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Environment and Sustainability Institute

An 'Outstanding' building - a BREEAM case study

The University of Exeter's Environment and Sustainability Institute (ESI) leads cutting-edge research into solutions to problems of environmental change; in so doing, we are enhancing people's lives by improving their relationships with the environment. We engage with hundreds of businesses in Cornwall, the Isles of Scilly and beyond to translate research and expertise across the research themes into innovative business practice, products and services.

Such work requires an exceptional building.

Located at the University's Penryn Campus near Falmouth (which is shared and jointly managed with Falmouth University in a pioneering arrangement) the £30 million ESI features a diverse range of interdisciplinary research facilities including three laboratories, a research hall, a workshop, a creative studio and conference and meeting facilities in a central interactive space. It has been enabled with a £22.9 million investment from the European Union's European Regional Development Fund and £6.6 million from the South West Regional Development Agency.

BREEAM rating and score

The ESI achieved a design stage (DS) BREEAM 'Outstanding' rating with a score of 91.57%. It is anticipated that this success will be exceeded at the post construction stage (PCS) with a final score of 94.33%. The increase is due to the achievement of additional credits for two approved innovations as well as an improved 'as built' energy performance certificate (EPC) rating.



Key innovative and low-impact design features

Energy consumption and CO₂ emissions

Opportunities to reduce regulated and unregulated energy consumption were identified during the design and construction. The ESI utilises a number of energy saving strategies including:

- ultra high levels of insulation were installed including triple glazing with a U-value of just 0.9W/m²/K, 300mm of floor insulation and 250mm of roof insulation with U-values of 0.05 and 0.07 respectively
- an air permeability rating of just 2.72m³/hr/m² at 50Pa against a Building Regulations requirement of 10 – a real achievement for the construction
- ultra low loss transformer

- water cooled heat rejection from -80°C freezers
- heat reclaim from freezer room
- a massive 120m^3 buried water “coolth” tank to allow coolth to be generated overnight (when it is most efficient to do so as external air temperatures are at their lowest) and stored ready to be used during the following day. These initiatives have resulted in energy consumption of just $36.39\text{kWh}/\text{m}^2/\text{yr}$ against a target of $78.37\text{kWh}/\text{m}^2/\text{yr}$.

In addition, excess waste energy (including heat from fridges and freezers in the laboratories) has been harnessed to power the Controlled Temperature Rooms. This has resulted in:

- a reduction from 132tonnes of CO_2/yr (traditional approach) to just 8tonnes of CO_2/yr
- reduction in electrical demand from $181,687\text{kWh}/\text{yr}$ (traditional approach) to $16,352\text{kWh}/\text{yr}$
- utilisation of Combined Heat and Power (CHP) for process cooling (as well as building cooling) via an absorption chiller, subsequently saving $76,7691\text{kWh}/\text{yr}$.

Low or zero carbon technologies

The ESI features a number of low or zero carbon technologies, including:

- a 210kWe thermal-led gas CHP engine coupled with an $8,000\text{ltr}$ buffer vessel ensures that system energy efficiency is maximised with needless heat rejection eliminated
- the CHP engine provides heat for hot water, heating and by utilising an absorption chiller, heat for cooling. An absorption chiller provides building (laboratory) cooling and a second absorption chiller provides cooling for process demands
- 250m^2 of high output roof-mounted photovoltaics.

This combination of innovative technologies and approaches achieved a 23.34% reduction in CO_2 emissions (in comparison to conventional technologies) while the CHP engine enabled maximum BREEAM credits for low NO_x emissions of below $40\text{mg}/\text{kWh}$.

Our space

- the total area of the ESI building and all landscaping: 1.6216 hectares
- gross floor area: $3,350\text{m}^2$

Areas

- the Creative Space: 21m^2
- a conference room (the Trevithick Room): 35m^2
- a second floor laboratory: 226m^2
- a first floor laboratory: 460m^2
- a clean technology laboratory: 35m^2
- a cold/freezer rooms: 48m^2
- a microscope/tissue culture facilities: 87m^2
- the Interactive Space including the Café: 207m^2
- shared work areas, and offices (including write-up areas and academic workspaces): 826m^2
- meeting rooms (the Davies Gilbert Room, the Elizabeth Carne Room and the Frederick Davy Room): 53m^2
- the Research Hall and Workshop: 263m^2
- area of circulation: 290m^2
- area of storage: 20m^2

Innovative construction management techniques

A number of innovative construction management techniques, many focused on waste management, were used during the construction process to reduce environmental impacts, including:

- during the construction of the ESI, no non-hazardous waste was sent to landfill
- overall, just 4.16 tonnes per 100m² waste was recorded during the build, exceeding the BREEAM resource efficiency benchmark of <4.7 tonnes per 100m²
- the project achieved maximum BREEAM credit for waste management and an additional exemplary credit
- the project was the first undertaken by The Leadbitter Group with the aim of no non-hazardous waste to landfill
- the waste management strategy included use of supplier 'take-back' schemes (including packaging) and required that suppliers proved re-use
- non-hazardous, non-recyclable waste was sent to a waste-to-energy plant for incineration
- during construction, The Leadbitter Group maximised the use of materials containing recycled and waste by products. This included the use of recycled water and secondary aggregate in all concrete, recycled content in the steel reinforcement and the use of an innovative Green Guide A+ rated precast plank and recycled plastic void formers in the floor structures. The materials used in the floors minimised the quantity of concrete required, whilst also reducing the overall weight of the structure.

In addition, the following initiatives were also undertaken:

- sub-bases used locally sourced secondary aggregates from the china-clay industry
- an on-site mortar silo ensured that mortar was mixed to meet daily requirements, minimising wastage
- responsible sourcing of materials from manufacturers certified to ISO14001, BES6001 or FSC/PEFC achieved three BREEAM credits. BRE confirms only 8% of schemes had previously gained such credits.

Other key technical and working practice achievements include:

- 35,000ltr rainwater harvesting tank (twice the normal BREEAM-compliant size) combined with low water use sanitary ware
- comprehensive transport analysis resulted in a new bus interchange for the campus, facilities for cyclists, and contractors' park and ride and car sharing schemes
- the majority of building elements specified achieved Green Guide A or A+ rating
- all insulation products procured achieved A or A+ rating and were sourced from manufacturers with ISO14001
- a Considerate Constructors score of 37.5
- key internal finishes and fittings used materials with low volatile organic compound (VOC) levels
- high-efficiency lighting switched through presence detectors, daylight dimming sensors and absence detectors. A significant proportion of the lighting installed in the ESI uses low consumption, light-emitting diodes (LED).
- naturally ventilated building - maximum BREEAM credits achieved for specification of ventilation systems
- energy and water metering
- ultra low loss transformer
- water-cooled heat rejection from -80°C freezers

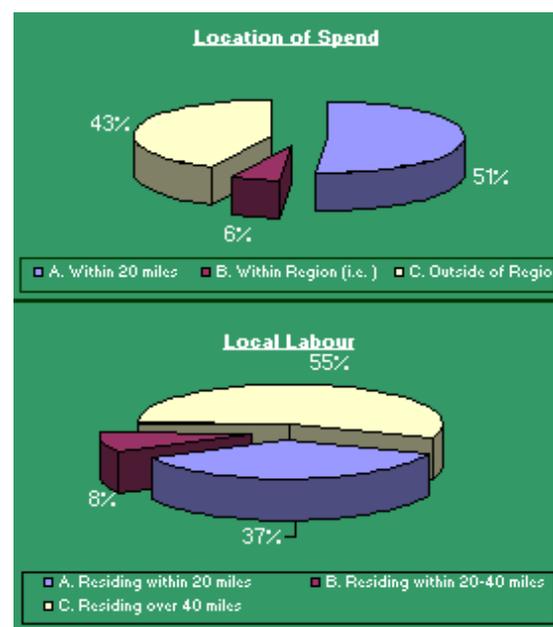
Our achievements in context

Measure	Benchmark	Achieved	Saving/Improvement
Emissions rate	34.9kgCO ₂ /m ² /yr	9.4kgCO ₂ /m ² /yr	73%
Energy consumption	78.37kWh/m ² /yr	36.39kWh/m ² /yr	53%
Air permeability rating	5m ³ /hr/m ² at 50Pa	2.72m ³ /hr/m ² at 50Pa	2.28m ³ /hr/m ² at 50Pa
Glazing U-value	1.8W/m ² /K	0.9W/m ² /K	50%
Floor insulation (300mm) U-value	0.22W/m ² /K	0.05W/m ² /K	78%
Roof insulation (250mm) U-value	0.18W/m ² /K	0.07W/m ² /K	62%
Controlled temperature rooms (120m ³ coolth tank and absorption chiller making use of waste heat)	132tonnes of CO ₂ /yr	8tonnes of CO ₂ /yr	94%
	Elec. demand for cooling 181,687kWh/yr	16,352kWh/yr	91%

Our costs and labour

Over half of the products and services, and more than a third of the labour workforce required in the construction of the ESI, were sourced from within a 20 mile radius of the Penryn Campus. A breakdown of the location of spend, and domicile locations of our labour workforce is shown to the right and below:

- basic building cost: £1,389/m²
- services costs: £1,325/m²
- external works: £99/m²
- gross floor area: 3,350m²



Our social contribution to the local community

A key facet of the ESI is that our activities should be accessible to and engage the local community. As such, the Institute regularly organises events and opportunities for members of the public to attend, and participate in research and activities led by the ESI. The following examples are indicative of the type of public events we have delivered within the building to date (dates given are press release issue):

21/03/14- *Art and science collaboration explores Cornwall's mining heritage*

Cornwall's illustrious mining heritage has provided the inspiration for a special collaboration between a local artist and University of Exeter scientist.

www.exeter.ac.uk/esi/news/title_365003_en.html

05/03/14- Cornish pond owners recruited for study into frog killing diseases

Pond owners across Cornwall are being sought by a student at the University of Exeter's Penryn Campus who is conducting research into whether two deadly frog diseases can be found in the county.

www.exeter.ac.uk/esi/news/title_360461_en.html

13/02/14- Research and creative industries workshop for creative practitioners

Creative practitioners are invited to the University of Exeter's Environment and Sustainability Institute (ESI) on Monday 7 April to learn more about how they can work with universities and academic researchers to support and develop their creative practice.

www.exeter.ac.uk/esi/news/title_356459_en.html

24/01/2014- Leading university researchers to deliver talks at local aquarium

Falmouth Aquarium, in collaboration with the University of Exeter, is hosting a series of public lectures from January which will see leading researchers discussing topical issues from climate change and food security to how we can reduce our own individual energy usage.

www.exeter.ac.uk/esi/news/title_353059_en.html

8/11/2013- Exhibition reveals night-time photography

An exhibition of images made during full moon night walks in the summer by local residents is now on display at the University of Exeter's Environment and Sustainability Institute.

www.exeter.ac.uk/esi/news/title_333815_en.html

14/10/2013- Exhibition and 'swish' event mark new sustainable fashion collaboration

The University of Exeter's Environment and Sustainability Institute and Falmouth University have celebrated their new sustainable fashion collaboration with a 'stylish' event.

www.exeter.ac.uk/esi/news/title_325656_en.html

5/08/2013- Public urged to have a say in developing bioenergy policy and priorities

Local people are invited to the University of Exeter's Environment and Sustainability Institute on Thursday 18 July to join researchers and the BBSRC (the Biotechnology and Biological Sciences Research Council) in an interactive session to help determine the future of bioenergy policy in the UK.

www.exeter.ac.uk/esi/news/title_305376_en.html

31/05/2013- Creative exchange event for local artists

Local artists are invited to the University of Exeter's Environment and Sustainability Institute on Wednesday 26 June to take part in the second Creative Exchange Programme's Melting Pot.

www.exeter.ac.uk/esi/news/title_294154_en.html

10/05/2013- Cornwall Campus hosts leading environmentalist

The University of Exeter Cornwall Campus recently welcomed British campaigner, writer, sustainability advisor and leading environmentalist Tony Juniper as part of the promotional tour for the release of his new book - What has Nature Ever Done For Us? How Money Does Really Grow on Trees.

www.exeter.ac.uk/esi/news/title_290165_en.html

25/04/2013- Opening of Environment and Sustainability Institute inspires next generation of researchers

The Environment and Sustainability Institute, a £30 million environmental research institute at the University of Exeter's Cornwall campuses was formally opened on Tuesday 23 April by more than 120 local school children.

www.exeter.ac.uk/esi/news/title_282567_en.html

20/03/2013- Free communicating green agenda event for local businesses

Local businesses are invited to a day of free talks and workshops showing them how to create and communicate their environmental messages successfully to customers and the public. The event takes place at the University of Exeter's Environment and Sustainability Institute, Cornwall Campus on Friday 19 April.

www.exeter.ac.uk/esi/news/title_275805_en.html

21/02/2013- Melting Pot event stirs cross-sector inspiration

The University of Exeter's Environment and Sustainability Institute hosted the inaugural meeting of the Creative Exchange Programme's Melting Pot on 30 January 2013. The event brought together local artists and creative practitioners with academics and professionals from the University of Exeter and Falmouth University.

www.exeter.ac.uk/esi/news/title_260688_en.html

- % area of grounds to be used by community - 100% (the Penryn Campus has several public rights of way across it)
- % area of buildings to be used by community – 8%

While the majority of the building is dedicated to research, the ground floor meeting rooms and Interactive Space are used extensively by visitors to the building including local businesses.

Anticipating our future environmental credentials

- Predicted electricity consumption: 52.37kWh/m²
- Predicted fossil fuel consumption: 22.76 kWh/m²
- Predicted renewable energy generation: 15.36 kWh/m²
- Predicted water use: 3.82m³/person/yr
- Predicted water use to be provided by rainwater: 13.5%

The ESI in pictures

Images: Sana Fisher Payne courtesy of BDP, and Tim Pestridge.



The courtyard



The entrance to the ESI



The north wing



The south wing



Detail of the brise soleil (sun-shades)



View from the second floor balcony



View across the atrium from the first floor



The Interactive Space



The Research Hall



The second floor laboratory

Keep in touch

- To find out more about the ESI, our building and research, please visit www.exeter.ac.uk/esi
- Download our brief guide 'An outstanding building and facilities' at www.exeter.ac.uk/esi/resources
- Image galleries, tracking the construction of the building through photos, are available on our Facebook page at www.facebook.com/exeteruniesi
- You can follow our ongoing developments, news, and updates on Twitter at www.twitter.com/uniofexeter