SUBMISSION TO THE NEW SOUTH WALES GOVERNMENT STANDING COMMITTEE ON PUBLIC WORKS ENQUIRY INTO ENERGY CONSUMPTION IN RESIDENTIAL BUILDINGS.

Royal Australian Institute of Architects
NSW Chapter August 2003

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Purpose

This submission is made by the New South Wales Chapter of the Royal Australian Institute of Architects (RAIA) to the NSW Government Standing Committee on Public Works inquiry into energy consumption in residential buildings.

At the time of this submission the office bearers of the NSW Chapter are: Caroline Pidcock (President), Stephen Buzacott, Peter Mould (Vice Presidents), Richard Francis-Jones (Past President), Beverly Garlick, Andrea Wilson, Jacqueline Urford, Tony Kemeny, Kirsten Orr, Prof. Lindsay Johnson, Graham Bell (Chapter Councillors).

Information

Who is making this submission?
The Royal Australian Institute of Architects (RAIA) is a voluntary subscription-based member organization with 7,723 members, of which 5,292 are registrable architect members. It is bound by a Code of Ethics and Disciplinary Procedures.

The New South Wales Chapter of the RAIA has 2,706 members of which 1,830 are registrable architect members representing 65% of all registered architects in NSW.

The RAIA, incorporated in 1930, is one of the 96 member associations of the International Union of Architects (UIA).

Where does the RAIA rank as a professional association?
At 7,723 members, the RAIA represents the largest group of non-engineer design professionals in Australia.

Other related organisations by membership size include: The Design Institute of Australia (DIA) 1,400 members; the Building Designers Association of Australia (BDAA) 1,350 members; the Australian Institute of Landscape Architects (AILA) 1,050 members; and the Australian Academy of Design (AAD) 300 members.

General

The RAIA supports the NSW Government in its efforts to reduce energy consumption in residential buildings.

Architects can affect the decisions made by clients about size and layout, the orientation, envelope and siting of the building, and the kinds of systems installed and built in to their buildings,. All these decisions will have an effect on the energy requirements of the building.

Architects are involved in large proportion of residential design and this is likely to increase however new building, and alterations and additions are only a small proportion of all existing residences.

Within this limited scope, architects are hampered in influencing client decisions by poor and fragmented policy, lack of information, distorted perceptions and lack of appropriate economic incentives and disincentives.

Despite these impediments, the RAIA believes architects can contribute to improved residential design and a number of initiatives are suggested that would facilitate the effectiveness of architects in influencing residential energy consumption.

The role of architects in residential design

It is important to understand the different types of residences and the extent of architects involvement.

Project homes

Many project homes are designed by architects. The client is the project home builder who interprets the needs and aspirations of the buyer. These designs can be termed speculative as there is no direct communication between the architect and occupant. The architect has no control or involvement in selection of services, siting or changes to the design. Project homes can be likened to manufacturing processes where economies of minimising wastage, volume purchasing, and significant lead times in designing the product are the main determinants of design. The volume production and small commitment to redesign means there is a large inertia in this part of the market.

Individual houses

Architect designed homes for individual clients comprise only a very small proportion of all residences but a relatively large proportion of architectural work. The indirect influence these houses have on public aesthetics and sensibilities is significant but has a large time lag in penetrating the mass market due to the inertia identified above. Architects have considerable influence on services and appliance selection, siting of the building and on client expectations.

Alterations and Additions

Many alterations and additions involve architects The total construction value of alterations and additions is now equal to that of new homes. The architects influence in these projects is similar to individual homes.

Multiunit residential development

About 50% of all new dwellings are multi unit in NSW. A high proportion of these are apartments three storeys and over and are therefore covered by SEPP65. SEPP 65 will require the involvement of architects in the future and therefore increase their influence. Apartments have in the past used less energy than

detached dwellings but centralised air conditioning is reducing this difference. Architects have limited influence over services selection but considerable control of orientation and built form which is supported, and required by most planning instruments.

New construction in relation to existing stock

Architects are only involved in new construction (including alterations and additions). It is important to bear in mind that new construction is equivalent to only 2% of existing stock and although there is no detailed analysis available, new housing is either on the fringe or on brownfields sites concentrated in particular areas. This means there is only a small amount of stock being replaced.

RAIA commitment to sustainable development

The RAIA is committed to the promotion and implementation of sustainable development. This commitment is set out in the RAIA Environment Policy.

Relationship of energy efficiency to sustainability

Energy use is one aspect of sustainability and needs to always be considered in relation to overall sustainability objectives.

It is important to clarify the ultimate aims of sustainability because this affects what should be the basis for policy. Energy efficiency is not an end in itself and should not be the primary concern. It can be a useful indicator but it is a secondary issue. Sustainability encompasses social equity and preservation of ecosystems.

It is important to recall that interest in energy efficiency was stimulated by the oil crisis of 1972. This narrowly focussed concern has been superceded by the broader framework of sustainable development.

For example, to illustrate the difference, the RAIA maintains that measuring the total energy use within a building ($kgCO_2$ per person per annum) is a better and more equitable basis for comparison than the more arbitrary MJ per sqm per annum that is used in the present NatHERS energy rating scheme.

Energy efficiency needs to be always seen as secondary to the equitable distribution of environmental resources.

The RAIA is aware of other issues relating to residential energy use that are of concern to the NSW Government, in particular the increased use of energy for residential air conditioning which results in very high peak demand on some summer days. Even these issues which appear at first glance to be a problem for energy suppliers rather than an issue of sustainability can be seen as a social equity issue, when it is considered that approximately 20% of all domestic tariffs are essentially a cross-subsidisation of the cost of supplying the 2% peak load which is 20% of total supply costs.

Again this reinforces the need for these issues to be considered holistically and within an overall framework of sustainability as adopted and promoted by the RAIA.

Residential energy use and the role of architects

The following sections comment on

- the relative importance of particular end uses of energy in different type of dwellings,
- issues related to architects, and
- possible measures that would assist architects to improve energy efficiency in the context of overall sustainability.

Hot water

In NSW hot water is the most significant end use in terms of both energy consumption and associated CO2 emissions. It is also the end use where the most significant reductions can be achieved through efficiency and fuel substitution (solar and gas in place of electricity). Gas boosted solar systems can achieve a 92% reduction in CO2 compared to electric storage but at additional cost.

If hot water systems were upgraded as they were replaced, significant gains could be made in energy use reductions in residential buildings. One could expect all hot water systems to be replaced with in 15 years so these significant reductions in greenhouse emissions can be made with in a relatively short time and for moderate cost.

Technology is now available to retrofit solar panels to existing electric hot water storage systems which would achieve an immediate 60% reduction in CO2for water heating or an average20% reduction overall for the individual residence. This is a quick and relatively inexpensive way to achieve significant outcomes. Many energy efficiency experts argue that hot water systems can be replaced at any time. Whilst this is true it is not happening. There are insufficient incentives or requirement for efficient hot water.

The role of architects

Individual houses

Architects have some influence over the selection of the hot water system, however clients are generally more concerned with warranties, guaranteed performance and recovery time for reheating than for environmental performance, or energy efficiency. There is less resistance to AAA rated showerheads.

Apartments

Architects can have some influence over the selection of hot water system. However the industry standard is centralised gas so improvements are restricted to solar preheat which is expensive or heat recovery and the efficiency of the system itself. Unless the proposal is in the context of a competitive situation where environmental performance is one of the criteria, it is unusual for projects to strive for better outcomes.

Issues

- Planning regulation that restrict the placement of solar collectors on roofs
- Poor understanding of controls and installation by trades
- Highly dependent on occupant behaviour
- Erratic incentives

- Additional cost

Recommendations

1. Mandatory retrofitting of solar panels to electric storage units or replacement
2. Further incentives should be introduced to mandate the use of efficient hot water systems.
3. Hot water systems with high CO2 intensity should be phased out from the market.
4. Consider mandatory minimum performance for multi unit
5. Consider mandatory cogeneration for larger schemes

Appliances

Refrigeration

Refrigeration is a significant end use because it is running continuously. Improvements are restricted to the efficiency of the appliance and providing adequate ventilation which can improve the efficiency by up to 20%.

Other appliances

The main determinant of appliance selection is price, aesthetics, status (imported) and capacity. Energy efficiency is not a major consideration. Architects and developers are not usually involved in the selection of other electrical goods and so these are not considered although they are about responsible for about 15% of total energy.

The role of architects

Individual houses

Architects have some influence over the choice of appliance but the main determinant is capacity. To cite refrigeration as an example Architects can have complete control over placement and design of the alcove or space around. Unfortunately there is generally poor understanding of the importance of providing adequate ventilation to the coils. This is exacerbated by the aesthetic desire for fully integrated refrigerators, and contributes to the lack of efficiency of the refrigeration unit.

Architects can have some influence over the selection of dishwashers, driers and washing machines.

Apartments

Architects have little influence over the selection of appliances in apartments. Refrigerators are not usually part of the inclusions in the sale of the unit. This is a significant lost opportunity across the state.

Architects can have little influence over the selection of dishwashers, driers and washing machines. Often only dishwashers and driers are included in the apartment. A major oversight is the provision of adequate clothes drying facilities either within the apartment, on a screened balcony or in an accessible common area. It is almost unknown for a developer to include a requirement for clothes drying. The energy required to dry clothes if no natural drying is available is potentially very significant in the order of 20% of total apartment energy. The RAIA understands that no analysis of this has been undertaken.

Issues

- Poor information
- There are a large proportion of poor performers on market

Recommendations

6. Require refrigerators to have adequate ventilation at occupation
7. Encourage apartment developers to include efficient refrigerators in the sale of the apartment.
8. Establish minimum 3 star rating for refrigerators for sale in NSW
9. Cash rebates for better performance of all appliances
10. Consider inclusion of ventilation for refrigerators in BCA
11. Require star rating and annual energy consumption information in all advertising and catalogues
12. Mandatory clothes drying area for apartments

Lighting

Lighting is about 11% of end use and is entirely electrical. Efficient lighting could reduce this by 80%. However there are very significant impediments including the “atmosphere” that can be achieved using efficient lighting which is very important in domestic design.
Significantly NatHERS generally discourages windows; contributing to an unnecessary reliance on artificial lighting during daylight hours.

The role of architects

Individual houses

Architects (and interior designers) have a significant influence on the design for daylighting and on the selection of light fittings but the range of energy efficient fittings (as opposed to low voltage fittings) is very limited.

Apartments

Architects have influence on the design for daylighting, but little influence on light fittings in multi unit development. Selection is usually by the electrical engineer and confined to the installation of bayonet fittings. The assumption is that the buyer will alter the lighting to their taste.

Issues

- Poor understanding by domestic trades
- Poor information
- Poor performers on market
- Very limited range of good energy efficient fittings available
- Inflexibility in efficient light fittings little interchangeability (2 pin 4 pin diagonal 2 pin etc.)
- Lights cannot be hard wired, so efficient fittings can easily be replaced with inefficient fittings.

Recommendations

13. Consider mandatory use of hard wired ie separately ballasted lighting in functional spaces including garage, outdoor, wc, bathroom, laundry

14. Encourage the development of more fittings to accommodate compact fluoro lamps.
15. Rebates for purchase of efficient lighting
16. Mandatory requirements for movement controls in common area and carparking,

Space Heating and Cooling

The proportion of CO2 generation for heating and cooling in a residential buildings in Sydney is between 7 and 11%. When energy efficiency measures, such as better insulation, orientation, sun shading and so on, are implemented, it is possible that this proportion may be reduced, however there is no reliable data available to indicate that there is a correlation between modelled performance and actual energy usage. Anecdotal evidence suggests that many home-owners see these measures as an incentive to install air-conditioning, or to heat more of their homes, because they can do so more efficiently, but the result is a net increase in actual energy use.

Architects are trained to understand envelope performance and solar orientation of residential buildings and do support initiatives which improve passive building performance. In Sydney, with good solar orientation and an efficient envelope, it is possible to achieve comfortable temperatures all year round without any artificial heating or cooling.

However the reality is that this can only be achieved if disincentives are also introduced to discourage occupants from turning on their heaters and installing air-conditioning.

It is difficult to convince a client that if adequate insulation and ventilation is built in they will not require air conditioning. Air conditioning costs little to install and the running costs are not prohibitive. Once air conditioning has been installed, the best design in world will not inhibit its use. In fact better passive design may actually encourage the installation of total climate control because it is easy and inexpensive to condition the entire house.

It is important to acknowledge that in Sydney at present, energy savings from reduced heating and cooling needs can only be modest, although If current trends to build very large homes, to install air-conditioning and to heat the entire house to higher temperatures continue, overall energy use and the proportion of energy used for heating and cooling will rise.

The role of architects

Individual houses

Architects have a great deal of influence over the siting orientation and built fabric of dwellings.

Apartments

Architects can have a very significant influence on the solar access and cross-ventilation of apartments. There is a growing industry acceptance and encouragement of apartments with good passive performance and there is a demonstrable “design dividend” in revenue.

However it is still difficult to convince multi unit developers that air conditioning is unnecessary. Usually the most that can be achieved is to leave the option open

to the purchaser by providing an acoustically and visually screened enclosure for an AC unit on a balcony.

Issues

Distortion of public perception

The ESD committee of the RAIA is concerned that current public perception is that a 5 star energy rated house is an effective way of addressing greenhouse for a total residence when in actual fact it can only address energy use relating to space heating & cooling, which is proportionally only a small part of the problem.

Current assessment of energy performance

The method used by most councils to assess the efficiency of a dwellings is NatHERS. There are a number of significant shortcomings in NatHERS.

The rating system is based on modelled energy use per square metre. This does not act as a disincentive to build large houses, as a larger house of an equal rating per m^2/annum as a smaller house can be assumed to use more energy in total simply on the basis that it has more m^2 over which to apply the energy use. If the embodied energy (generally in excess of 10 years operating energy) contained in the house is taken into account, then larger houses can be seen as having even greater environmental impact.

This is the exact opposite of what any environmental assessment method should do. By narrowly focussing on operational energy, by using an inappropriate measure, by assuming occupant behaviour that has a very low tolerance for variations in temperature and by not be able to model ventilation in its current form, it can be argued that NatHERS has embedded unsustainability by encouraging large houses and presenting them as sustainable in the public's perception.

Although a NatHERS modelling can discriminate between heating (winter) and cooling (summer) loads, the single combined star rating is what is required by planning codes and anticipated in the BCA. This ignores the consequences in subsequent system selection and the particular characteristics of climate zones, patterns of living in those areas and other policy imperatives such as peak load reduction.

To explain: if a dwelling has the need for heating of 100MJ psqm and zero for cooling then the whole load can be met by gas heating. If on the other hand a dwelling has a heating load of 50MJ and a cooling load of 50MJ then it is highly likely that this will be met by reverse cycle air conditioning. Assuming a coefficient of performance of 2.5 for the AC this would result in double the CO2 for the same load as suggested by NatHERS. The consequences for electricity demand and peak load are obvious. In the first case there is no effect on the peak, in the second a significant increase.

Clearly heating and cooling are not interchangeable - the greenhouse and overall infrastructure implications of the next step- system selection are very different.

To make matters worse NatHERS in its current form doesn't model natural ventilation effectively so that even if the loads were separated, the need for cooling would appear greater than it actually would be.

In other words, the NatHERS assessment would suggest that a reverse cycle system is the most appropriate form of technology to meet the modelled demand.

In summary issues with NatHERS in its current form include:

- Potential to build in unsustainability by not discriminating against larger houses.
- Inability to provide guidance for appropriate heating/cooling system selection.
- Not related to broader policy such as peak electricity demand reduction.
- Inappropriate parameters (MJpsqm).
- Known modelling inaccuracies associated with the present software.
- No reliable data to indicate a correlation between predictions based on modelling & actual occupant behaviour.
- Distorted public perception of effective response to greenhouse.

Recommendations

17. There should be a detailed evaluation of AccuRATE and how it rectifies the failings of NatHERS not only as a modelling tool but also as part of a whole design and system selection process.
18. NatHERS not adopted by the BCA until AccuRATE is developed and fully resolves the above issues. Because most architects are expected to use a verification method in preference to the proposed deemed to satisfy provisions & there are so many known technical problems with the present NatHERS software, adoption of the energy efficiency amendments should be delayed until AccuRATE is ready to be referenced as a verification method.
19. Encouragement of shading and minimisation of cooling loads given higher priority than heating load reduction
20. Minimum efficiencies for AC systems in NSW minimum Coefficient of Performance (COP)3.0
21. Pricing of electricity and ramped tariffs for excessive electricity consumption
22. Separate circuits, metering and tariffs for air conditioning
23. Consider making all AC and electric heating be on OFF PEAK 1 (night time). This has the added benefit of encouraging high thermal mass in housing.
24. Encourage Greening of suburbs- vegetation can reduce ambient temperature by 1-2 degrees and the use of air-conditioning is very sensitive to temperature
25. Mandatory purchase of green power could be rolled into the purchase of air conditioning
26. Mandatory co generation for combined water heating and power generation for developments over a certain size
27. SEPP65 requirements for minimum energy performance of HVAC systems

General issues

Lack of market signals in pricing

There are occasionally incentives for owners to pay for more efficient systems or appliances such as the rebate scheme for efficient hot water systems, however on the ground it is often difficult to convince a client to spend extra on an efficient hot water or heating system rather than using expensive marble in the bathroom for the marginal cost.

Even with rebates, the most efficient appliances are usually considerably more expensive than inefficient appliances.

However moderately efficient appliances are often in a similar price bracket to the least efficient appliances. This can be used to argue removing the least efficient appliances from the market altogether.

Recommendation:

28. Energy pricing. The RAIA believes that a ramped pricing policy would encourage a change in consumer behaviour and be the most effective way to reduce energy use in residential buildings. One model might be that the first amount of supply would be free to provide relief to low income and efficient consumers. The next amount (say up to 75% of average current demand) would be at current rates or slightly higher. The next amount would be at a greatly increased rate that would discourage profligacy in use and encourage energy reductions. Implications for architects: Architects would then be under pressure from clients to produce energy efficient homes, rather than the other way around as is the case now.

Lack of economic incentives

Most significantly there is no change in price for excessive use of electricity. A significant ramped increase in tariffs would provide a context for architects to advise clients about efficiency. At present there is little reason to have a conversation about the advantages of energy efficiency- because the benefits are very small.

Recommendation

29. Continue and expand rebate schemes for efficient appliances

Data and analysis

There is generally a poor understanding of actual energy usage in residential other than detached housing. This analysis and data is important for policy formulation particularly as the proportion of multi unit development is increasing.

Recommendation

30. Undertake an analysis of the end use of energy including type of fuel for different housing types, detached, villa town house and low mid and high rise apartments

Urban design and planning

Transport energy and associated CO2 must also be considered as part of the overall operation of a house. Private car use adds approximately an additional 60% to household CO2. New residential developments on the fringe often have poor access to public transport. Increased car dependency in these areas must

account for at least part of the recent and much publicised rise in car ownership with associated increases in CO2.
There is a directly proportional increase in embodied energy in large residences and a correlation between the size of house and energy consumption.
Detailed design of houses respond to site opportunities that may have been constrained by poor subdivision layout.

Recommendations

31. Transportation energy needs to be built into the consideration of residential energy use.
32. The higher energy consumption of large housing should be recognised and discouraged by the planning system. Discouragement of large dwellings would be more effective than dealing with the efficiency of the fabric where buildings are rated on the basis of Mj per sqm
33. Consideration for building orientation should be given at the planning and subdivision design stage for any new development sites to ensure optimisation of solar access.

Conclusion

Many of the RAIA's concerns stem from a distorted and misplaced emphasis on fix it solutions which do not address sustainability in a holistic manner. Energy efficiency needs to be always seen as secondary to the equitable distribution of environmental resources and the reduction of CO2 emissions, not as an end in itself.