

VICTORIA UNIVERSITY



FIRST LIGHT^{NZ}

SOLAR DECATHLON - TEAM NEW ZEALAND
FRANK KITTS PARK, MAY 2011



SOLAR DECATHLON

A Victoria University team is a finalist in the prestigious U.S. Department of Energy Solar Decathlon 2011, which challenges 20 university teams to design and build energy-efficient houses powered exclusively by the sun.

The Victoria team has designed and built the Meridian First Light house—a reinvented Kiwi bach powered entirely by solar energy— to be displayed later this year in Washington, D.C.

The team is the first ever from the Southern Hemisphere to make the finals.

Led by students from Victoria's School of Architecture, the team is made up of students from right across the university, supervised by university staff and industry partners who are donating their time and expertise to the project.

The winner of the Solar Decathlon is the team that best blends affordability, consumer appeal, and design excellence with optimal energy production and maximum efficiency.

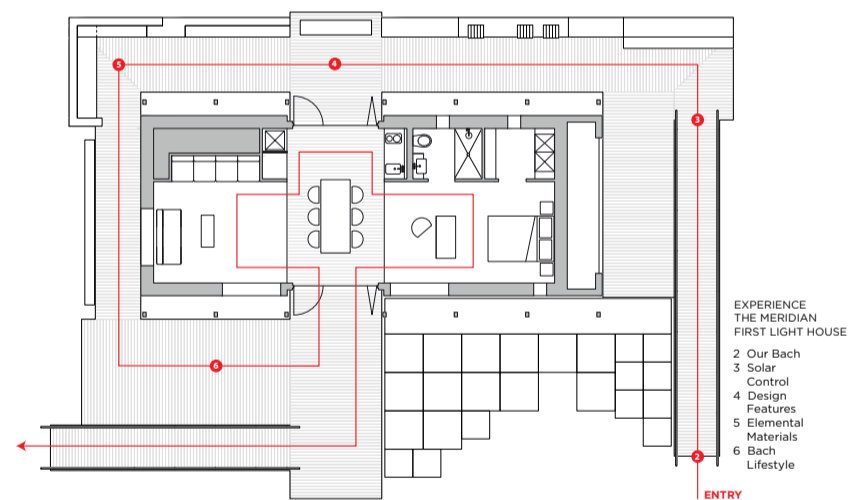
There are 10 contests:

- Architecture
- Market Appeal
- Engineering
- Communications
- Affordability
- Comfort Zone
- Hot Water
- Appliances
- Home Entertainment
- Energy Balance

Teams from New Zealand, China, Belgium, Canada and the U.S. have spent almost two years creating solar powered houses to compete in this event in September and October 2011.

The Meridian First Light house will be exhibited alongside other entries in the National Mall's West Potomac Park, which is nestled amongst national landmarks and memorials, just a stone's throw from the White House.

Over ten days in October 2011, around 300,000 people will visit this temporary solar village.



OUR BACH

The idea for our entry comes from the classic Kiwi bach (pronounced batch) where New Zealanders retreat to 'get away from it all'. Baches exemplify our Kiwi values: a strong connection with the landscape, a hands-on 'do it yourself' mentality, and socialising outdoors.

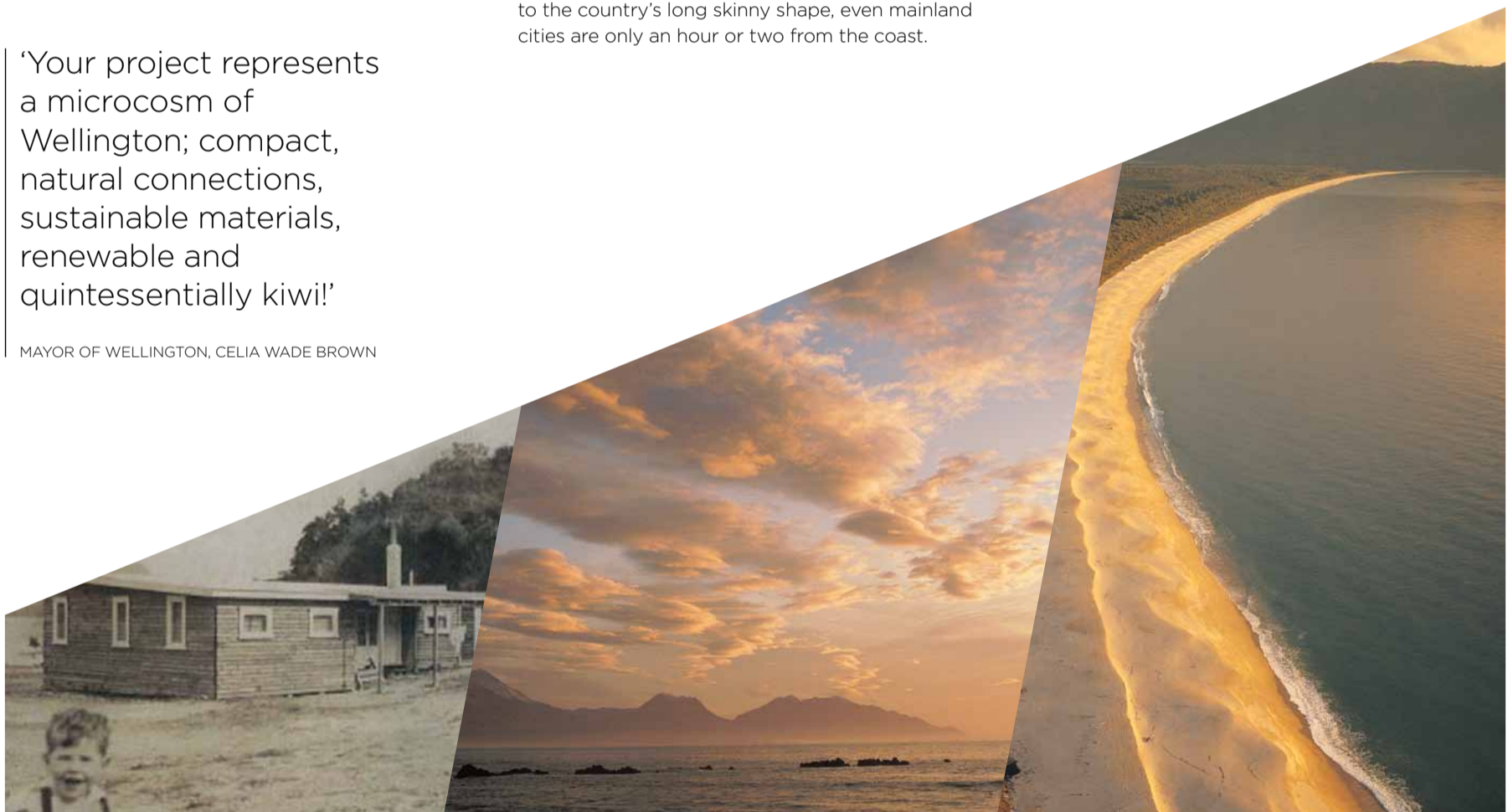
Our island nation is known for its sheer natural beauty, outdoor adventure and distinctive scenery and seasons. From fiords and lakes to lush pasture, sweeping beaches and semi-tropical forests, there's a lot packed into a small place.

Our country is the first in the world to see the light each day, hence the inspiration for the name—the Meridian First Light house.

New Zealanders have a strong connection with the sea and the beach, with the majority of the population living in coastal cities and towns. Due to the country's long skinny shape, even mainland cities are only an hour or two from the coast.

'Your project represents a microcosm of Wellington; compact, natural connections, sustainable materials, renewable and quintessentially kiwi!'

MAYOR OF WELLINGTON, CELIA WADE BROWN



JOURNEY THROUGH OUR LANDSCAPE

The landscape surrounding our bach takes you on a journey through the changing landscapes of New Zealand. Starting at the beach, you travel through coastal shrub lands and bush right up into the mountains.

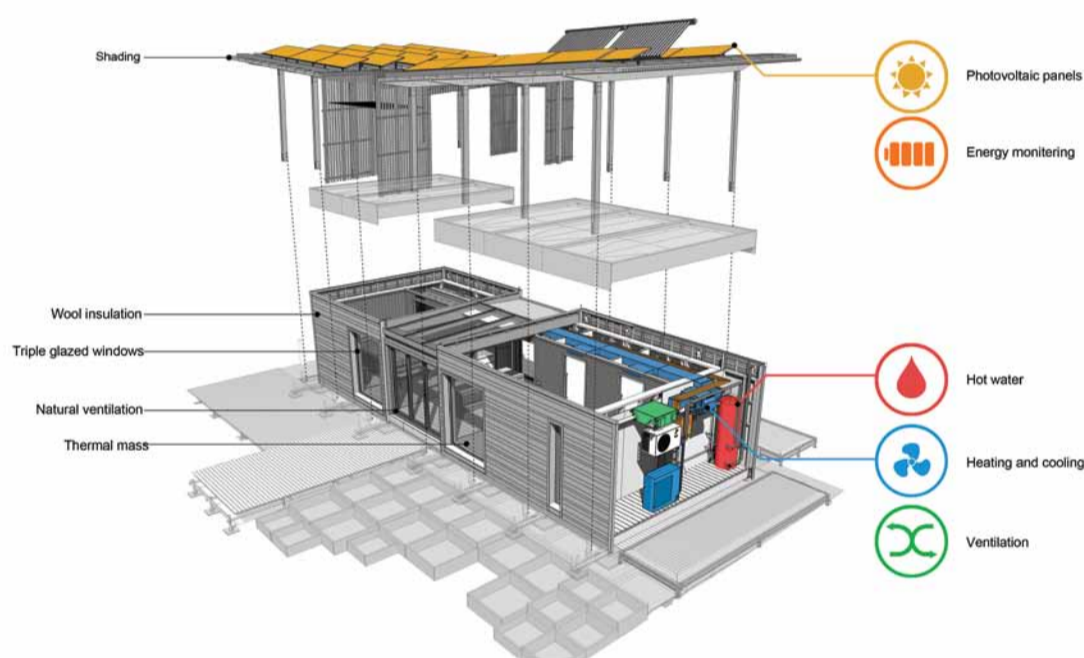


Coastal edge. You begin at the beach. Approaching the house you enter a coastal edge with a constructed dune landscape.

Carex testacea, Orange sedge is a native grass with a distinctive rich orange and green colouring and a weeping form. It is hardy to drought and salt winds and found throughout New Zealand in forests, grasslands and sand dunes.

SOLAR CONTROL

The Meridian First Light house is a net zero energy dwelling, designed to produce at least as much energy as it uses. The house has been designed to maximise natural energy using a combination of passive and active energy strategies. The result is an efficient comfort-controlled house that consumes less than a third of the energy of a typical New Zealand home.



ENERGY MONITORING SYSTEM

An interactive monitoring system has been created to show how energy is being used in the home. The system records and displays complex data such as peak energy usage, peak energy production, water usage and climate data in a simple and tangible way.

Energy use in the home is represented by rings of a tree trunk, the number of which increase as more energy is used. This real-time representation is a way for the home owner to see immediate results when energy use is reduced.

JOURNEY THROUGH OUR LANDSCAPE

Shrub land - As you move away from the coast you enter into a coastal shrub land with flaxes and shrubs.



Phormium cookianum, Harakeke - has robust, sword-like leaves that are arranged in two adjoining sets around the growing point to form a fan. It is the principal traditional weaving plant, leaf strips are used in raranga, the plaiting of kete (containers) and whāriki (mats). Extracted fibre (muka or whītau) is used to make traditional kākahu (cloaks), and for cordage.



Muehlenbeckia astonii, Shrubby tororaro. Also known as Wiggy (Wiggy-wig) bush, it is an endemic New Zealand shrub with a great number of fine reddish brown to reddish orange branches that zigzag with one another to form a dense ball. Tiny heart shaped leaves grow in clusters of two or three or along the longer branchlets.

PHOTOVOLTAIC PANELS (photo - light, voltaic - electricity)

The house has 28 highly efficient polycrystalline photovoltaic panels that convert energy from the sun into electricity. The panels consist of a group of solar cells that are connected electrically and packaged into a frame. The panels generate electrical power by converting solar radiation into direct current electricity.

The system generates enough power to run the house during all seasons by collecting extra power during the sunnier months to be used during colder, darker times of the year. The owner of this net zero home should never need to pay another power bill.

HOT WATER

Hot water accounts for one third of residential energy use in New Zealand. The Meridian First Light house has 40 evacuated tube solar collectors that use energy from the sun to heat water for all of your hot water needs.

An innovative drying cupboard using zero power was developed for the house. It uses energy stored in the water to dry clothes as quickly as a traditional dryer. Hot water is pumped through the heat exchanger which then heats the air inside the cupboard. Hot air, along with the hot water filled rails, work together to dry the clothes quickly while a fan extracts humid air from the cupboard.

HEATING AND COOLING

A comfortable internal environment is maintained using an energy-efficient heat pump. Heat is pulled from the air to warm the house in cooler months and to provide cool air in summer. This heat pump is capable of transferring up to 4kilowatts of heat into the space while only consuming 1kW of electrical energy.

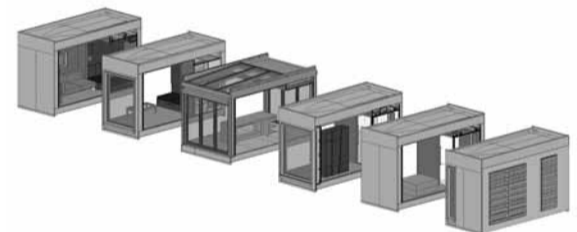
VENTILATION

Along with fully opening windows, a highly efficient energy recovery system provides ventilation for the house. Energy from the air in the house is used to pre-heat or pre-cool filtered fresh air coming into the house while leaving the temperature and humidity in the house relatively stable.

DESIGN FEATURES

The entire design of our house is oriented towards the outdoors. Decking runs around the house and also right through the centre, allowing occupants to effectively live outside during summer and bringing a sense of the outdoors inside during the colder months.

The central section of the house is surrounded by glazing and functions as a bridge between the natural environment and the indoors. This is at the heart of our design—reflecting a kiwi lifestyle where outdoor socialising and entertaining are central to living.



CANOPY

The cedar canopy provides independent support for the photovoltaic panels. The canopy also keeps the solar panels cool and provides shade, especially over the windows during the warmer seasons when the sun is higher.

SKYLIGHT

A triple-glazed skylight illuminates the central section of the house. Sunlight penetrates the space to provide heat and light, bringing the outdoors in. A shading system has also been incorporated for additional flexibility of the interior climate.

MODULAR/PREFABRICATED DESIGN

Fully prefabricated and modular, the Meridian First Light house has been designed to be easily transported. The house is made up of six independent modules that can be quickly assembled using a crane.

This level of prefabrication allowed the team to fit out the modules with finishes, fixtures, plumbing, electrical, and mechanical equipment which makes for a simple and fast connection onsite.

Timber decking surrounds the house linking the interior to the surrounding environment. The decking is also constructed from modules which are lifted into place for quick assembly.

ENVIRONMENTALLY SUSTAINABLE DESIGN PRINCIPLES

The Meridian First Light house has been designed using environmentally sustainable design principles. Where possible we have:

- made use of materials that use recycled content and/or can be recycled
- considered the embodied energy in materials used
- selected materials that have certification with environmental agencies
- used low cost, low energy materials sourced locally.

JOURNEY THROUGH OUR LANDSCAPE

Forest Edge – The forest edge is replicated behind the house with ferns and other native plants which create lush edges and provide privacy from surrounding sites.



Clematis forsteri is found in lowland forest in the central-southern North Island and northern reaches of the South Island. This native clematis has soft creamy-green flowers with a delicious fragrance in late spring



Pseudopanax crassifolius, **Horoeka or lancewood**. This tree (juvenile) starts life as a single erect stem, with numerous long and narrow down-pointing toothed leaves. It grows into a medium-sized round-headed tree with smooth, rounded leaves.

ELEMENTAL MATERIALS

The connection to the land was central to the design of the Meridian First Light house and the materials used reflect this. Key construction materials used within the house are natural, enduring and classic.

Wood, concrete, wool and glass are essential elements in the house and have largely been sourced from sustainable local resources. These materials lend strength, quality and integrity to both the structure and the aesthetics of the house.



TIMBER

Timber is a widely used building material in New Zealand due to its resilience, relative low cost and ease of construction. The Meridian First Light house uses a combination of timbers that lend a feeling of warmth to the house.

Recycled New Zealand native Rimu is featured along the interior rear wall of the house. The decking, made from sustainably sourced Pinus Radiata, surrounds virtually the whole house,

creating a bridge between the natural landscape and the interior of the house. The exterior cladding and timber canopy are made from Western Red Cedar which is naturally durable, light weight and stable in a variety of climates.

Laminated veneer lumber (LVL) and plywood were used for the walls and floors due to their stability and resistance to becoming deformed.

Glue laminated (Glulam) Douglas Fir was used for the posts and support beams for the canopy.



CONCRETE

Our house makes the most of the sun's warmth. The concrete slab flooring acts as a thermal mass, it stores heat during the day and releases it at night, helping to moderate the temperature inside the house.

We have used fibre-reinforced concrete which is a new form of flexible concrete, commonly referred to as ECC or Engineered Cementitious Composite. It is resistant to cracking, making it ideal for our transportable, prefabricated house.

WOOL

Our insulation material makes the most of an abundant renewable New Zealand resource. The entire house is insulated by a minimum of 240mm of recycled sheep's wool insulation. Recycled sheep's wool gives the house a thermal resistance value (R-value) almost three times greater than is usual.

Wool insulation has a high thermal performance and a natural resistance to slumping once installed.

GLAZING

Large areas of triple glazing provide natural light throughout the house while maintaining the thermal integrity of the house. Large windows face the sun along the front of the house, letting the sun and warmth in.

The windows and skylight are all argon filled, grey tinted and triple-glazed. Along with having a high thermal performance, they block 99 to 100 percent of UV rays. The cedar window and door frames minimise heat loss by preventing thermal bridging.

JOURNEY THROUGH OUR LANDSCAPE

Alpine zone - Landscaping takes you right up to the mountains with vegetation found in the alpine zone.



Chionochloa flavicans, Minature Toe Toe (pronounced toy-toy) is a native grass with deep green, graceful weeping foliage and tall spikes of fluffy white flowers during the summer.



Acaena inermis purpurea, Purple Piripiri or bidibidi is a compact and hardy herbaceous groundcover with attractive deep purple leaves and a one metre spread. Unlike most species of Acaena, it doesn't have barbs on the spines of its seed heads.

PASSIVE PRINCIPLES

Passive solar design makes the most of the natural environment by controlling the positioning and materials used for walls, floors and windows. Designed correctly, these surfaces will collect, store and distribute solar energy to keep the building warm in the winter and cool in the summer.

Optimising these passive elements of the design allows for minimal reliance on mechanical heating and cooling, resulting in a reduced need for energy overall.

The Meridian First Light house has been designed to use less than one third of the energy of a typical New Zealand home.

BACH LIFESTYLE

The ability to use the space for socialising is an important component of the design of the Meridian First Light house. The layout provides functional, flexible social spaces, that can be transformed to suit the owner and make the most of the natural environment.

The house has been designed to create multi-functional rooms while keeping practical concerns, such as storage, in mind.

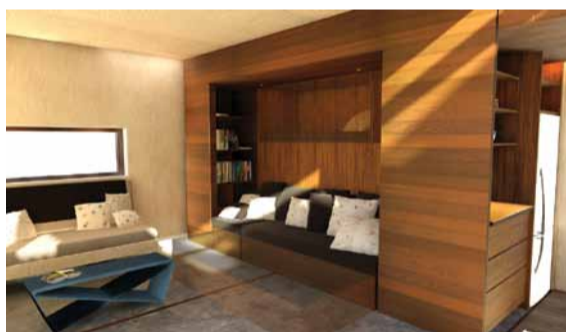
Space has been used sensibly to minimise the overall size of the house. A house perfect for a couple can be modified quickly and easily to accommodate friends and family.



KITCHEN/DINING

The kitchen and dining area can entertain both small and large groups. Large bi-fold doors open to extend the living space to the outdoors, providing for a continuous flow between the internal and external decking. The table seats eight and can be extended to create extra seating and cooking space with a movable bench unit.

Compact and energy efficient appliances have been chosen to maximise space and minimise energy use. Materials throughout the interior of the house were chosen for their durability and ease of maintenance. Concrete, wood and stainless steel materials were chosen as they are hardy, attractive and easy to clean.



LIVING

The living area has been designed to be a comfortable and laid-back social space. A custom-built furniture unit can be used as a seating area with ample storage or can be transformed to accommodate up to four overnight guests.



STUDY

A self-contained study unit creates a partial partition between the bedroom and living areas, creating visual privacy while keeping the open feel of the house. The unit offers storage on both sides and it can be transformed from a relaxing reading nook to a fully functional work space.

While entertaining, the desk can be either used for extra serving space or folded away to provide more floor space.

JOURNEY THROUGH OUR LANDSCAPE

Living off the land - Coming out of natural landscapes found in New Zealand you reach the Kiwi backyard where it's common to grow fruit and vegetables.



Puha is a green vegetable native to New Zealand, found growing wild.



Apium prostratum, New Zealand Celery has thick grooved stems and a thick, deep taproot. It is a creeping plant which is found in the wild along the coast of New Zealand.



Tetragonia tetragonioides, New Zealand Spinach is a rambling plant with bright green fleshy leaves.

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