EMERGING ENGINEERS COMPETITION 2024

Low Carbon Footprint

Design to Power a House in 2040

CONTACT US

Emerging Engineers
M302
The University of Western Australia
35 Stirling Highway
Crawley, Perth
Western Australia 6009

E-mail: emergingengineers@uwa.edu.au.

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ABOUT US

The University of Western Australia (UWA)

UWA's main Crawley campus is located on the banks of the Swan River, or Derbal Yerrigan, on the land of the Whadjuk Nation. We have the immense privilege of sitting on the sacred soil where Western Australian kaartdijin, or knowledge, began. It has been a place to gather and learn for tens of thousands of years, with stories and lessons shared from generation to generation of the world's oldest continuous culture.

Our students take their learning beyond the books, at the cutting edge of knowledge creation, from passionate lecturers with real industry experience and connections.

The global impact of our research and education places us as a world top 100 university (QS 2023) with a sustained reputation for excellence across Science, Technology, Engineering and Mathematics (STEM) fields.

The UWA School of Engineering currently offers nine engineering specialisations: Automation and Robotics, Biomedical, Chemical, Civil, Electrical and Electronic, Environmental, Mechanical, Mining and Software.

OceanWorks

OceanWorks is a joint initiative between The University of Western Australia and Woodside Energy aimed at increasing research capabilities to better respond to society's current and future needs in marine science and ocean engineering. Located at the Indian Ocean Marine Research Centre at UWA, OceanWorks brings together a community of researchers to collaborate and innovate to identify solutions to some of the greatest global challenges affecting our oceans.

Girls+ in Engineering (GiE)

The UWA Girls+ in Engineering (GiE) outreach program inspires female students to explore Science, Technology, Engineering and Mathematics (STEM) study and the career pathways available in this area. Along with our industry partners, we recognise the gender imbalance in STEM fields should be addressed from an early age. We aim to challenge stereotypes, demystify fields of study and work, and work to create the engineers of the future.

Thanks to our foundation partner Rio Tinto and additional industry support from SLB and Newmont, the program has reached over 20,000 students in Years 2-12 since 2014.

COMPETITION OVERVIEW

PARTICIPATION

The Emerging Engineers Competition is a 20-week competition which sees students work on a project in small teams (at school or home), to design a solution in response to the project theme.

The competition is open to students currently enrolled in Years 2-10 in schools across Western Australia or in equivalent studies in a home-school group that is registered with the Department of Education in Western Australia.

Students must register in a team of 3-5 (maximum of 5 students per team). Teams may include students from mixed years. As a team, students are required to develop a design solution for the competition theme outlined on page 6.

Please see page 8 for information on the teacher and student registration process.

COMPETITION OBJECTIVES

The Emerging Engineers Competition introduces engineering research and development in a real-world context. Students will follow the engineering design process and design criteria to research, develop and pitch an innovative solution.

This year's theme is an open challenge in engineering design that encompasses a number of specialisations including civil; electrical and electronic; and environmental engineering.

In addition, the competition provides opportunity for students to demonstrate transferable skills such as:

- Critical and creative thinking
- Communication
- Independent research
- Project management
- Teamwork

COMPETITION THEME

Low Carbon Footprint Design to Power an Australian House in 2040.

In 2024, the competition theme is to innovate a low carbon footprint design to power an Australian house in 2040. This theme focuses on the ways we can optimise energy systems and decrease our carbon footprint through our house design.

A 'carbon footprint' can be defined as the calculated amount of greenhouse gases generated by a process or product. It is a broad concept that can never be accurately calculated, but it provides a reasonable measure of our impact on the environment and allows us to evaluate the efficiency and sustainability of a product or process. A low carbon footprint design to power a house should aim to increase the efficiency of our energy usage and/or generate better sources of energy.

Currently, Australian houses contribute to more than 10% of the country's total carbon emissions, this is mostly due to energy usage or inefficiencies. Due to increased greenhouse gases in our atmosphere, our urban spaces are hotter, dryer and at a higher risk of natural disasters. Our current ways of designing and using our homes are no longer effective and need to be updated to combat increasing energy demands, environmental pressures and rising carbon emissions.

Our houses provide a great opportunity to reduce our carbon footprint in Australia. For example, solar panels were introduced and started to grow in popularity around 2010, now over 3M households have installed solar panels in their houses. They generated around 10% of the country's electricity in 2020-21, with that percentage increasing each year. There have also been initiatives to increase the energy efficiency of house appliances such as air-conditioners and refrigerators. As you can see, there is an exciting opportunity to implement new technologies and designs to power an Australian house with a low-carbon footprint.

You can take inspiration from the many innovative designs that have been developed already, from passive solar houses, using experimental sustainable materials and plants integrated into walls. Work through the engineering method to develop your design, keep in mind how Australian conditions may affect your design solution and what the carbon footprint of your design is throughout its lifecycle.

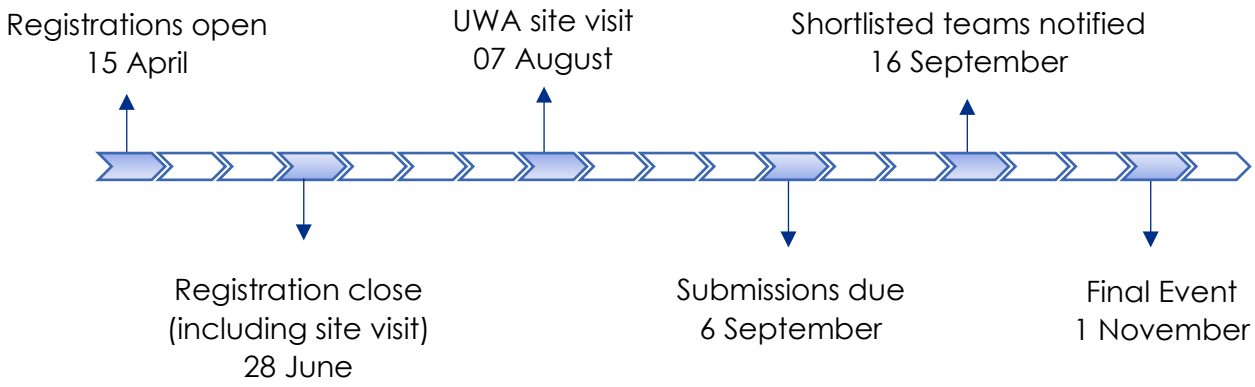
How can your team power a low-carbon footprint house in Australia in 2040?

TIMELINE

The competition begins with an on-campus site visit at UWA, **Wednesday, 07 August 2024**. This full-day event is an opportunity for students to gain a deeper understanding of the theme, meet experts from UWA's School of Engineering and ask questions before beginning their research.

The competition takes place over Term 3 and Term 4, with the final submission due **5pm AWST Friday, 6 September 2024**.

All schools will be notified of the outcome of their first submission by **Monday, 16 September 2024.** Shortlisted teams will be invited back onto campus to present their solution to a panel of judges at the Final Event, on **Friday, 1 November 2024.**



TEACHER & STUDENT REGISTRATION

Teacher, student and UWA site visit registrations close 5pm AWST, Friday 28 June 2024.

Throughout the competition, students must be supervised by a registered teacher from their school. This teacher will be the main point of contact for all correspondence from UWA during the competition. In the event that two groups are participating from one school, please nominate only one teacher as the primary contact and supervisor.

Female or non-binary students currently enrolled in Years 2 – 10 or in equivalent registered home-school can register in teams of 3 to 5 students.

A maximum of **two groups** (10 students) can be registered per school.

Students must have a signed permission form to participate in the competition. The nominated teacher is responsible for forwarding signed permission forms before registration closes.

UWA Crawley site visit

The competition includes a site visit to UWA's Crawley campus. Although not compulsory, the site visit is a great opportunity for participants to gain a greater understanding of the competition theme ahead of their own research and design.

To register attendance to the site visit, supervising teachers must contact competition organisers at emergingengineers@uwa.edu.au and obtain the required documentation. Registrations for the site visit are also to be returned to the competition organisers at emergingengineers@uwa.edu.au by **5pm AWST Friday, 28 June 2024.** .

Students attending the site visit must also have returned their permission forms to the competition organisers via their supervising teacher by 5pm AWST Friday, 28 June 2024.

SUBMISSION GUIDELINES

Project Submission due 5pm AWST, Friday 6 September 2024.

Projects must be submitted digitally via email to emergingengineers@uwa.edu.au

The format of this submission require all documents (e.g. research reports, PowerPoint slides, links to websites and short videos) attached in **one e-mail**. All work submitted needs to be clearly labelled and using an appropriate email subject. Annotated images of prototypes developed are also encouraged, but not compulsory.

Please note this is an open design competition, where students have autonomy over the medium used to communicate their ideas. Teams are welcome, but not required, to build a prototype or model. Shortlisted teams are invited to bring any prototypes, models or displays to the Final Event.

Regardless of submission format, competitors will be judged on the quality of their research, the innovation of their design and the engineering process.

Please see page 14 for further information on the submission guidelines.

Final Event, Friday 1 November 2024.

Shortlisted teams will be invited to present their project at the Final Event.

At the Final Event all student work and presentations must be saved to a USB or external hard drive and be compatible with Windows operating systems.

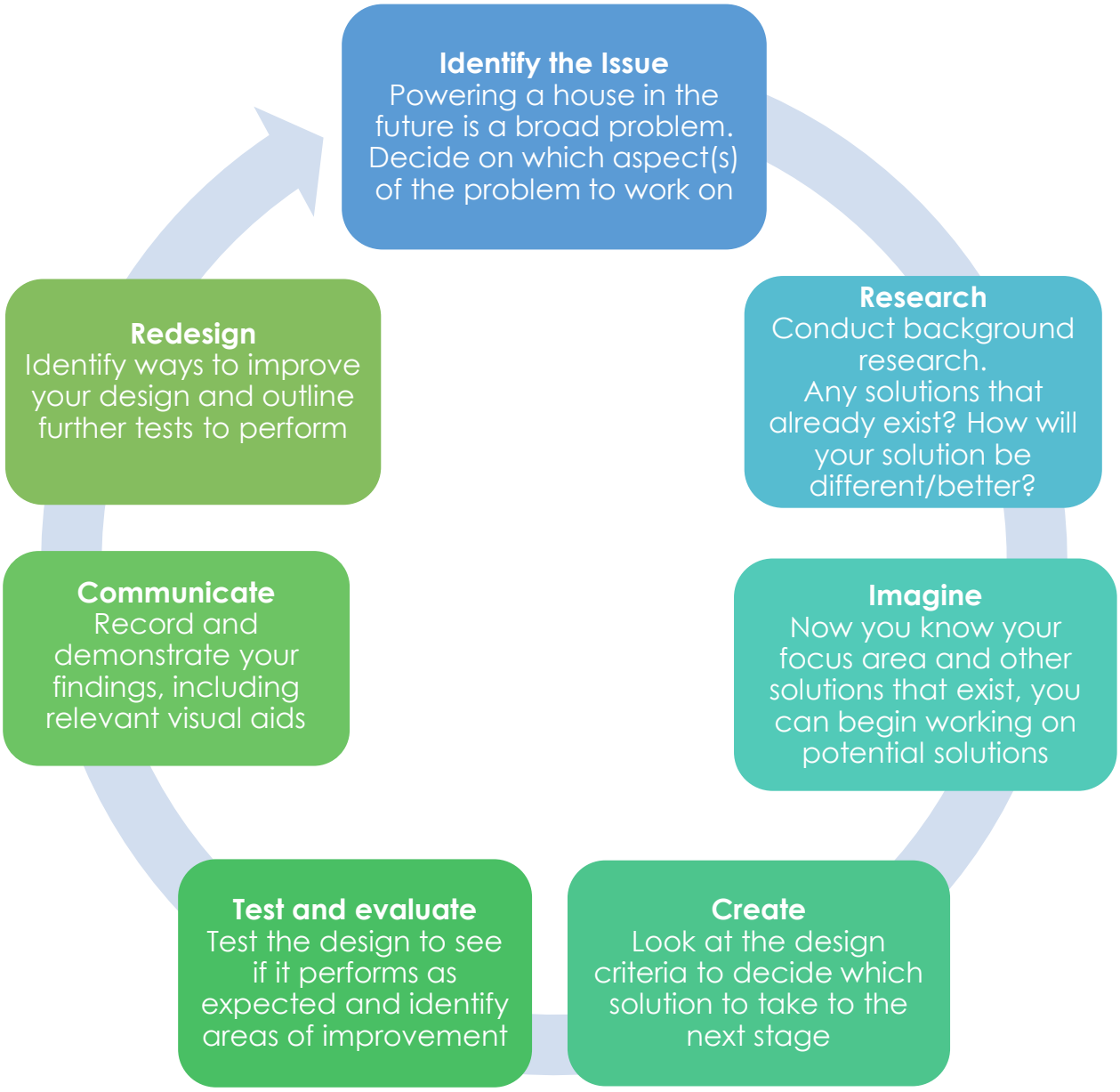
Teams must be prepared to present **'offline'** without relying on internet access for their final presentation. UWA will **not** provide Wi-Fi access to any students or teachers at the Final Event.

The panel of judges will be made up of UWA and industry experts. Further details surrounding the Final Event will be shared with supervising teachers of shortlisted teams on Monday, 16 September 2024.

ENGINEERING DESIGN PROCESS

Teams are expected to follow the Engineering Design Process in the development of their design solution. The design process is cyclical in nature. It is a continual process as engineers strive to constantly improve the solutions that we have.

The judges are not only looking for the 'best' solution; they will also be looking for evidence that the team has followed the engineering design process.



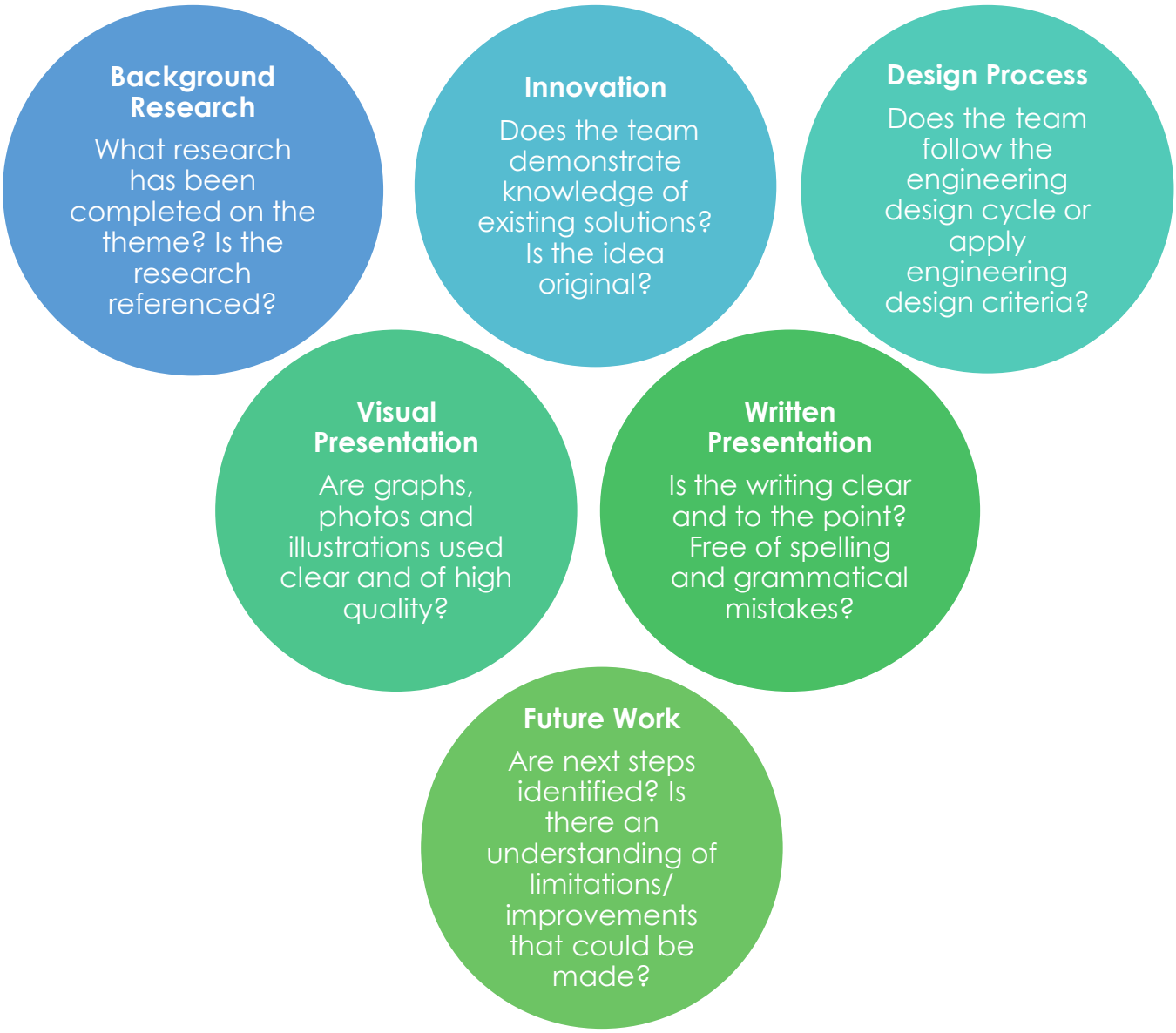
DESIGN CRITERIA

Consider each of the design criteria below for each potential solution you have come up with. These criteria can be used when deciding which the best possible solution to create and test is. While the judges will not explicitly assess these criteria, it is expected that it will be embedded in your team's research and design.

JUDGING CRITERIA

The diagram below highlights key criteria that judges will use to shortlist teams following the first submission. Students are encouraged to refer to these criteria throughout their research and design to be reflected in their final work.

A detailed breakdown of the judging criteria for the first submission is provided in Appendix I.



BACKGROUND RESEARCH

Conducting high quality research is the key to success in this competition. The judges will be looking for evidence that the team has conducted their own independent research beyond the information provided in this manual, drawing on credible sources to develop their innovative solutions.

We recommend students source credible research via online databases such as:

Directory of Open Access Journals: https://doaj.org/

PLoS One: https://journals.plos.org/plosone/

State Library of Western Australia: https://slwa.wa.gov.au/

Trove: https://trove.nla.gov.au/

Links to some articles students might be interested in, to give them inspiration for their designs and an introduction to current Australian house designs:

1. https://www.greenhouseliving.se/naturhus
   (An innovative Swedish house design that has high energy efficiency and was designed specifically for Swedish climate and context)
2. https://www.csiro.au/en/news/all/articles/2023/december/australian-homes-climate-ready

REFERENCING

It is expected that students will provide a list of references that is formatted according to a referencing style of their choice. For example, The University of Western Australia uses Harvard referencing style.

Examples of Harvard referencing of the pervious links are provided below.

1. Olson, F 2023, 'The Naturhus Concept'. *Greenhouse Living*, accessed 25 March 2024, <http://www.greenhouseliving.se/naturhus>.
2. Gill, A 2023, 'Australian homes can be made climate-ready, reducing bills and emissions – a new report shows how' *CSIRO,* accessed 25 March 2024, <ps://www.csiro.au/en/news/all/articles/2023/december/australian-homes-climate-ready>

DESIGN SUBMISSION GUIDELINES

The final design must be submitted digitally via email to emergingengineers@uwa.edu.au

This is an open design competition, where students have autonomy over the medium used to communicate their solution. Teams are welcome to, but not required, to build/ submit a prototype.

Whichever format is chosen, it is expected that the submissions will include the following content:

Theme Explanation

- Describe which aspect of the issue you are focusing on in your solution
- Explain what the issue is
- Review current solutions to this problem
- Define the scope of your project

Design Description

- Describe the application of your solution and how it works
- Reference any diagrams or photos to support
- Describe your use of the Engineering Design Process

Evaluation

- Assess your team's performance
- Critically reflect on your design and include evidence
- Summarise the strengths and weaknesses of your design
- Identify next steps

APPENDIX I: 2024 Emerging Engineers Competition, Submission One Judging Criteria

Criteria	Not demonstrated 0-2	Developing 3-4	Satisfactory 5-6	Above standard 7-8	Excellent 9-10
Background research 20%	Students have found a few credible sources. Information presented is somewhat accurate.	Students have found an average number of credible sources. Information is accurate and relevant.	Evidence of independent research is presented. Multiple and varied credible sources used. Information is accurate and relevant.	High standard of independent research has been presented. Multiple and varied credible sources. Information is accurate and relevant.	Very high standard of research has been presented. Sources are credible and comprehensive. Current research/ experts are drawn on.
Innovation 20%	Limited attempt to review current solutions. Design presented shows some originality or small degree of improving existing solutions.	Some analysis to review current solutions. Design presented contains original elements or shows improvement on existing solutions.	Good analysis of existing solutions. Design presented contains original elements or shows good improvement on existing solutions.	In-depth analysis of existing solutions. Design presented is highly original or shows significant improvement on existing solutions.	In-depth and comprehensive analysis of existing solutions. Design presented is original or shows outstanding improvement on existing solutions.
Design process 25%	Limited attempt to follow design process. Limited attempt to use engineering design criteria.	Some aspects of the design process have been followed with some attempt to use engineering design criteria.	Design process has been followed well and group has considered use of the engineering design criteria	Design process has been followed very well. Team has considered and applied the engineering design criteria	Design process has been followed accurately and the team has, in detail, applied this to the engineering design criteria.
Future Work 20%	Team has made none to small attempts to identify limitations of their own design.	Team has stated some limitations of their own design with some attempt to link these to future steps.	Team has explained some limitations of their own design and stated how these are linked to future steps.	Team has identified and exampled a number of limitations to their design and has linked these to future steps.	Team has identified and explained several limitations of their design and have applied this to future steps.
Presentation 15%	Limited use of visual aids to support research. Written report is unstructured with spelling and grammar errors.	Adequate use of visual aids to illustrate research. Writing is mostly clear and structured with some errors.	Clear visual aids used to enhance any written report, which is clear and concise. Few spelling and grammar errors.	High quality visual aids used to support written material, which is clear, structured, and concise, with no errors.	High quality visual aids supporting explanation to written material, which is clear, well-structured and with no errors.