SURREAL ESTATE
PROJECT REPORT

Suburban Single-Family Division

The U.S. Department of Energy

Solar Decathlon 2020

MSDT

MONASH University

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U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON

PROJECT SUMMARY

As a team from Monash University in Australia, Surreal Estate proposes a net-zero energy, bushfire-resistant, suburban single-family home of the future. We have focused on sustainable design and innovation to bring forward a competitive house that does not compromise on comfort.

Figure 1: Rendering of Single Suburban Family home design

Our aim was to optimize design in order to create a home that would be fire-resistant and affordable, as well as reaching a net-zero energy target. This design is a result of surveying the devastation caused by the bushfires in Australia over the past year. Record-breaking temperatures and severe drought led to the deaths of at least 24 people and 1 billion animals, leaving 12 million acres of land scorched[1] (an area the size of the U.S. states of Vermont and New Hampshire combined). Climate change and resource scarcity require shifts to renewable energy sources and reductions in energy consumption in every sector of the economy to ensure resilience in the face of extreme weather events. Monash University stands by the motto 'Ancora Imparo', meaning 'I am still learning'. Our team believes it is imperative to learn from past misfortune and take action where possible to learn from past devastation. The purpose of the suburban single-family home presented by Surreal Estate is twofold:1) to protect the environment by standing operating at net-zero energy, and 2) to protect families by introducing fire-resistant housing.

Our industry partners for this design competition included Aquarevo and Jacobs, who have been invaluable in providing production considerations and experience. We have also benefited from the knowledge and advice provided by our lecturers at Monash University, including Brandon Winfrey and Victor Bunster, both of which are based in the Department of Civil Engineering.

RELEVANCE OF PROJECT TO COMPETITION GOALS

The Solar Decathlon challenges teams to design and build the most efficient, affordable and innovative homes. In order to have an impact on the housing industry, our design must be attractive to families in suburban Australia.

Surreal Estate desires to provide families in Australia with a home that can combat the annually occurring wildfires while improving the environment . This challenge requires innovation and forward-thinking from our engineers and architects and has a positive impact on the world we are living in.

DESIGN STRATEGY AND KEY POINTS

Our team decided on a triad of key points for our design strategy. These priorities included creating fire-resistant suburban homes which are net-zero energy and affordable for the average Australian family purchasing their first home.

On the basis of this, our initial focus was finding an appropriate location, where a typical Australian home would be impacted by bushfires. As a team, we chose to design a home in the Melbourne suburb of Tarneit.

This is a growing suburban area in Melbourne, Australia, with a climate zone of 3, similar to that of San Francisco, California. This area allowed us to focus on the realistic struggles a new family would face when moving to the suburbs.

Our goal was to ensure that we could incorporate all the innovation needed for fire resistance, while still catering to the environmental and financial interests of our home buyers.

To reach necessary conclusions about our target demographic, our team had to survey young families looking to buy their first home in the suburbs. Our team analyzed market data and researched potential buyers in order to adjust our design accordingly.

Figure 2 Triad of Key points

PROJECT DATA AND TECHNICAL SPECIFICATIONS

Table 1: Project Data and Technical Specifications

Location: Tarneit, Victoria, Australia	**Envelope**: R-30 wall, R-31 foundation, R-53 roof
Climate Zone: 3 (Melbourne has a climate similar to San Francisco, CA)	**Windows U-values**: 0.24
Lot size: 6,039 ft^2	**HVAC SEER Rating**: 20.0
Building size: 2,174 ft^2, 1 story	**HVAC type**: Central air source heat pump
Annual Utility Cost Estimate: $1,228 USD	**Ventilation**: Ceiling mounted ducting system
Construction Cost Estimate: $190,611 USD	**Energy**: 6 kW PV array with a 10kWh battery

TEAM INFORMATION

Monash University dedicates a lot of research to sustainable energy technology. A range of courses can be found in the Engineering and Architecture Faculties which focus on innovation and inquiry into creating a positive ecological footprint.

Our university recently joined forces with Woodside Energy to produce the Woodside Building for Technology and Design. The Monash Solar Decathlon team were offered one of the first building tours to discuss optimization and sustainable practices. MSDT was also given the opportunity to take team photos in this building. Due to the ongoing development of COVID-19, we took care to stand 1.5 m apart in all photos, to demonstrate our dedication to social distancing, whilst remaining focused on the project goals.

Figure 3: Surreal Estate team photo in accordance with 1.5m social distancing. Sarah Manning absent from photo.

Our team of undergraduate engineering and architecture students is based in Melbourne, Australia, at Monash University. Established in 1958, the Monash encourages creativity, innovation and activism in its student body. Monash is ranked 75th in Times Higher Education World University rankings and the Civil Engineering program is ranked 21st in the QS World University rankings. Monash focuses on innovative research in collaboration with industry.

Surreal Estate is a subset of the Monash Student Decathlon Team, in affiliation with two other teams competing in separate divisions. As a new team, we are focusing on development and growth, ensuring excellence is at the basis of all the work we produce. We are made up of students from a range of academic backgrounds, including the Architectural and Engineering departments.

Our faculty advisor from the Department of Civil Engineering, Brandon Winfrey, has aided our team's continuous development, running building science lectures to encourage learning and

putting us into contact with industry support. Moreover, Dr. Elizabeth Sironic has also been overseeing our progress and been giving us continuous feedback on our designs from a civil engineering perspective. Our support from the architecture department has come through Dr. Victor Bunster, who has provided ongoing advice and recommendations from an energy modelling perspective as well as an architectural and design perspective.

We have been building connections with industry for continued mentorship from various companies, such as Jacobs Engineering Group, South East Water and Stiebel Eltron. Aside from general consultations with us about our long-term partnership, they have also offered various advice and recommendations regarding our designs. Furthermore, we had the privilege of hearing from Simon Topliss and Pablo Sepulveda about their net-zero, passive design for a student accommodation on the Monash Peninsula campus.

Throughout the course of this competition we have learned how to use programs such as Revit and SketchUp for modelling, VELUX Daylight Visualizer for daylight simulation rendering and RSMeans for financial estimations.

Table 2: Advisors, Lecturers, and Team Members

Faculty Lead:

Brandon Winfrey
Lecturer in Water Engineering
Department of Civil Engineering

Technical Advisor:

Victor Bunster
Postdoctoral Research Fellow
Faculty of Art, Design and Architecture

Technical Advisor:

Elizabeth Sironic
Senior Lecturer
Department of Civil Engineering

Team Members:

Alba Carbonell Rivela **(RES)**

Nathan Imperial **(CIV)**

Ying Fai Fung (Owen) **(MEC)**

Saad Nauman **(CIV)**

Sarah Manning **(CIV&S)**

Srishty Varma **(ARC)**

Sarah Yin **(MTH&S)**

Yue Wang **(MTH)**

Sandy Awad **(MTH)**

Bachelor of Materials Engineering (MTH), Bachelor of Architecture (ARC), Bachelor of Science (S), Bachelor of Civil Engineering (CIV), Bachelor of Mechanical Engineering (MEC), Bachelor of Resources Engineering (RES)