**BEDZED** At a glance

**PROJECT DETAILS**

**LOCATION:** London Borough of Sutton, United Kingdom.

**YEAR BUILT:** planning approved 1999, construction 2000 and completed and occupied in 2002

**ARCHITECTS:** Bill Dunster & Partners (now ZED Factory)

**DEVELOPERS:** Peabody Trust (Client Co-Developer)/BioRegional Development Group (Co-Developer, Sustainability solutions)

**MANAGEMENT:** Peabody Trust

**BUDGET:** undisclosed

**AREA:** 16,544 sq m.

**DENSITY:** 60 dwellings per hectare

**CONSTRUCTION:** Ove Arup & Partners (Building physics, energy, water, ventilation, services); Ellis and Moore (Structural and Civil Engineers); Gardiner & Theobald (Quantity Surveyors, Project Managers & Main Contractor); BP Solar (Photovoltaic installation)

**AWARDS**

**UN-HABITAT AWARDS**
Finalist 2002

**SUSTAINABILITY AWARDS**
winner of RIBA 2001 for Sustainability

**ARCHITECTURAL AWARDS**
Stirling Prize, shortlisted

**Environmental Sustainability Objectives**

- Minimise use of resources: 4
- Minimise pollution: 4
- Protect biodiversity: 4

**Social Sustainability Objectives**

- Ethical standards: 5
- Adequate facilities: 5
- Housing needs met: 5
- Interaction with locality: 5
- Quality of architecture: 5

**Economic Sustainability Objectives**

- Competitive businesses: 4
- Economic diversity: 4
- Employment: 4

**Brief Description**

The Beddington Zero (fossil) Energy Development (BedZED) was the largest and first eco-community in the UK. Today it is regarded as a flagship example for many environmental organisations across the world.

BedZED was built on a brown field site and comprises 99 mixed tenure homes of 1, 2, 3 & 4 bed houses and flats. The mix includes social, key worker¹, and for sale homes (50 per cent housing for sale, 25 per cent key worker shared ownership, and 25 per cent social housing for rent). In terms of functions, the scheme also adds 3,000 sq m of live/work spaces and some retail. Other on-site facilities include a medical centre, nursery, café/bar, sports pitch with clubhouse and village green. The community is home to approximately 220 residents and 100 office workers.

Bill Dunster founded Zedfactory in 1999 after working for 14 years in other practices specialising in sustainable developments. He is the co-author of The ZEdbook: Solutions for a Shrinking World and regularly delivers speeches on sustainable housing in universities and other institutions around the world.

¹ A key worker purchase is a way of providing affordable housing where people who are working in a specific economic sector can buy a property at a discounted rate.
PROJECT ANALYSIS

BedZED has been selected as a case study because of its innovative approach to reducing carbon emissions at the start of the project (development and construction); during the life of the project (resident’s behaviour) and even considering a sustainable reuse of the materials in case of demolition in the future. Other issues addressed were transport and connectivity, water usage, waste disposal and food supply. Some of these propositions were successful and some were not. But is the holistic approach to creating a sustainable community that makes BedZED one of the most important case studies in our sample.

Environmental sustainability

Arup is a renowned international firm of designers and specialists who have helped to raise standards of sustainability office environments all over the world. For BedZED, Arup developed a technique to evaluate and match renewable energies to energy demands called ‘energy grading’ (Twinn, 2003). What the research team discovered was that there was a disconnection between the available energy resources of a particular area and energy needs of future users. This was causing many sustainable projects to become unprofitable, as both energy and capital costs were higher than traditional methods and, even worse, the needs of the energy demand were not matched. The concept behind Arup’s thinking is more widely known at a larger scale in the so called smart cities technologies (Tratz-Ryan, Velosa, Jacobs, 2011). The energy grading system consists of searching for the options for potential sources of renewable energies, estimating the end-use energy needs and matching the two in a ranking system. The aim is to build a list of sustainable design priorities for the building.

The novel discovery of this method is that energy sources are not just those which are naturally occurring. For example, in terms of heating other sources can be used, such as occupants (our bodies emit approximately 100W of heat), appliances, cooking, washing or solar heat through glass panes and materials. All of this heat is highly variable both in timing and quantity, which is the reason why it is usually disregarded. Another factor in its dismissal is that internal heat is mostly seen as a damaging component during the summer months, despite the fact that the opposite effect will have benefits in winter. In addition, each home at BedZED has a hot water cylinder that is stored in a cupboard which is also used as a source of heat. A low energy fan was engineered to blow this warm air out of the cupboard and into the house (see Twinn, 2003 for a full report on Dunster-Arup’s development of the system).
To retain all this heat, the design teams used 300 millimetres of rockwool as insulation while dense concrete blocks provide the thermal mass to keep the homes consistently warm in the winter and cool in the summer (Chance, 2009). Each dwelling therefore operates solely on the ambient energy harvested indoors.

To complete the system, photo-voltaic (PV) cells were installed. The same system is used to power electric zero carbon emissions urban-use cars.

**Social Sustainability**

Communal spaces around BedZED include: the pedestrianized “living streets”; a small village square popular with young children; a sports pitch; allotments (for growing food); and a community centre called the Pavilion. This centre provides changing rooms with showers, toilets, basic catering facilities and two large spaces that are commonly used for exercise and dance classes, conferences, parties, residents’ meetings and other social events which are all managed by a group of residents. A recent survey showed that the community centre is used by 66 per cent of households (Chance, 2009).

Community interaction is prompted not only through the use of shared facilities but also the layout of the site that gives every unit an outside space. Most ground floor units have raised front gardens which encourage sitting out. Roof gardens are accessible via bridges over streets. This unusual layout prompts more informal opportunities to meet neighbours. The scheme gives all residents their 300 mm of topsoil, allowing the option of raised beds, coupled with allotments in the proposed eco-park. This communal activity is a simple, practical but effective way of increasing interaction by sharing experiences of home-grown food.

**Economic Sustainability**

The scheme was originally designed to have work/living spaces as well as private residences. Access to Broadband was important to complement the working objectives. The information and communications technology (ICT) cable routes are intended to be fully rewirable so they can respond to future changing requirements. However, some work spaces were not occupied and have now been converted into homes (Chance, 2009). This, of course, poses questions about the heating system that was originally adopted and was based on functional usage (see previous section). If these units have now changed function, do they generate less heat and therefore need an energy top-up?

An important factor that is usually overlooked in residential developments is the availability of facilities on site. BedZED has communal facilities but its environmental impact could have been reduced further with greater access to food shops.

Source: ZED Factory
Design and Construction

In the UK the Commission of Architecture and the Built Environment (CABE) has praised BedZED for its sustainable features such as pedestrian priority streets, balconies and gardens for every home. These features, CABE claims, bring the concept of the garden city to the 21st century (CABE, Case Studies. Archived content 2011).

Site Plan

The buildings are organised in rows, following the UK traditional layout of terraced houses. Using a familiar typology helps to integrate the project to the area and enhances the feeling of familiarity for residents of a new development. The mix of workspaces and residential units ensures round the clock usage of outside spaces, enhancing the vitality and sense of security of the place. This is even more evident at night with the use of subtle illumination that aims to minimise extremes of light or dark areas and create a safe effect, free of extreme shadows.

The rows of terraced houses are arranged on a grid layout. Streets give priority to pedestrians creating a relaxed, village atmosphere. Connectivity with local transport network was an integral part of the design process to fulfil sustainability objectives. There is a bus stop just outside the development and the London Road leads further south and within easy walking distance to Hackbridge railway station. Minimal car usage is encouraged by ample provision for cyclists with secure parking and storage space inside the homes. Schemes such as the car club make it easier for people to get rid of their own car and share one of three maintained by a company. Drivers pay per mile, so incentivising further reductions in mileage (Chance, 2009).

The large area of the development has been broken into smaller parts by a grid layout of pedestrian streets. Two main roads (New Road and Orchard Avenue) continue into the site providing strong anchorage for the development and the surrounding context.

The orientation of the two main functions -work and living- were considered according to their degree of usage. The work spaces have a high occupancy level during day time, with usage of office equipment constantly generating heat. They were therefore oriented north. Homes with less usage during the day and less internal heat gain were oriented south. Workspaces were thus shaded by living spaces, reducing solar gain and minimising cooling in summer. The thermal inertia coupled with cool night ventilation also keeps summer room temperatures low enough (Twinn, 2003).

The south side of the buildings are fronted with ground-to-ceiling conservatories that act as green houses, capturing warmth from the surrounding air and the sun. In the summer, the windows can be opened so that the conservatories are effectively external spaces, which remain cool to prevent overheating. In high density developments such as this one, calculating the right height and orientation of buildings is crucial to guarantee access of sunlight to all rooms.

As units in BedZED use their own internal sources of heat (human bodies, electrical equipments, as explained). A crucial part of the design process for BedZED was to estimate future residents’ movements and levels of activities. Computer simulation programmes are available to do this, and can offer a range of different scenarios. For example, what happen if residents travel and leave the unit empty for long periods of time? How much top-up heating does a new-born child need to be warm and comfortable? Assessing worst case indoor and outdoor drops in temperature, and long periods of overcast sky was important for making the correct decisions about materials and insulation of units.
In addition, the objectives of achieving sustainability during construction are very challenging. BedZED sourced most of the material within a 55 miles radius, minimising transportation. But it has been pointed out that this sometimes conflicted with other sustainability objectives. For example, the team made a compromise by using imported high quality, double- and triple-glazed timber-framed windows from Denmark that reduce heat loss, rather than purchasing lower quality windows in the UK. As an important member of the development team explains, there was a constant need to weigh the benefits and losses and in this case “the difference in embodied energy and lifecycle performance outweighed the transport impact significantly” (Chance, 2009).

The scheme is the first to achieve a considerable set of sustainable aims including long term ones. The units are designed to last for 120 years – this is more than double current lifespan of new homes in the UK- and can be dismantled easily so materials can be re-used.

Notwithstanding the sophistication of the technologies, recent surveys show that an important factor in reducing carbon emissions is still the occupier. As Chance explains, much more could have been achieved if residents of BedZED had been told how to use the systems at the time when they first moved in.

BedZED Key Sustainable Features:
- Green roof areas: help increase the site’s ecological value and its carbon absorbing ability, as well as giving the occupants private gardens.
- EU ‘A’ rated domestic appliances, low-energy compact fluorescent luminaries, and meters visible to the consumers: aims to encourage energy waste reduction.
- 107kWp of PV sufficient for 40 electric cars with free charging points.
- Wind cowls as part of a passive ventilation system that can be easily regulated by occupants.
- A gasifier system that converts woodchip into a wood-gas suitable for fuelling the CHP’s spark ignition engine.
- Reduction of water demand by preventing excess flows, restricting mains pressure showers to avoid power-showers, meters visible to consumers, EU ‘A’ grade water-consuming appliances, and very low/dual flush toilets.
- Collection and storage of rainwater for irrigation and toilet flushing. An ecological on-site foul water treatment system was added to the development.
- Domestic waste: a segregation strategy was agreed with the local authority, with segregation bins provided in all kitchens and around the site for local authority collection. There is on-site processing of green waste.
- Construction materials locally sourced within a 55 miles radius to minimise transport. Recycled materials (steel and wood) were also used.
- Materials with a recognized environmental standard, like Forest Stewardship Council (FSC) certified wood, were used extensively.
- Building waste was segregated on site and sent for recycling.
- Reduction of car usage by good connection to transport, ample provision for cyclist and car club schemes.

Endnotes:
1 Key worker housing is provided to those in professions that are considered vital for the community but their salaries are not sufficient for them to afford a house. Professions considered key workers are teaching, policing, or nursing.