A Canberra renovation has transformed a dark and cold house into a livable and family-friendly home that is more energy efficient and responsive to the environment. The clever renovation has also made the house more adaptable to fit the long-term needs of its occupants.

When the family of four moved into the poorly designed two-storey brick and weatherboard house they faced some tough questions about what to do to improve it — should they knock it down and start again, remove the top storey and extend outwards or build a bungalow at the back?

Environmental considerations and cost made them settle on an extensive retrofit of the existing house, making it far more habitable and suitable to the climate while keeping an eye on the family’s future requirements.

The house in Curtin, an inner suburb of Canberra, has good access to bike paths, parkland and public transport. Temperatures on winter mornings can fall below zero; summers are usually dry and warm. The house was built as a single-storey dwelling by previous owners in the 1960s; a pitched roof ‘Cape Cod’ second storey was added in the 1980s.

Case studies
Curtin, Australian Capital Territory

Curtin, Australian Capital Territory

- Renovation
- Medium density
- Climate zone: 7. Cool temperate

**Topics**
- Passive design
- Adaptive reuse
- Recycled/renewable material use
- Indoor air quality
- Embodied energy reduction
- Greenhouse gas reductions
- Adaptation

**Thermal comfort rating**
7.5 stars
Heating 65.6MJ/m²/year
Cooling 17.3MJ/m²/year
Total 82.9MJ/m²/year

**Sustainability features**
- Evacuated tube solar hot water
- Double glazed windows and doors
- Hydronic heating
- Light emitting diode (LED) lighting
- North facing design
- Effectively sealed building with minimal gaps
- Rainwater tanks
- Reconstituted timber cladding
- Bamboo flooring
- Low volatile organic compound (VOC) paints and finishes

**Project details**
**Designer and builder:** Jigsaw Housing
**Size:** 228m²; 185m² excluding garage and laundry; two bedrooms on ground floor, three upstairs
**Size of land:** 825m²
**Cost:** $296,000 + $15,000 professional fees
Case studies
Curtin, Australian Capital Territory

Design brief
The owners wanted a house that was warmer in winter and had more access to light. A desire for environmental sustainability meant passive heating would be the key. The house would need to open to and connect with the environment.

They were also keen that the house be subtly designed so that in future, when their two children moved out, the upper storey could become a separate rental property. The couple were looking for flexibility and were happy to accept smaller living space in years to come — the renovation was to make the house smarter rather than bigger.

Design response
The worst element of the old house was the central staircase, which allowed heat to escape up the stairs and left the ground floor bitterly cold in winter. It also divided the living areas of the house and made family interaction difficult.

In the renovation the old staircase was demolished and a new one built at the east side of the house — so that the house could effectively function as a two-apartment residence in the future.

A new laundry and garage are also in the home’s eastern end. The once small and pokey laundry was in the way as people passed through the house to the backyard. Now, it is tucked underneath the staircase and clothes can be dried under cover in the garage.

The kitchen, once in the south–east corner, is now part of a large kitchen–dining area in a central, north facing position. Double glazed doors bring light deeply into the area, making it a warm, social family space.

The lounge, where the kitchen once was, faces south to the backyard, with a double glazed sliding door allowing easy access to the garden and beyond.

Upstairs, the three bedrooms and living area were left largely as is, though a terraced garden was constructed on the roof of the garage to provide more outdoor space.

A crucial aim of the renovation was to ensure the home was well sealed in a tight building envelope, with no unnecessary ceiling penetrations and few gaps in the house through which heat could pass. This would ensure that passive heating and cooling could be most effective.

Study nooks and a purple glass splashback were additional design features used to bring a sense of life and character to the house.
A terraced garden provides outdoor space on the second storey.

**Solar hot water and solar power**

The owners installed an evacuated tube solar hot water system, north facing at a 55-degree pitch, to replace the old electric hot water service. The efficiency of the new system has meant the family rarely uses its electric booster.

The steep, Cape Cod pitched roof made the installation of solar panels difficult. The owners decided against a solar power system, instead focusing on improving the home’s overall energy efficiency to reduce heating and cooling costs.

**Passive heating and cooling**

Good window design and location maximise natural lighting. Bright, naturally lit homes promote health and well-being and reduce the need for electric lighting. To maximise the effectiveness of passive heating in this house, north facing double glazed windows and doors were installed. All windows and doors are tilt and turn with flexible opening mechanisms — assisting natural cross-ventilation for cooling.

The windows and glazed door frames are made from lead-free uPVC, a material with good insulating properties similar to timber.

**Active heating and cooling**

Canberra’s cold winters mean a form of active heating is a must. In this house, an energy efficient hydronic heating system works through a gas-fired boiler and radiator panels. The hydronic heating has replaced an inefficient heater downstairs and a reverse cycle split system upstairs. Energy efficient ceiling fans provide the only form of active cooling in the house.

**Building materials and insulation**

In parts where bricks were removed, reconstituted timber weatherboards have been used as cladding. Timber cladding has low embodied energy and generally low environmental impact.

Insulation acts as a barrier to heat flow and is essential to keep a home warm in winter and cool in summer. In Canberra’s cool temperate climate, the main priority of insulation is to reduce heat loss. As part of the renovation, the existing walls were insulated with R3 rated recycled polystyrene and the timber floors with R2 polyester batts; the ceiling was topped up to R5+ with wool cell insulation.

**Energy saving lighting**

Efficient LED lighting has been fitted throughout, sourced from an electrician and a local lighting store. The owners made creative use of a range of LED lights, in strips for pelmet lighting, wall-recessed hall and stair lights, and unvented/airtight downlights that give excellent light while using just 8W.
Case studies
Curtin, Australian Capital Territory

Materials reuse
The old staircase, kitchen, bathroom and curtains were given away free to anyone who could come and collect them. All the original whitegoods in the house were reused, as were old pavers in a new driveway.

Water saving
Canberra’s annual rainfall of just over 600mm is modest compared with most other Australian capital cities. It means that capturing rainwater and using it in the garden and home is an important environmental consideration. In this house two 5,000L rainwater tanks were installed, plumbed to the ground-level toilet and the laundry.

Draught sealing
Draught sealing around doors and windows can save up to 25% of heat loss and gain. The owners paid close attention to keeping as much heat in as possible through the installation of tightly sealing windows and doors. All exhaust fans in the house were fitted with effective dampers.

Paints, finishes and floor coverings
The new floor of the house is made of bamboo, and the carpets are of pure wool. Low VOC paints and finishes were used throughout the home.

Design for the future
An outstanding aspect of the renovation is the way it has made the house more adaptable. The staircase situated at one side means the upper storey could be separated as a second dwelling in the future. The laundry, with ample undercover clothes drying in the adjacent garage, can be shared by a number of occupants. With future mobility and wheelchair access in mind, a ramp has been built to the front deck as has a low-threshold entry.

Evaluation
The house’s energy rating is now an overall 7.5 stars, up from the original 2.5. The ground level has a rating of 8 stars, the upper storey 7 stars. Electricity consumption has halved. The house is now much brighter and more open to the environment, which the owners say has dramatically improved its livability and enhanced family life. It has a good balance of thermal efficiency, aesthetics, practicality, functionality and cost.

The plan now is to do more work on the upper storey so that it can function properly as a separate dwelling. A major change flagged for within the next 10 years is the addition of a kitchen to replace the current small kitchenette.

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