

“An ‘eco-house’ learning and teaching environment to facilitate the development of sustainability literacy.”

Dr. Andy E Young

a.e.young@shu.ac.uk



Sheffield
Hallam University

SHARPENS YOUR THINKING

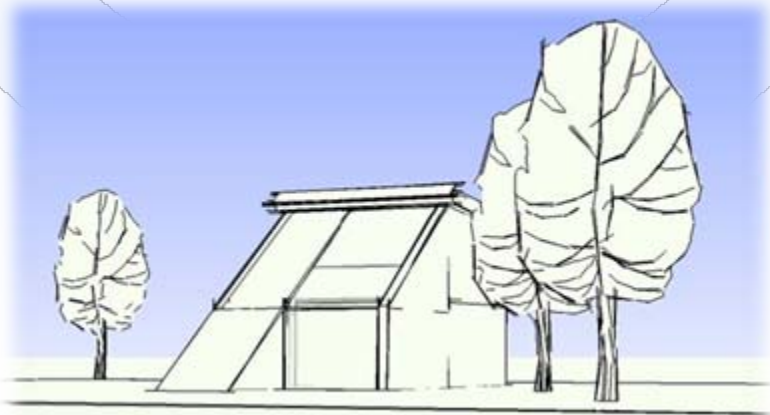


Overview of the eco-house project

- “An ‘eco-house’ learning and teaching environment to facilitate the development of sustainability literacy.”
- A context for applying engineering knowledge to analyse the efficiency and effectiveness of renewable energy systems
- Working at a 1/5th scale brings a number of advantages, and challenges

Overview of the eco-house project

- Began in October 2006, starting from scratch!
- In May 2007 we have a working eco-house with a wide range of renewable energy systems!



To develop a working scale model of an eco-house capable of providing adequate levels of: heat, power, light, and ventilation for the UK environment

maximising the use of local and natural resources, and minimising carbon impact and reliance on fossil fuels.

Acknowledgements

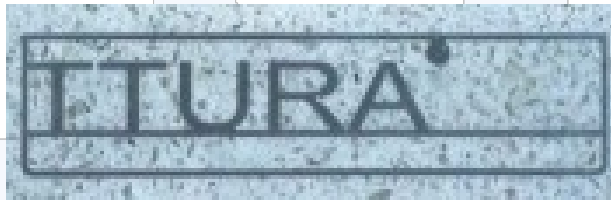
- Prof. Mike Bramhall: Head of LTA, Faculty of ACES
- Dr. Simon Steiner: Engineering Subject Centre, HEA
- Environment and Sustainable Development small grant project, funded by the HEA.



Outline

1. Meet the team
2. Sponsors
3. Eco-house design
4. How the eco-house was embedding in the curriculum
5. Interactive activity
6. Sponsorship and support

Sponsors



Danfoss

pico
Technology

InnoTHERM



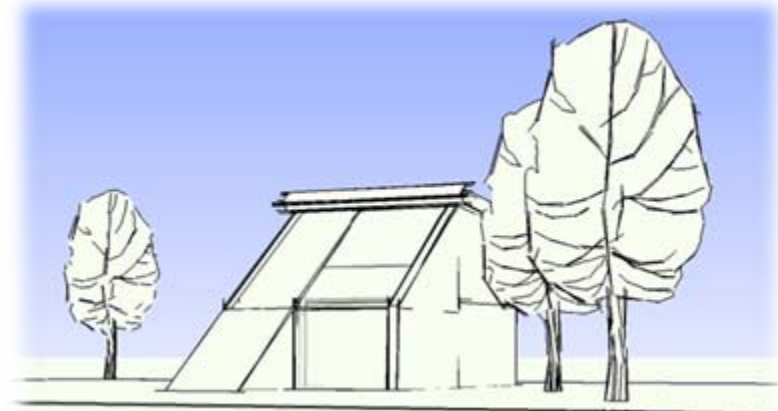
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Eco-house design: **Architectural Design**

- Inspired by Jestico and Whiles
- House of the Future, in Cardiff, Wales, UK.
- Recreated on a 1/5th scale
- 4 person family dwelling

Collaboration between engineers and architects to integrate mechanical and electrical services, and natural ventilation and passive solar heating.





Eco-house design: **Basic Construction**

- Timber frame
- Plywood cladding



Eco-house design:

Electrical power systems

- Vertical axis wind turbine
- Photovoltaic solar panel
- Lead acid batteries
- The grid

Integrated by a power controller, which combines AC and DC renewable energy and used it to power the heating systems, or store in the batteries, according to demand.



Eco-house design:

Heat power systems

- 200W heating required
- Solar water heater
- Under-floor heating
- Passive solar heating
- Air-to-air heat pump

200W of heating is required to maintain temperature during winter, while 300W of cooling is required during summer



Eco-house design:

Insulation systems

- Natural fibre insulation
- Solar Mass
- Green roof
- Double glazing

Integration of passive systems which retain heat and make use of natural resources and recycled materials.

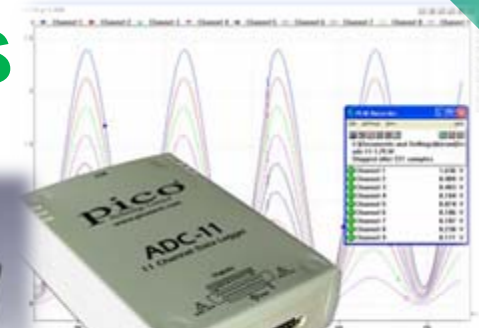



Eco-house design:

Control and Environmental Monitoring systems

- Weather monitoring system
- Integrated controller
- 24-7-365 performance monitoring system

Integrated by a fuzzy logic environmental control system, which predicts the weather, makes best use of available energy to maintains comfort levels.





How the eco-house was
embedded into the curriculum:

Student Working Party

- Interdisciplinary team of level-6 'project engineers' responsible for key systems
- Students encouraged to consider their strengths and weaknesses
- Bid for support from other students in learning sessions

Promoting adoption of
professional roles,
responsibility, and leadership



Student Working Party: Meet the team

- **Babur Hussain:** Green Roof and natural fibre insulation
- **James Parker:** Underfloor heating and solar water heater
- **Rob Simmonds:** Air-source heat pump
- **Sebastian Schweer:** Passive solar heating and natural ventilation
- **Marcel Gathmann:** Wind turbine electrical power generation
- **Agathe Grenier:** Photovoltaic electrical power generation
- **Dave Farmer:** Internal and external environment monitoring
- **Simon Blackburn:** Integrated control systems
- **Senan Haddad:** Integrated power supply
- **Gus Evans:** Coordination and fabrication
- **Nick Jones:** Architectural design

Electrical
Architecture Mechanical
Design Building Services

11 strong, from a range of
disciplines and backgrounds


How the eco-house was
embedded into the curriculum:

Student Working Party

- Multi-disciplinary team
- Appreciate the impact of their decisions on the perspectives of others
- Collaborating to develop holistic solutions
- Working party responsibilities:
 1. Selection
 2. Development
 3. Sponsorship
 4. Building
 5. Integration
 6. Commissioning
 7. Monitoring

Communicate to develop
practical solutions through
innovation






How the eco-house was embedded into the curriculum:

Links to other levels

- Engaged as ‘technical experts’ in level-5 learning sessions
- Volunteer ‘consultant’ students at level-7 from other disciplines
- Maximises the number of learners linked to the project

Promoting adoption of professional roles, responsibility, and leadership





How the eco-house was
embedded into the curriculum:

Links to other levels

- Developed assignments focused on analysis and design of elements of the key systems
- Students compete to develop winning design
- Judged by working party

1. evaluate and reflect on the impact of their decisions
2. relate to the values and perspective of others
3. Apply a systemic, holistic approach to decision-making
4. approach problem-solving in a non-reductionist manner
5. work effectively with others in inter-disciplinary teams
6. respond creatively and imaginatively to challenges
7. providing pragmatic, long term solutions
8. bridge the gap between theory and practice
9. engage in self-reflection (both personal and professional)
10. manage and evaluate the outcomes of change



Motivation by Competition
and Ownership



Extensions

- Project web page (performance monitoring)
 - Involvement of wider range of disciplines
 - An open competition to other Universities
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- Publications
 - University Open-days
 - School visits
 - Exhibitions



Interactive session description

Disciplinary

1. Form disciplinary groups
2. Each group explores what role their discipline could have in the development of the eco-house (5 mins)
3. Develop an illustrative example (5 mins)
4. Each disciplinary group reports back, highlighting (10 mins):
 - a. the role
 - b. what it brings
 - c. Illustrative example

Interactive session description

Inter-Disciplinary

1. Form interdisciplinary groups, with one new role per group (advocated by disciplinary group member)
2. Explore opportunities for inter-disciplinary teaching and learning (5 mins)
3. Highlight barriers and possible solutions (5 mins)
4. Each inter-disciplinary group reports back, highlighting (10 mins):
 - a. Opportunities
 - b. Barriers and Solutions

Interactive session

Results

- **Disciplinary group**
 - a. Disciplinary role
 - b. What it brings
 - c. Illustrative example
- **Interdisciplinary group**
 - a. Opportunities
 - b. Barriers and Solutions



Closure

- A great achievement given time and resources
- Continue to build on what we have developed
- Involvement of wider range of disciplines
- Role out as challenge to other Universities
- a.e.young@shu.ac.uk
- 0784 126 1138

Thanks for your support!

