson's own data shows that there is evidence to suggest that the application of the rating will save energy because there is a link between consumption and simulated load. All his work has proven is that which is already known: that the rating gives a greater weighting to summer performance because it does not adjust for appliance efficiency. In this respect the rating scheme is considering matters of public benefit which are beyond the 'individual benefit only' terms of reference of the Inquiry.

The case study information presented would only seem to identify that it is true that through conservative use a highly motivated occupant can achieve low energy bills. Given the many other features these buildings have implemented that would reduce the environmental impact of the house such as photo voltaic electricity generation, solar hot water, low embodied energy materials etc it would be reasonable to assume that the occupants are highly motivated. On this basis alone the case studies would appear to prove nothing. Furthermore, the case studies do not establish that the houses would achieve low energy bills regardless of who was living in them or that the case study houses themselves performed well on the basis of comfort. It has identified that there may be a problem in the over-prediction of cooling loads but this has been accounted for in the next version of the rating tool.

Neither the case studies nor the field test support Williamson's central thesis that a regulation based on simulated loads will not save energy.

3 Research linking building fabric efficiency with energy consumption

The Draft report quotes from Williamson's submission which suggests there is no data linking energy consumption with the building fabric:

> "… the evidence submitted here based on data from surveys and case studies reveals that:
>
> - results are often counter intuitive (effects seem opposite to computer model predictions);
> - results are often confounding …; and
> - results are often inconclusive (small sample sizes, incomplete data of existing studies).(sub. 28, pp. 2–3).

The fact that some studies do not show a link between building element properties and energy consumption, given the variability of user behaviour is not surprising. However there are several studies where this link has been observed. This section reports some of these findings.

3.1 Gas and Fuel Corporation Gas Demand Management project in Victoria

The gas and Fuel Corporation undertook a number of significant studies of residential energy use in the 1980's and early 1990's. The Gas Demand Management Discussion Paper No. 9 released in December 1991 analyses the energy savings observed for gas heating due to the installation of ceiling insulation. This was a longitudinal survey of 300 houses households. It analysed the winter energy consumption of these households before and after they had installed ceiling installation and surveyed these households to determine the type of heating and cooling, the extent of use in terms of rooms heated and times of operation and whether the occupants had changed the way they heat their houses after the installation of insulation.

Longitudinal studies give a much better indication of the impact of House Energy Ratings because they demonstrate how building fabric improvement affects the energy consumption of the same cohort of houses rather than try to draw inferences on energy savings by comparing different cohorts.

The study found that ceiling insulation did result in statistically significant energy savings at the 95% confidence level in centrally heated homes. The observed average saving of 22% is virtually identical to the theoretical savings that might be calculated using heat flow analysis indicating that there was little if any rebound effect.

The study also found that in space heated homes a saving of 6% was observed, but that this did not meet statistical confidence tests. This surprised the researchers who quote two earlier studies from 1982 and 1989 which found a statistically significant saving of 8%. Further they were confounded by the lower percentage savings thinking that the theoretical saving should approximate 25%. In fact it is easy to demonstrate that because the proportion of heat loss through the ceiling is lower in a space heated home than a centrally heated home the full theoretical savings are more like 12% in a space heated house. Furthermore the study failed to take into account the energy use of the space heater pilot light and overestimated heating energy use due to the simplistic technique they used to disaggregate other energy uses like cooking and hot water from the total consumption. When this is properly accounted for the level of savings they actually observed was more like 10% than the reported 6% i.e. close to the full theoretical value. Had such adjustment been made at the time the study may well have found that the savings were statistically significant. Similar adjustment to the earlier studies which found an 8% saving would show that the full theoretical savings were obtained.

Because savings in space heating energy use had been lower than expected (erroneously as mentioned above) they also asked a number of questions to determine whether people had changed the way they used their heaters after the installation of insulation. The table below presents these results:

User behaviour affected	**% of centrally heated homes**			**% of space heated homes**		
	Increase	No change	Decrease	Increase	No change	Decrease
Hours of use	11	45	44	5	60	35
Heating thermostat	7	60	33	5	50	45
Area heated	17	76	7	21	71	8

The table above demonstrates that after installing insulation the majority of the sample did not change the way they use heating. For those households which did change most of them:

- reduced their thermostat setting: the better heat distribution afforded by insulation meant that the house could be heated to a lower temperature and still remain comfortable,
- reduced the hours of use: the ceiling insulation meant that the house did not cool down as quickly and so maintained comfortable conditions without heating for longer, and
- around 1 in 5 households increased the area heated.

The first two factors listed should act to reduce energy use while the increase in area heated will increase energy use. Taken together these changes to user behaviour suggest that there is NO REBOUND EFFECT that can be associated with the installation of insulation. This is in stark contrast to the evidence submitted by Williamson and quoted by the Commission in their report.

3.2 Study of public housing in Tasmania

After earlier research projects into the energy use of public housing tenants failed to establish statistically significant trends in energy use Australian Housing Research Council Project 106 by Melbourne University (Coldicutt et al, 1983) was carefully designed to ensure that such effects could be observed. Earlier research used utility bills to estimate heating, hot water and other energy uses. This proved problematic so a sample of 140 houses were fitted with meters which directly metered off peak heating, auxiliary heating, hot water, lighting, cooking and general power for a period of 21 months. Meters were read on the same day for each house at monthly intervals. Householders were interviewed about the extent of their energy use and their understanding of and attitudes toward energy use. The sample was selected to include only a handful of house design types and only two types off peak heaters were used. This limited the variability of the sample in terms of heater type, area of house and construction materials. Further the use of public housing tenants reduced the socio-demographic variability of the sample.

This study was one of the first of its kind to successfully find statistically significant differences in energy use between houses of differing construction and to find links between householder attitudes and energy use. It found that houses with wall and ceiling insulation used 12% less energy than houses with ceiling insulation only. This is close to the full theoretical value which again indicates that there is little rebound effect. Furthermore, respondents who considered that their living rooms received 'plenty of light' had a much higher proportion of north glass than the rest of the sample and used 14% less heating energy than other houses. This indicates that the north glazing when unobstructed led to significant heating energy savings.

Far from offering 'counter intuitive' and 'confounding' results this study demonstrates that when steps are taken to measure heating energy use directly and the overall variability of the sample is reduced statistically significant energy savings are observed due to the effect of building fabric.

3.3 Evaluation of the Home Energy Advisory Service in Victoria

The Home Energy Advisory Service was established in Victoria to provide energy saving advice and retrofitting for Commonwealth Health Card holders. To ensure the program was effective the energy use before and

after receiving the service was analysed for 3000 clients i.e. a longitudinal study. Having a large sample allowed the researchers to ensure that the comparison of energy use eliminated other extraneous variables while still providing samples of sufficient size to ensure statistical significance.

The phase 2 report (DITR, 1985) showed that households who received ceiling insulation had 9.2% lower gas usage and 7.6% lower electricity usage indicating that in addition to reducing heating required from the main space heater that supplementary heating using fans heaters etc. was also reduced. As described above, the full theoretical saving for a space heated home will be in the order of 12%, so again close to the full theoretical savings have been obtained with little or no rebound effect. This is a particularly important finding for if any sample is likely to be under-heating - and would therefore show potential for rebound - it would be those with lower incomes such as the clients of this service. It is evidence again that the rebound effect is not as large as many have claimed it to be.

3.4 Impact of retrofit wall insulation in the ACT

The ACT Government offers a rebate to those who install Cavity Wall Insulation. This product is a loose fill insulation which can be blown into existing walls. The ACT government engaged consultants to examine the impacts of the retrofit wall insulation on the energy use of a sample of households. Over the 72 houses in the sample a total energy saving including gas and electricity was 15%. While this is less than the ACT Greenhouse plan forecast, it is in line with the theoretical savings that simple heat flow calculations would indicate. This aggregate saving was observed despite the fact that some households had installed new appliances, a small proportion of the sample admitting they had turned up their heater thermostat, and the fact that 1/3 of the houses performed other alterations to the house over the period.

3.5 Conclusion

The studies which Williamson refers to as showing counter intuitive or confounding results are generally not longitudinal studies which show the impact of changes to building fabric on the energy use of the same households before and after modifications. These studies appear not to account for the variability of user behaviour and do not measure heating or cooling energy use directly. As shown in the Tasmanian study (3.2) above

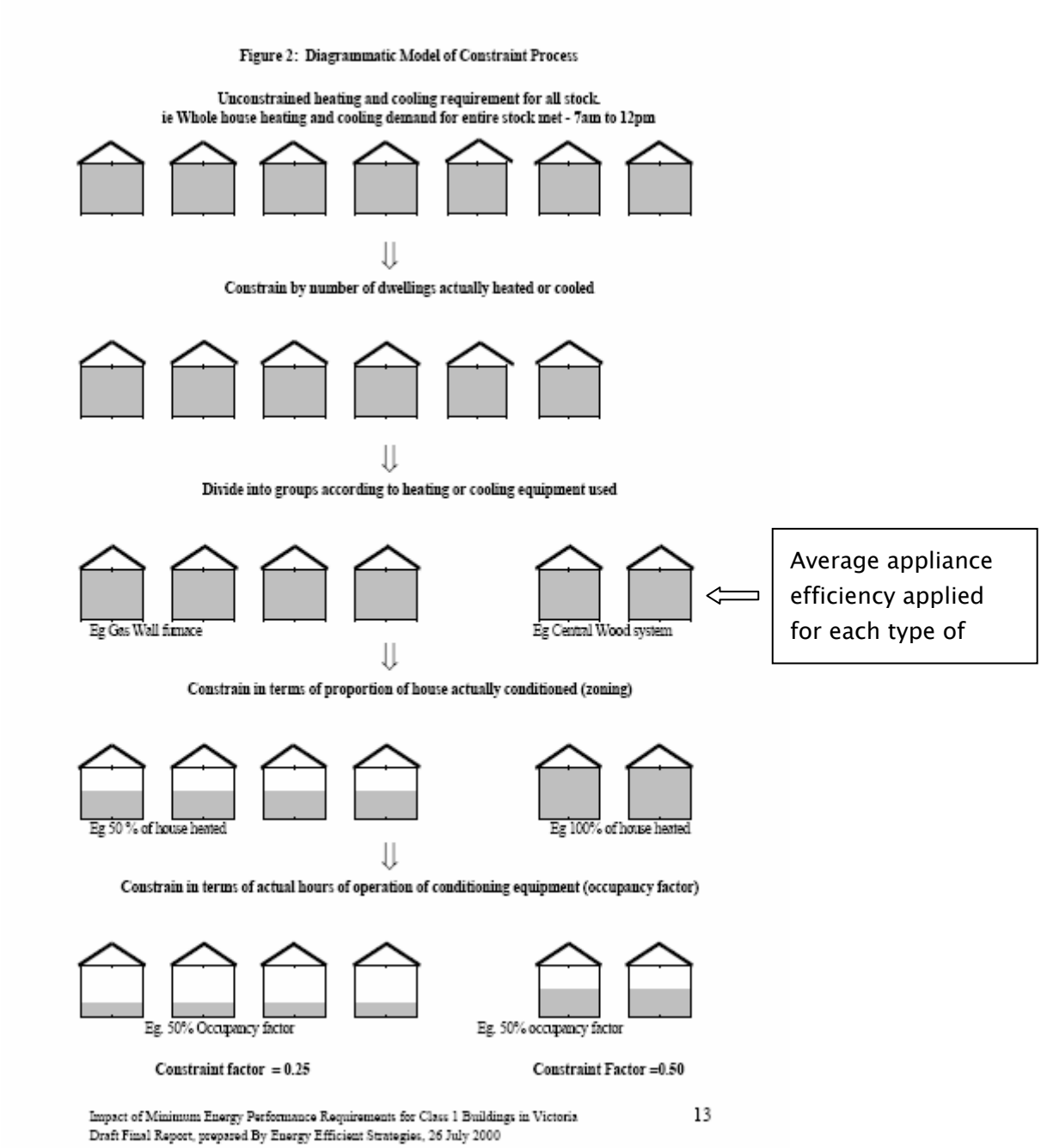
when the research design is modified to reduce sample variability and measure heating use directly statistically significant results correlating building fabric properties and energy consumption are observed. Williamson claim that “There is little or no evidence to show that efficiency standards … will be in any way effective”[10] is seriously flawed. The research projects he refers to which do not show a link between building fabric properties and energy consumption are hamstrung by their inadequate methodologies and he conveniently fails to mention the results of Australian studies with robust research design where significant effects are shown. Furthermore there is little or no evidence in Australian field studies supporting rebound effects that the Commission refers to with respect building fabric measures.

[10] P 148

4 The use of simulated load in the evaluation of energy savings for Regulatory Impact Statements

4.1 Constraint of energy savings predicted by rating tools to allow for other determinants of energy use

It is also not clear whether the Commission understands how the costs and benefits of improved fabric performance are evaluated for the purposes of regulatory impact statements. The rating is based solely on the energy load unadjusted for appliance efficiency and assuming a fixed, intensive user behaviour pattern. However, the estimates of energy savings used for RIS work are adjusted to reflect a variety of factors. This is shown in the diagram below:



Williamson's paper demonstrates that when adjusted for appliance efficiency the energy rated load does correlate well with energy bills. Therefore one can have some confidence that the private benefits estimated by the Regulatory Impact Statements are realistic because appliance efficiency is included. Furthermore, the other user influences on a building's energy efficiency are all accounted for by this type of analysis.

4.2 The use of average effects

RIS analysis shows the 'average' impact on households. The nature of an average is that half of households will receive greater benefit and half will

receive less. It is therefore likely that some households will be negatively affected in terms of the balance of financial costs and benefits by the regulatory change. The Commission recommends that this RIS work should be revisited to "analyse the distributional impacts of standards on different socioeconomic groups, including first-home buyers and less-affluent groups". This suggests that there may be some groups who are permanently disadvantaged by the proposed regulations and that RIS work does not consider this. In fact a proper consideration of who will benefit and who will not would reveal that it is likely that the households will experience a variety of levels of benefit over the life of the household and that there is no single group who would consistently fail to derive benefit from the regulation.

A key determinant of the energy use of a home is occupancy. If the house is not occupied then in most circumstances the house will not be heated and cooled. Over the lifecycle of a family occupancy will vary considerably:

- The 'Dual Income No Kids' family: both partners in paid employment, occupancy mainly in evenings,
- The 'Young Family' where one parent is at home taking care of pre school children: house occupied all day, evening and there may be a demand for heating and cooling at night,
- The 'Established Family' where children are learning during the day and both parents may be in full or part time employment: house unoccupied during school hours,
- The 'Empty Nest family' where children have left home and parents may both be working, but may also have chosen to return to study or start a business from home: occupancy variable, and
- The 'Retired family': occupancy all day and evening.

This analysis suggests that benefits will vary over the life of a household i.e. that the same household which currently derive little benefit are the same households who will derive the greatest benefit at different times of the household lifecycle.

There are also times within these family phases where home occupancy – and therefore heating and cooling demand – may be greater, e.g. times of

unemployment or illness. Even under the 'established family' model where the house is assumed to be unoccupied during the day if one accounts for weekends, public holidays, annual leave and sick days the house is potentially occupied during the day 40% of the time.

When the home is occupied during the day it often means that one or more of the adults are not in full time employment. As a result the benefits of houses regulated to save energy will be greatest at those very times when need for heating and cooling is higher and income is lower. The Regulatory Information Bulletin for the Victorian 5 star regulation makes reference to these effects. (Building Commission, 2003)

4.3 The conservatism of RIS work

The submission to the Productivity Commission by ICANZ criticises RIS work for being too conservative in the estimation of energy savings. The Federal Government predicts an increase in the ownership of air conditioners of 50% over the next ten years[11] but this is rarely taken into account by RIS work. Furthermore, information on hours of use of heating and cooling is taken from studies of usage by the ABS which is 20 years old and there is significant anecdotal evidence to suggest that today's use is significantly greater. These two conservative assumptions alone mean that the benefits of regulations are likely to be significantly higher than shown in previous RIS documents. As a result the proportion of households which do not (immediately) benefit from building regulations is likely to be significantly lower than the conservatively estimated average benefits would indicate.

4.4 The value of ex-post studies into regulatory effects

There is no doubt that ex-post studies of the efficacy of building fabric regulations in reducing energy consumption would be useful. However, the Commission's finding that further development of regulations should be delayed until this work can not be supported. This recommendation appears to be virtually entirely based on the evidence presented by Williamson's submission. As shown above not only is there evidence from field studies that building fabric regulation will be effective, but Williamson's own studies demonstrate that there is a link when appliance

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efficiency is accounted for. All Williamson's work demonstrates is that the benefit is not directly proportional to the rating. And the non-fabric effects on energy consumption ARE evaluated in the Regulatory Impact Statements that support the regulations even if these effects are not included in the rating itself.

It is worth noting that NO GOVERNMENT IN THE WORLD has required the level of evidence the PC's draft report requires for building fabric regulation. Countries throughout the world have not only introduced regulations without conducting ex-post studies they have continued to increase stringency over time. This is because there is already evidence that such measures work from field studies such as those quoted above. Further, the simulation tools used in these countries to evaluate these impacts –which the NatHERS/AccuRate programs match in the BESTEST and IEA Empirical Validation Studies – have been shown to provide reliable results. These programs show that such substantial improvements in comfort are achieved through improving building fabric that it is inconceivable that this better house performance will not result in some energy saving even if it is not the full value of the savings rating tools predict under standardised behaviour. This evidence together with the evidence from field studies is adequate for all other governments in the world and it is inappropriate for the Commission to call for a higher level of evidence in Australia before moving to further regulate building fabric performance.

Williamson quotes research from the US which compares energy ratings with consumption by Stein (Stein 1997) and finds no relationship. It is interesting to note that the responses to this finding in the US were similar to those of Australian governments to Williamson's research:

> "**Rate the Home, Not the Occupants**--HERS rating tools assume typical occupancy assumptions relative to thermostat setpoints, internal heat gain, hot water usage, and other occupant related energy use factors (i.e. lights and appliance operating schedules and energy usage). The goal is to establish the energy efficiency of the home and potential for cost-effective improvements, not to establish the energy-consuming behavior of the occupants. Thus, I think it inappropriate to base an energy rating on utility bills. ...
> **"Rating Tool Energy Cost Prediction vs. Utility Bills**--The goal of a HERS rating is not to match an existing home's utility bill. The home's occupants can influence energy costs by a factor of two. Rather, the rating tool attempts to predict likely energy use for the home under average or typical occupancy, just as the MPG test uses a standard driver protocol when establishing the MPG rating on a specific automobile."[12]

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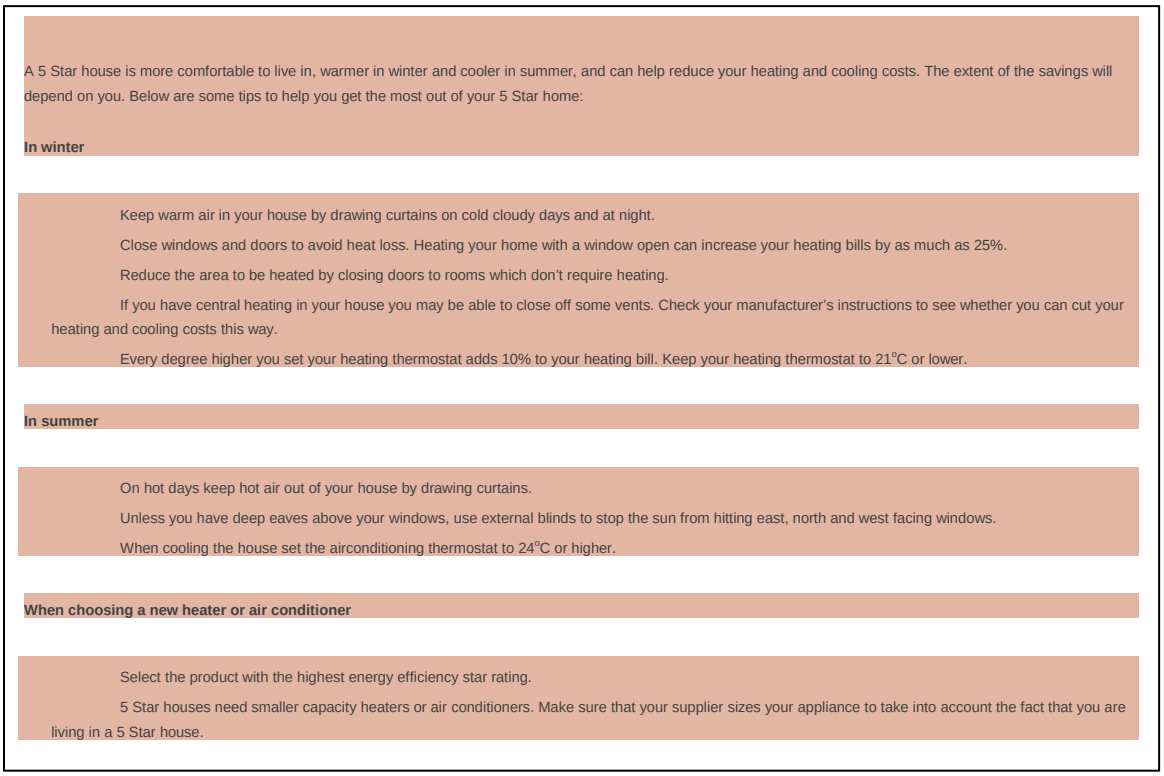
[12] Michael J. Holtz, A.I.A.
Architectural Energy Corporation
Boulder, CO

The relationship between ratings and actual energy consumption is well understood in those countries where these have been used as a technique for regulation building fabric performance. The supposed lack of correlation Williamson has observed is clearly not believed to important in other countries just as it is not a problem in Australia.

4.5 Energy efficiency regulation in context

Building fabric regulation also needs to be seen in the broader context of the various government policies and programs designed to reduce the energy use of households. It is true that the building fabric is just one element of the equation which determines the energy consumption of households. The other key effects, namely appliance efficiency and occupant behaviour have been targeted by other government programs. Minimum Energy Performance Standards raise the efficiency of the worst performing appliances while star ratings help to promote more efficient appliances. The star ratings in particular have been so successful that for a number of appliance types the rating criteria have had to be revised to greater levels of stringency as there were simply no low rating appliances on the market. In terms of occupant behaviour all governments in Australia provide information resources for householders to assist them in containing their energy use. One such example is shown below. It is taken from a brochure was distributed to Victorian households to support the introduction of the 5 star regulations. It gives the following advice on appliance selection and user behaviour:

<http://homeenergy.org/archive/hem.dis.anl.gov/eehem/98/980102.html>



A 5 Star house is more comfortable to live in, warmer in winter and cooler in summer, and can help reduce your heating and cooling costs. The extent of the savings will depend on you. Below are some tips to help you get the most out of your 5 Star home:

In winter

- Keep warm air in your house by drawing curtains on cold cloudy days and at night.
- Close windows and doors to avoid heat loss. Heating your home with a window open can increase your heating bills by as much as 25%.
- Reduce the area to be heated by closing doors to rooms which don't require heating.
- If you have central heating in your house you may be able to close off some vents. Check your manufacturer's instructions to see whether you can cut your heating and cooling costs this way.
- Every degree higher you set your heating thermostat adds 10% to your heating bill. Keep your heating thermostat to 21°C or lower.

In summer

- On hot days keep hot air out of your house by drawing curtains.
- Unless you have deep eaves above your windows, use external blinds to stop the sun from hitting east, north and west facing windows.
- When cooling the house set the airconditioning thermostat to 24°C or higher.

When choosing a new heater or air conditioner

- Select the product with the highest energy efficiency star rating.
- 5 Star houses need smaller capacity heaters or air conditioners. Make sure that your supplier sizes your appliance to take into account the fact that you are living in a 5 Star house.

The draft report states that:

> "Given that simulated energy loads exclude many of the determinants of building energy efficiency, it has to be asked whether building standards are an effective way to raise energy efficiency. Building standards may have little impact on actual energy efficiency, compared to, say, a policy that changes householder behaviour." (PC 2005, p 147)

This would seem to imply that governments have not explored other measures to influence energy consumption in housing when the large number of information sources available to consumers demonstrates this is clearly not the case.

5 Conclusion

The PC draft recommendations have been framed in light of the evidence submitted by Dr. Williamson. This report shows that this submission has ignored studies showing contrary evidence and that the interpretation he offers of his own research is not substantiated by the data provided. Accordingly it is recommended that the Commission review its draft findings and recommendations in the light of the flaws this report has shown in Williamson's submission and the clear evidence field studies show supporting building fabric measures.

Bibligraphy

Appendix A