rating tools

A range of specific purpose modeling and rating tools has been developed for Australian conditions. These tools measure anything from a particular building element to the entire building envelope. However, no single tool exists yet that is capable of assessing the total environmental impact of a project.

When using the various tools available, it is important to understand what building element or performance properties the tool has been designed to rate. Specific information generated by individual tools should be interpreted as a proportion of the total environmental, economic and social impact of the building.

This allows better use of the rating tools and promotes awareness of the true impact of buildings globally. Awareness of the "bigger picture" leads to informed choices about the design, construction and operation of homes and a reduction of their overall impact at least cost to individuals, society and the environment.

Some aspects of building performance that can be rated include:

> Energy performance of the building fabric and design.

> Energy efficiency of appliances and services.

> Performance of individual components (eg. windows, insulation, wall construction).

> Lifecycle environmental impact of the materials used in terms of emissions and depletions.

Whilst each of these individual assessments is extremely valuable, the way we interpret the results is equally important. It is easy to lose sight of the main objectives in a forest of details.

Three steps to a meaningful rating.

1. **Decide** what it is that you want to rate.
2. **Select** an appropriate tool for the purpose from the range available. See list below.
3. **Evaluate** any limitations the tool might have and factor these limitations into your interpretation of the rating data you receive.

INTRODUCTION TO ENVELOPE RATING TOOLS

House Energy Rating Schemes (HERS) are being introduced throughout Australia. The aim is to reduce residential energy consumption and increase thermal comfort by encouraging improved building envelope design. In many areas HERS ratings are a mandatory part of the development approval process.

A range of residential energy rating tools is available from simple scorecards to whole building computer simulations. Most are relatively accurate in cold temperate (cool to warm) and arid climates.

BERS currently gives the most reliable, relevant results in tropical and subtropical climates.

Cheenath is the core energy software model developed by CSIRO for Australian climates. Most modeling systems are based on it. (NatHERS, FirstRate and Quick Rate, BERS, Q Rate and ACTHERS).

NatHERS is currently the most commonly used. It has been widely tested, calibrated and verified to provide consistent results for most climate zones. A national testing protocol will allow other tools to be calibrated and verified to the same standards.

HERS tools rate building envelope thermal performance only. They predict demand for heating and cooling energy to maintain conditions of thermal comfort inside the building. Predictions are based on the extensive research and development embodied in Cheenath.

A demonstration version of First Rate can be found on the CD ROM version of this document.

NatHERS and BERS actually simulate the operational energy use in a home.

FirstRate, QRate, ACTHERS and Quick Rate are correlation programs which do not simulate.

Assumptions that energy will be used for cooling when internal temperatures exceed pre-determined comfort levels can be misleading where mechanical cooling is not used.

BERS allows the assessor to select whether mechanical cooling is to be used and can assess a number of natural ventilation options.

Heating and cooling energy requirements form a significant proportion of total household energy consumption in most climates. However, in well designed buildings in more benign climates, heating and cooling energy share can be low.

Hot water heating is often the largest single energy user in these climates. Many energy rating tools do not include energy used for heating water in the rating. This should be factored in.

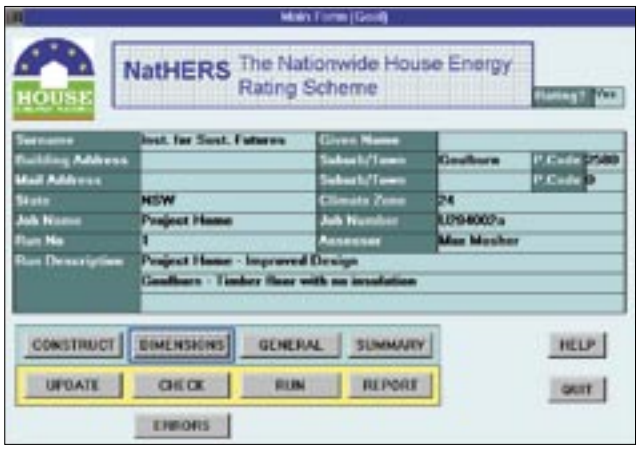
Embodied energy content of building materials can (in extreme cases) also exceed the heating and cooling energy used, during the lifetime of the building. Embodied energy should be considered when interpreting a rating. [See: Embodied Energy]

NatHERS

A national building envelope energy rating software tool developed by CSIRO to provide a relatively fast, comparative assessment of building envelope design in an easy to use format.

NatHERS is a useful tool for architects, building designers, regulators and builders, providing useful assessment of designs and additional service to clients.

Graphs and displays clearly demonstrate the temperature within each of the building's zones over a twelve-month period. These highlight the advantages of good design in minimising energy bills and maximising internal comfort in a home.



Climate zones are determined from the postcode, simple templates prompt input for wall lengths, window dimensions, floor areas and materials.

A simple report is produced after each simulation, showing how much energy is needed to maintain comfort, and the star rating (1-5) provides a quick analysis of the efficiency of the design.

Assesses factors such as insulation levels, window orientation and area, wall type and ventilation to provide an estimate of the heating and cooling energy required over a twelve-month period to maintain comfortable temperatures. Alternatively, it can estimate temperatures in a house without the use of heating and cooling.

Star values, from one to five, determine the energy efficiency of the design. A low rating will result in either high energy bills or a relatively uncomfortable house. A four or five-star design is a sign of a thermally comfortable house that will minimise the need for heating and cooling.

Data entry time: about 30 minutes for a simple plan and an hour or more for a complex design for an experienced operator.

Ratings by accredited assessors are accepted by most authorities. Accreditation is usually available from state government authorities. For example, in NSW, assessor accreditation and training is conducted by SOLARCH at UNSW, contact www.fbe.unsw.edu.au/units/solarch.

Source: Significant sections of the above from the CSIRO website: http://www.dbce.csiro.au/index.cfm

See the case study "Modifying a Project Home" which demonstrates how various changes to the building envelope are assessed by NatHERS.

This standard project home has also been modeled in several climates to demonstrate how NatHers adjusts for varying energy use and construction in each climate.

FIRSTRATE

The FirstRate House Energy Rating Software package was developed by the Sustainable Energy Authority Victoria. It provides a simple method to assess and improve the energy efficiency of house designs and completed homes.

Automated hints suggest options for optimising energy efficiency, making this a useful design tool.

Rates homes using the 5 star scale, with 5 stars being the most energy efficient.

A useful tool for Builders, designers, architects and planners, or indeed anyone who needs to know how energy efficient a home will be.

Provides a reliable measure of comfort and cost savings in 20 different Australian climate zones.

Star rating assessment is based on years of research and over 55,000 thermal performance simulations per climate zone.

Two rating modes: the comprehensive FirstRate mode and the fast QuickRate mode.

QuickRate is particularly useful at the sketch design stage.

User friendly FirstRate will show you how to improve the energy efficiency of a design making it easier to produce a better home.

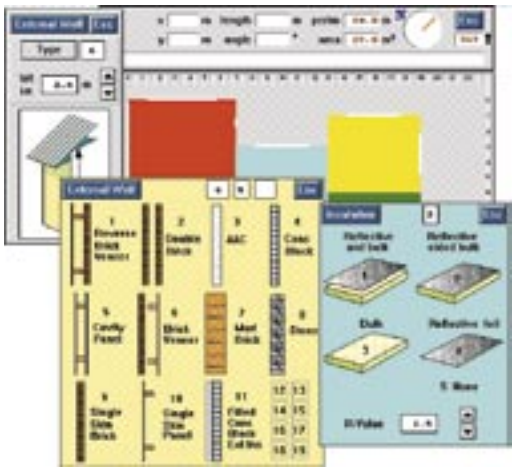
SEAV run an Accredited Energy Raters program for energy assessors operating in Victoria.

Contact: Energy Smart Advisory Centre
(03) 9655 3232 or 1300 363 744 (Victoria only).

Source: Significant sections of the above from the SEAV website: http://www.seav.vic.gov.au

BERS

The BERS (Building Energy Rating Scheme) computer program was developed by Solar Logic. It is a powerful tool capable of simulating and analysing the thermal performance of Australian houses in all climates from Alpine to tropical.



Unlike other HERS programs, BERS allows the assessor to select whether mechanical cooling is to be used and can assess the performance of a number of natural ventilation options. Its most common application is currently in Queensland but it is equally appropriate in other states.

Assigns star ratings to specific house designs according to their particular climate type.

User interface of the program is graphics based.

Data entry about the building, the type and the conditions of use is selected from pictures displayed on the screen.

Floor plans are drawn with a mouse. This eliminates the need for time consuming data entry of dimensions, orientations, adjacent zones etc. making data entry fast and accurate.

Calculated data is displayed in graphic form as well as being written to files.

Output files can be printed, or imported into spreadsheets, (for further processing), or moved into reports generated by word processers.

BERS also provides a comfort index (degree hours of discomfort) for buildings which are not heated or cooled mechanically. This is based on temperature, air speed, relative humidity and acclimatisation. This feature allows designers and occupants to design heating and cooling around occupation patterns.

BERS ratings of 3.5 stars or better, by an accredited assessor, are recognised by Maroochy Shire Council and Brisbane City. Currently there are over 130 trained, accredited users of BERS in Queensland.

QRATE

Solar Logic has another computerised rating scheme called QRate which is much faster and easier to use than a full simulation. QRate is currently available for the subtropical coastal regions of Queensland and NSW.

QRate has been specifically designed for use by builders, designers and owners and requires little prior experience to get quite accurate results.

More information: http://www.solarlogic.com.au

SEDA SCORECARD:

Developed by SEDA / Greenlight Consortium for use in NSW in the Energy Smart Homes Program, the scorecard is a simple form designed for building envelope energy rating. Whilst not as accurate as computer tools, it gives a transparent view of the features that influence envelope performance and could be adapted for use in other states and climates.

Scorecards are produced for each NSW regional micro climate and have reasonable correlation with NatHERS for most regions, although they are open to variable interpretation depending on the skill and biases of the assessor. Where rigorous assessments are required, a NatHERS, BERS or FirstRate assessment should be obtained.

Ratings are fast (20-30 mins), simple, inexpensive and very transparent.

Scores and weightings for various features are visible as you complete the scorecard.

Includes hot water service in rating.

Available from SEDA or NSW Councils participating in Energy Smart Homes program. Specific to each council / climate.

More information: http://www.seda.nsw.gov.au/

BUILDING COMPONENT ASSESSMENT TOOLS

WERS

The Window Energy Rating Scheme rates the energy impact of residential windows anywhere in Australia. [See: How to Use WERS]

WHOLE BUILDING ASSESSMENT TOOLS

ECOTECT

Developed by The School of Architecture and Fine Arts, UWA, ECOTECT is a comprehensive conceptual environmental design tool for architects, designers, building services engineers and planners. It is a professional tool and requires substantial skill on the part of the operator.

Ecotect features a sophisticated 3D geometric modeling engine along with shadow, thermal, lighting, acoustic and cost analysis functions.

It is suitable for a wide range of applications at all stages of the building design process. From conception to completion, performance analysis is made quick and easy. It gives fast results to inform the design process and provides instant access to initial capital outlays, ongoing running costs and life cycle assessment at all stages of the design process.

More information: http://fridge.arch.uwa.edu.au/

INTERPRETING RATING TOOL ASSESSMENTS

The following questions and examples demonstrate how and why ratings should be interpreted.

Does the performance of the item being tested give a true representation of its performance in the application proposed?

eg. In a warm climate, and unshaded wall of WERS 5 star cooling rated windows will cause more overheating in summer than a similar sized bank of zero star rated windows with well designed external shading.

In a cool or cold climate, large areas of WERS 5 star heating rated windows will allow more heat loss than a smaller area of 0 star windows with snug fitting drapes and pelmets.

A NatHERS, BERS or FirstRate assessment would reveal that the window rating alone does not give the complete picture.

WERS can only rate the performance of a given window in a given climate application. It does not assess how the total area of glass affects the thermal comfort and energy performance, or how window orientation, external shading and internal insulation (drapes) affect heat gain and heat loss.

Does the rating reflect all the impacts or simply focus on a single issue?

An appliance might carry a five star energy rating but be very inefficient in its use of water. Would a similar product with 4 star energy rating and AAA water rating be a better choice?

A least cost lifecycle planning assessment would reveal that the 5 star appliance uses considerably more energy during its lifetime because of the additional energy consumed in pumping and supplying more water, without even considering the environmental cost of additional water consumption.

Fortunately, most energy efficient appliances are also water efficient.

Does the rating system address relative scale in assessing the impact of a proposal?

A 400 square metre home may score 5 stars on NatHERS whilst a 200 square metre home with identical construction and similar number of occupants will score lower because it has more external wall area per square metre.

HERS tools rate buildings in terms of average energy consumption per square metre.

Clearly the smaller building will require less heating and cooling energy to maintain similar comfort levels because it has less volume. Its embodied energy content and materials consumption will be 40 percent lower than the large home.

Is the application economically viable ? Would alternative options beyond those being rated yield equivalent benefits over total lifecycle?

It has been estimated that the cost of raising a zero star energy rating to 3.5 for some homes in coastal south east Queensland can be as much as $2,000 to $3,000.

In such a benign climate, the average energy used for heating and cooling is less than 10 percent of total household consumption. Hot water heating can account for up to 50 percent of the total.

A solar hot water service costs approximately $2,500 more than electric or gas and could save up to 40 percent more energy for the same initial outlay and repay that investment much sooner.

However, a solar HWS cannot improve interior comfort levels.

What are the main environmental impacts of the material or building element being rated and are they addressed in the assessment?

Cotton shopping bags can be re-used many times reducing waste and lifecycle energy use.

However, the soil loss and water used in growing the cotton and the chemicals used during production could have a greater total impact than a single use plastic bag. Which is the best to use?

A 1999 Life Cycle Assessment using SimaPro 4.0 with Australian data showed that the plastic bag, used once had a lower overall lifecycle impact on the environment.

SUMMARY

We need to measure our real progress towards sustainable reform. To do this, a framework is needed to link and prioritise a set of real indicators and benchmarks against which progress can be monitored.

A National Building Environmental Rating Scheme (NABERS) is currently being developed with funding from the Commonwealth Government. It will prioritise the actions required to reduce environmental impacts from Australian buildings in terms of both cost effectiveness and urgency of need.

Measurement requires specific tools, and frameworks require a system for ordering, ranking and comparing measurements.

ADDITIONAL KEY REFERENCES

A comprehensive review of building analysis software including Life Cycle Assessment software and programs from other countries has been compiled by *The Centre for Design at RMIT University, Building LCA Project*

http://buildlca.rmit.edu.au/menu7.html

This site includes a useful and comprehensive range of links to other related sites.

http://www.ea.gov.au/industry/waste/construction/abers.html

Principal author: Chris Reardon