The Entopia Building
CAMBRIDGE

World class retrofit
May 2021
Introduction

The Cambridge Institute for Sustainability Leadership (CISL), together with its parent institution, the University of Cambridge, have initiated a pioneering project to transform 1 Regent Street into the Entopia Building through an exemplar low carbon refurbishment which will reduce carbon emissions from the building by more than 80% over the next 100 years. The Entopia Building will provide new headquarters for CISL and will outwardly demonstrate the institute’s core values and demonstrate how existing building stock can be successfully upgraded to tackle the climate crisis.

In 2019 the University of Cambridge became the first university in the world to adopt a 1.5 degrees Science Based Target for carbon reduction, committing itself to reduce its energy-related carbon emissions to absolute zero by 2048, with an ambition to achieve this by 2038 - a decade early.

Cambridge City Council has recently declared a climate emergency, which requires major changes to the way that energy is generated, distributed and used in order to reach net zero carbon by 2030. In common with most UK cities, existing buildings provide the majority of the challenge, due to the relatively low rates of replacement with new building stock, as well as desire to respect the existing urban environment. We therefore recognise the crucial role that projects such as The Entopia Building play in exploring these challenges, and dramatically reducing our carbon footprint.

The Site

1 Regent Street lies within the Central Conservation Area and occupies a prominent central Cambridge location at the corner of Regent Street and Park Terrace, with a small amount of access land to the north and east. Both Regent Street and Park Terrace are considered ‘significant’ streets within the Central Conservation Area Appraisal.

1 Regent Street is not listed, although it is considered a ‘positive’ building within The Cambridge Historic Core Appraisal (2016). Neo-Georgian in style, the building is a former telephone exchange, originally designed by architect George Ford, built in 1939 and adapted and extended over the years. The recently redeveloped University Arms Hotel sits on the other side of Park Terrace, also facing onto Regent Street. Emmanuel College is located to the north and east of the site, and are in the process of purchasing the remaining car park behind 1 Regent Street along with Furness Lodge.

Over the years a number of changes and later additions have altered the external appearance of 1 Regent Street, most notably a new entrance portico on Park Terrace, an additional one-window-wide bay to the rear easternmost corner (possibly dating from 1998), a set-back fourth storey at roof level (possibly dating from 1965) and an external escape stair to the rear. The existing windows are timber, vertical sliding sash units divided into small panes, with horns. The window frames appear to be late twentieth century replacements of the originals in a matching style and form but with glazing bars that appear thicker than the originals are likely to have been.
Spatial Brief
Cambridge Institute for Sustainability Leadership have a vision for an inspiring refurbishment providing open plan and contemporary space, with locations for social interaction, networking and hospitality. Their headquarters are to include exhibition and presentation space alongside offices, meeting rooms and flexible workspaces supported by catering and welfare facilities.

A dedicated Accelerator and Sustainability Hub will allow CISL to support and engage with small and medium sized enterprises and entrepreneurs via collaborations, capacity building and knowledge transfer between industry experts, researchers, and major companies.

Sustainability Brief
CISL have set demanding sustainability targets for the Entopia Building, challenging the design team and contractor across a wide range of metrics and guaranteeing an inherently sustainable project. These targets are:
- Passivhaus EnerPHit standard
- WELL Building Standard Gold or better
- Embodied Carbon of 300kgCO2e over a 100-year life
- Maximise bio-based materials
- Circular Office case study

There is some overlap between these targets, illustrated by the Venn diagram (right), and together they cover a broad range of issues. Further detail is included below to explain these targets.

Passivhaus standard or equivalent
The Passivhaus standard is a fabric first approach to reducing energy demand whilst offering high levels of internal comfort. The Entopia Building is being designed to meet Passivhaus’s EnerPHit Standard, which has been developed specifically for refurbishments, taking into account the practicalities of dealing with existing buildings. This requires relatively high levels of insulation to the building fabric with thermal continuity and triple glazing, to ensure no heat loss through cold spots, as well as providing an airtight building with controlled ventilation through a Mechanical Ventilation with Heat Recovery System to ensure good indoor air quality. Quality control throughout the construction and independent certification ensure the building performs as designed.

BREEAM Outstanding
Launched in 1990, by the Building Research Establishment (BRE) BREEAM is a globally-recognised standard for the environmental performance of buildings through the design, specification, construction and operation phases. The project is targeting BREEAM ‘Outstanding’ (which less than 1% of UK new non-domestic buildings achieve), measured against the BREEAM Refurbishment and Fit-out (RFO) 2014 scheme.

WELL Building Standard Gold or better
Launched in 2014 by the International WELL Building Institute (IWBI), WELL focuses on human health and wellness, both physical and mental, and how buildings influence this. There are currently only 7 certified WELL projects within the UK, but over 100 in the pipeline. The project is being assessed against the WELL v2.0 standard, and although the target has been set to Gold, the pre-assessment suggests the higher Platinum level is achievable.

Embodied Carbon of 300kgCO2e over a 100 year life
The embodied carbon of the building is the combined carbon footprints of all its component materials. The embodied carbon includes the production, construction, use and deconstruction, together commonly termed “cradle to grave”. The figure typically includes biogenic carbon (carbon sequestered within a material such as wood). The project should minimise embodied carbon by undertaking a full life cycle assessment over a 100 year assumed life.

Maximise bio-based materials
Bio-based materials have many advantage such as minimising the use of plastics and VOC emitting compounds, acting as carbon sinks for sequestration, adding to the aesthetic quality of the user experience as well as providing enhanced functionality. A target of 50% bio-based materials has been set.

Circular Office Case Study
A circular economy is an alternative to a traditional linear economy (make, use, dispose) where products are designed and built to be more durable, and to be repaired, refurbished, reused and disassembled. The project aims to achieve this through the following:
- retaining as many existing materials and elements as possible.
- responsible removal of existing materials and elements
- new materials—selected based on recycled content, durability and design for deconstruction
The new headquarters for CISL will include a wide range of innovations, focused on providing exemplary retrofit office spaces to inspire and inform future generations.

Innovations

- First retrofit building in the world to achieve multiple accreditations - EnerPHit, BREEAM Outstanding and the WELL Gold Standards
- Supporting use of innovative software ECCOlab to assess carbon impact which will bring wider industry benefits
- 50% use of bio-based materials, and materials with low VOCs
- High water and air quality standards to be measured and met through independent accreditation
- Use of innovative materials such as cork
- Embodied carbon impact used to drive design decisions
- Use of recycled materials such as light fittings and paint, recycled steel for the roof solar panels
- Smart building technologies
- Design for disassembly

CISL’s new HQ at The Entopia Building will exemplify and enable our mission to support and inspire the leadership and innovation we need to transition to sustainable economy. Our aim is to create a highly collaborative and sustainable workspace to bring together Cambridge’s academic and innovation communities with our network of companies and sustainability leaders to accelerate solutions to global sustainability challenges.”

The Entopia Building aims to be an international exemplar for sustainable office retrofits, demonstrating how an existing office building can be made highly energy efficient in its redevelopment and use, whilst supporting the enhanced wellbeing of staff and visitors.

Dame Polly Courtice, Emeritus Director, CISL
Low impact floor finishes proposed for functional reasons, and feature areas.

Exposed ductwork distributes fresh air, tempered through heat recovery and peak-lop cooling.

Exposed raised access floor retained, and exposed in lower traffic areas to reduce embodied carbon.

Plants promote access to nature (effect on IAQ is minimal).

Internal wall insulation wrapped around building.

Airtightness detailing.

FF+E strategy being developed - aiming to reuse existing furniture where possible.

Task-based lighting with intelligent lighting controls.

Existing raised access floor retained, and exposed in lower traffic areas to reduce embodied carbon.

Suspended ceilings removed to increase height (+daylight) - absorbent finish proposed.

Diagram showing the wide range of benefits and interventions that will make 1 Regent Street an exemplar new HQ.
Overview

The majority of the refurbishment works to 1 Regent Street to enhance the building’s performance are internal and therefore invisible to passers-by. These include insulation applied to the inside of the walls and roofs, airtightness layers and detailing, new efficient ventilation and heating plant, as well as the modifications to finishes and fittings. There are however several key changes that will be visible from the street, and these are highlighted here, and have been approved in a planning application to Cambridge City Council.

Windows

The most significant change is to the windows, as the proposed contemporary single-pane window units do not retain the multi-pane character of the existing sash windows. In order to meet the high energy efficiency targets set for the project, the windows are a key component, as they are often the biggest source of heat loss in the building envelope.

A number of options were considered and tested for their impact on the overall energy performance of the building, and their impact on the daylighting of the internal space. These options ranged from a double glazed sliding sash window, a triple glazed mock sash window, to a standard installation of a triple glazed single pane window, and a triple glazed single pane window installed with the frame recessed behind the window’s existing opening.

The windows’ U values, and therefore impact on the heating demand, are critical to meeting the EnerPHit standard. In addition, daylighting is a key issue for the wellbeing of the building users, as recognised in both the BREEAM and WELL standards. Having modelled the daylight factors internally, the average daylight factor, even with the best windows, is still below the minimum required to gain credits. However, there is no desire to enlarge the existing window openings or add new ones, so the strategy has been to maximise the daylighting available via the existing openings.

The results indicated that a typical double glazed sliding sash window would not meet the energy performance standard, and the combined impact of the transoms and mullions reduced glazed area significantly, consequently impacting negatively on the internal daylighting. Although the triple-glazed mock sash windows improved the energy performance, the daylighting was still negatively impacted by the transoms and mullions. The triple-glazed single pane window showed a further improvement in energy performance, but even the perimeter frame reduces the glazing area. The proposed solution of triple-glazed single pane window with recessed frame maximises both the energy performance and daylighting, and offers the optimum solution for the internal environment.

It is felt that the benefits to the buildings users and the wider public derived from the performance of the building outweigh the impact of the change on the character of the original building and surrounding context.

Key Features

Improved energy efficiency

25 kWh/m².a limit to achieve EnerPHit

Improved daylighting

Improved daylighting

graphs showing modelling results of various window options

3D View - Existing Window Bay Elevation - Existing Window Bay

3D View - Proposed Window Bay Elevation - Proposed Window Bay

Windows

The current windows are neo-Georgian sliding sashes with thick frames. Unlike traditional elegant Georgian windows, the sliding sashes with thick frames.

The proposed triple glazed windows sit beyond the basement, first, and second transoms and mullions. The triple-glazed single pane window showed a further improvement in energy performance, but even the perimeter frame reduces the glazing area. The proposed solution of triple-glazed single pane window with recessed frame maximises both the energy performance and daylighting, and offers the optimum solution for the internal environment.

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Removal of rooftop plant
The rooftop to the rear of the building was dominated by a variety of ventilation plant and ductwork which were considered to detract from the building’s overall character. As the proposed new plant will be installed internally, this has allowed for the removal of the rooftop plant and a large roof terrace to be created for outdoor entertainment.

Photovoltaic array
The feasibility of incorporating renewable technologies into the development has been analysed, and the most appropriate technologies were found to be photovoltaic panels (PVs) and air source heat pumps (ASHP). An ASHP is being installed internally, and a PV array will be installed at rooftop level where there is minimum overshadowing, and the ability to orientate the PVs predominantly south-facing for maximum efficiency. The 70 or so PV panels will be installed on a simple frame structure to form a canopy to shade the roof terrace to the rear of the building.

Lightwells
The existing building has lightwells at basement level along the Regent Street and Park Terrace elevations. Recommendations on enhancing the site’s current very low ecological value have been produced by an ecologist, including planting nectar-producing climbing plants within the lightwells. The species planted could include honeysuckle, ivy, jasmine and clematis, which would be likely to increase the number of flying insects upon which bats, birds and other wildlife feed. As well as supporting biodiversity, it is intended that the greenery of these spaces provides a more pleasant outlook from the basement spaces, an area where the building’s users can step outside, as well as bringing glimpses of greenery to passers-by.

Ramp
The main entrance to the Entopia Building will remain via the existing portico on Park Terrace. This entrance is currently served by several steps and a platform lift, which is too small to meet current standards. In order to improve accessibility, under both normal and escape conditions, these will be replaced by steps and a ramp.

Cycle Parking
132 secure staff cycle spaces and 38 visitor cycle spaces are proposed to the rear of the building to meet the anticipated demand, which is in excess of both Cambridge City Council’s and the University of Cambridge’s minimum number of spaces.

Electric Vehicle Charging Point
An electric vehicle charging point is proposed adjacent to one of the three retained parking bays.
Key Facts

- The deep green retrofit is projected to result in an 80 per cent saving in whole life carbon emissions (over 10,000 kg CO₂e), compared to a standard office refurbishment.
- The retrofit will be carried out according to EnerPHit, the Passivhaus standard for refurbishment and one of the most stringent standards for energy retrofits. It will deliver 75 per cent lower heating demand in comparison to an average office building, and airtightness at more than five times that required by building regulations.
- The Entopia Building is on track to gain world-leading sustainability and wellbeing certification from BREEAM (Outstanding) and the WELL Building Standard (Gold).
- The project is one of the first to reuse lighting from another building refurbishment, re-testing and re-warranting more than 350 LED lights that were then reinstalled in The Entopia Building.
- Leftover furniture in the building has been diverted from landfill avoiding 21,000kg of CO₂, with 21,600kg of chairs, tables and storage cabinets donated to local communities.
- A third of the building’s paint needs have been covered by a donation from Dulux of paint made from 35 per cent recycled paint content.