This Sunshine Coast display home is designed to meet Australia’s highest house energy rating of 10 stars. A local building company, specialising in sustainable small lot homes, set out to produce a modern, affordable energy saving home to suit the property market. The home’s net zero energy use is a key selling point, appealing to home buyers looking to cut energy bills.

The dwelling, part of a housing development display village, showcases the benefits of energy efficient design to a broad range of consumers. The builder has aimed to meet the market’s needs, deliberately blending the home in with the 20 others on show.

Site, location and climate
The builder found an ideal site in the Bells Reach Display Village at Caloundra West, 90km north of Brisbane in the midst of the Sunshine Coast. It’s an urban area close to the beach with a temperate year-round climate averaging around 21°C in the winter months. Most days are warm and humid especially in summer with hot averages around 28°C. The temperature can drop on winter nights to around 10°C and rainfall peaks in summer. Thermal mass would work well in the home, storing heat on winter days and releasing it on cool nights.
Case studies
Caloundra, Queensland

The site was picked for its almost north–south aspect conducive to good passive design. It was determined that a 10 star house could be built on the block. However, designing for small lots requires overcoming several restrictions, width being one of them. The lot is only 10m wide x 32m deep with houses sitting tightly on either side. Once essentials such as a garage and entrance are placed at the front of the block, the layout still needs to address passive design principles, flow-through ventilation and optimisation of the aspect.

Design brief

The builder set three high goals for the display home that would make it a benchmark for sustainability and energy efficiency. The new home needed a 10 star house energy rating to make it a showcase design. It needed to achieve net zero energy use by producing more electricity than it consumed over a year, demonstrating the environmental and financial benefits to living there. And the design needed GreenSmart Accreditation from the Housing Industry Association (HIA), to further assess and endorse its environmental performance. Good passive design would help meet these goals.

The builder wanted the construction to be environmentally sustainable, so used locally sourced, recycled and recyclable, renewable and low volatile organic compound (VOC) materials as much as possible.

The layout and design had to appeal to consumers and demonstrate that sustainable and energy efficient homes are affordable. Visitors had to feel comfortable enough to imagine living there while recognising the sustainability and financial benefits. A contemporary, relaxed design was essential.

The proposed home had to adhere to the developer’s Minimum Architectural Requirements which give guidelines on everything from landscaping to external wall finishes. A certain look and feel is expected in these homes. These requirements must be followed before any other features the builder wants to showcase, including energy efficiency measures, can be implemented.

Design response

The contemporary design is for a small family home with three bedrooms, two bathrooms and a single lock-up garage, all on a narrow block. It has tiled living areas and epoxy finished bedroom floors. The master bedroom features a large en suite, and minor bedrooms are in a separate wing with their own bathroom.

Low-VOC paints and laminates throughout reduce greenhouse gas emissions and provide healthier air for residents.
The north facing living area is open plan and opens to a rear alfresco area that faces the yard. The 2.55m ceilings add to a feeling of spaciousness.

Mains water use is kept to a minimum with all taps having a high WELS rating.

A 10 star house energy rating was secured with good northern orientation, high levels of thermal mass, ceiling and wall insulation, and careful consideration of window size and position. These elements were adjusted in the design until the target rating was achieved with house energy rating software.

The site’s near north–south aspect was advantageous, offering perfect orientation for a 10 star home. The dining and living areas have a northern aspect for best solar access and natural light; and the low pitch roof helps efficient operation of the solar photovoltaic system to achieve a zero net energy goal. (see Orientation)

The home was initially designed using the builder’s regular construction methods, with more thermally efficient materials added to achieve the 10 star rating only where needed. Reverse brick veneer was specified for the northern living room wall to increase thermal mass — not a first choice by the builder due to its added expense. In addition, masonry block walls, some painted and others coloured and honed during manufacture, were used elsewhere to provide additional thermal mass while acting as a feature wall in the main living area.

Other features essential for gaining a 10 star rating and thermal efficiency include light-coloured exterior walls to reduce heat gain, weather strips for draught proofing, ceiling fans to ensure good airflow and low-e glass to reflect radiant heat.

Waste was kept to a minimum by altering the design where needed to optimise material size. Changing the size of a room by 100mm could save an entire sheet of construction material, such as external cladding, with the builder implementing this during the design and following through during construction. (see Waste minimisation)

The house is built with new materials that contain recycled materials as well as materials that can be recycled. Most of the house can be broken down or reused at the end of its life, including insulation made from recycled glass bottles and cladding made partially from pinewood pulp. The steel roofing contains up to 25% recycled materials and can be completely recycled again at the end of its service life. The concrete slab is recyclable as is the plasterboard and numerous other components.

A renewable energy system was essential to achieve the net zero energy use goal. The home was independently assessed for its energy efficiency to determine what size solar photovoltaic system would generate more electricity than the household would consume in a year. The display home is not carbon neutral for greenhouse gas emissions as it has a gas hot water system, but anyone buying this home can elect to have a solar hot water system installed. (see Renewable energy)

Indoor air quality was important to sustainability goals, with low-VOC paints and laminates used throughout, reducing greenhouse gas emissions and being healthier for residents.
Concrete slab
The right combination of horizontal and vertical mass was needed to achieve a 10 star rating, with a concrete slab providing horizontal thermal mass. The concrete sits on and around a series of waffle pods, thus the slab is mostly resting above the ground and is less susceptible to changes in ground temperature. The air pockets created by the pods form an insulating layer between the structure and the ground. (see Concrete slab floors)

Reverse brick veneer
Reverse brick veneer provides vertical mass in the north and west facing living area to achieve the 10 star rating. A layer of brickwork facing into the living area on the internal wall absorbs and releases heat. Next to it is a thick layer of insulation designed to minimise heat intrusion from the outside or heat loss from the inside, thus stabilising the internal temperature. The external cladding is painted in a light colour to assist in reducing heat absorption through the outside wall. (see Brickwork and blockwork)

Reverse brick veneer was specified for the northern living room wall to increase thermal mass.

Lightweight construction
The home is built using composite construction. In addition to reverse brick veneer and masonry construction, lightweight building materials such as sustainably sourced timber are used, reducing embodied energy.

Insulation
High levels of wall and ceiling insulation were needed to achieve a 10 star house energy rating. The ceiling has thick R3 batts as well as a layer of R1.5 glass wool roofing blanket underneath the actual metal roof sheeting. The external walls have R1 isolation wrap on the outside with R2 batts in the wall cavity. (see Insulation)

Energy saving windows
All windows and doors have low-e glass. A thin film coating helps reflect radiant heat, reducing heat loss in winter. Double glazing was not necessary to achieve a 10 star rating.

Windows are strategically placed, especially in the living areas, to allow good ventilation, and are sized to provide best natural light to reduce energy use.

Solar photovoltaic system
A 1.5kw solar photovoltaic system helps to counter power bills. This in effect gives the home a net zero energy rating as the system generates more electricity than projected household consumption.

Energy efficient appliances
A whole of house fan in the ceiling operates like an extractor fan, drawing air through the windows into the home and exhausting it through roof vents. This creates a cooling breeze in summer by virtue of an evaporative effect on the occupants. The system doesn’t need to operate long to have an effect, and helps minimise air conditioner use, thereby saving energy consumption.

Rainwater tank
Mains water use is kept to a minimum. A 5,000L poly rainwater tank collects water for reuse in toilets, laundry and gardens. All taps have a high WELS rating to save more water. (see Rainwater)

Evaluation
On paper, the Bells Reach 10 star home meets all the builder’s benchmarks and goals for an energy efficient dwelling. Currently there’s no thorough analysis of what it is like to live in, as it is a show home, although it maintains stable indoor temperatures at its exposed display village site and is meeting energy use expectations. A comparison with a real 7 or 8 star home would be useful to test the benefit of building to higher house energy ratings.
The builder took a very systematic and scientific approach to creating a 10 star home in what turned out to be a very successful project. They adjusted the design and materials only where necessary so the home could be constructed as economically as possible, in turn dispelling the idea that energy efficient homes are necessarily expensive. It also shows that a modern sustainable design can be achieved on a small lot.

The project demonstrates that the highest performing homes can be made affordable, with the Bells Reach 10 star home able to be replicated for approximately $244,000, excluding land, and ready to be rolled out in the housing development.

**Author**

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