BedZED, Sutton, England
Source: Dennis Gilbert photographer, reproduced in Gregory, p. 44

Case Study: BedZED

The Beddington Zero-fossil Energy Development (BedZED) is radical and successful experiment in ecological housing in the greater London metropolitan area. Designed by architect Bill Dunster, the project achieves remarkable reductions in energy use, while positing a new ecological take on an established paradigm for multi-family projects. BedZED is not a co-housing development or eco-village per se; it does not have explicit aspirations for creating an ecologically or socially based community.

Typical interior at BedZED
Source: http://www.bedzed.org.uk

Instead, the project squarely accepts the model of speculatively produced mass housing in its marketing and finances. The project succeeds because it combines a radical and creative re-thinking of ecological living with a well-designed, hospitable, modern design.

BedZED Environmental Agenda: The Carbon-Neutral Home

Given the challenge of selling units in a speculative development to a mainstream buyer, it was necessary the environmental aspects of BedZED be well thought out and not make onerous or Puritanical demands on its residents. The overall ecological ethic is to address the primary environmental impacts of the average British family. Noting the extreme urgency of global climate change, the designers chose a goal of a carbon-neutral development: that is, a place that would contribute no net carbon emissions to the atmosphere as a result of residents living there.

According to a study by Brenda and Robert Vale in The New Autonomous House, carbon emissions caused by the average UK family can be split into three equal categories:

1) home energy, which includes both heating the home and powering appliances;
2) land-based travel, which includes private automiles as well as commuting; and
3) foodmiles, or the emissions associated with petroleum-based farming and its transportation to the dinner table. (Dunster 2003)

Arguably, the study ignores some other significant forms of carbon emissions (manufacturing and transportation of other goods besides food, e.g.). However, the consumption of these goods and their environmental impacts is a matter of personal choice and lifestyle and largely outside the designer's purview. In contrast, the three primary emission causes identified by the Vales are both necessary for survival in the modern age, and, importantly, can be addressed by the design of housing.

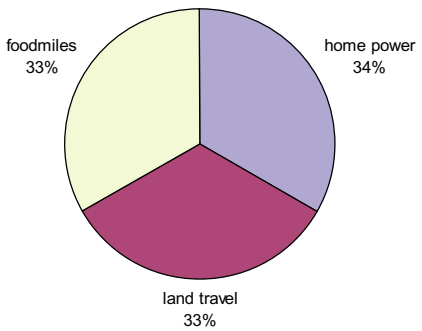
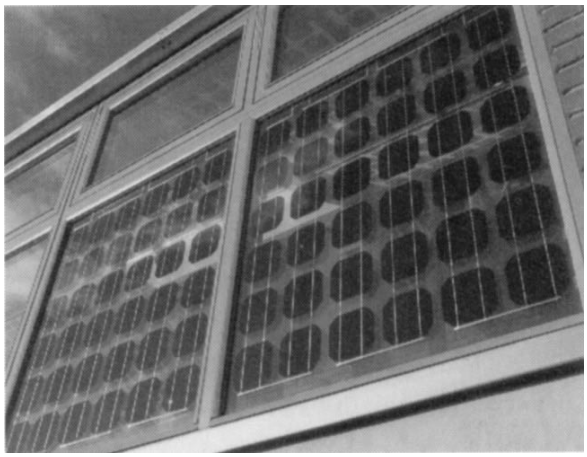


Figure 1, Average UK Family Carbon Emissions

BedZED's fundamental goal, explicit in its name, is zero-operating energy. In contrast,

most notable energy efficient projects in the United States are commercial and achieve reductions up to 50% percent.[1] In actuality, the project is designed to cut carbon emissions and associated energy use by 90%, compared to the recently updated UK residential energy code.



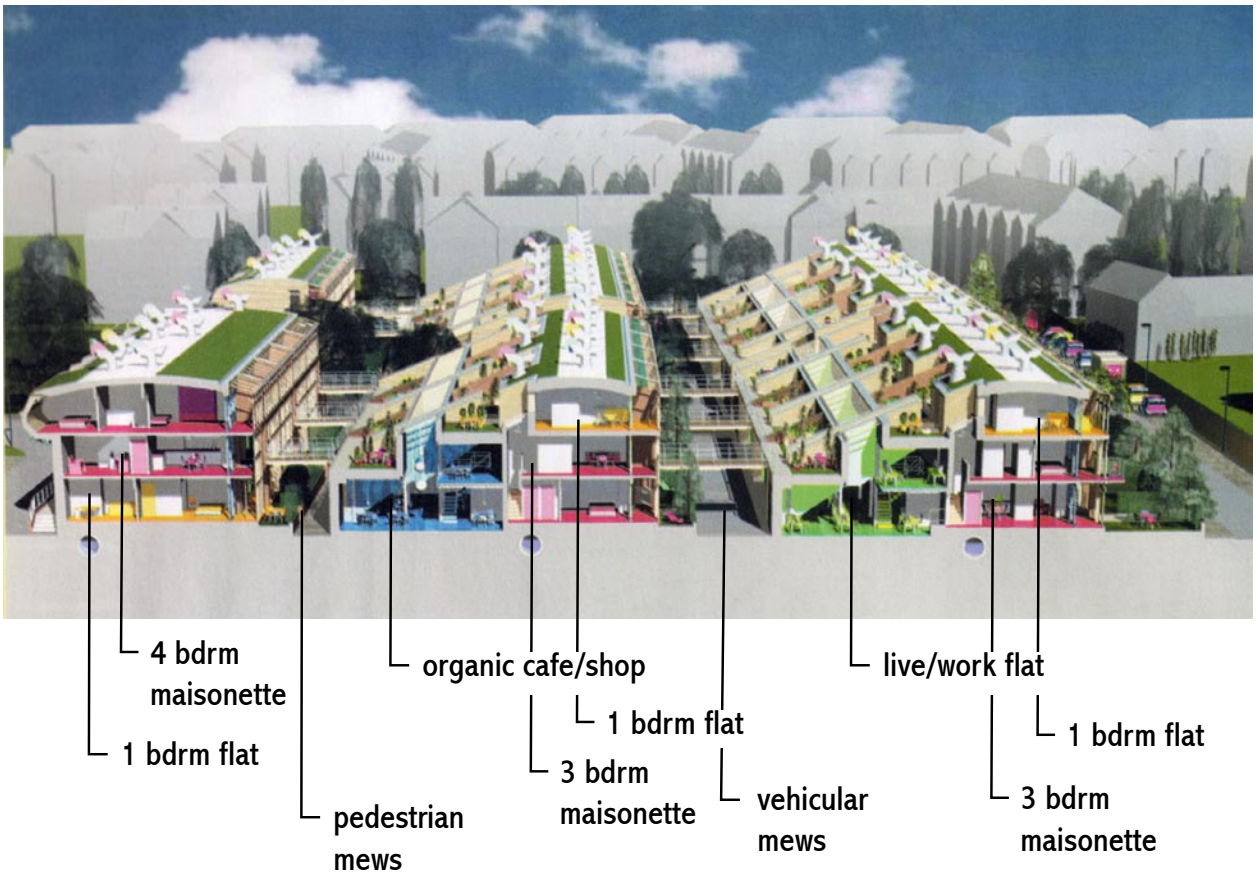
PV cells integrated into sunspace glazing
Source: Dunster, p. 170

Architect Bill Dunster and partner charging an electric vehicle
Source: Dunster, p. 171

Land-travel emissions are reduced through a number of means. The development is in close proximity to mass transit (2 bus routes within 300 feet, 0.34 miles to regional railway station), allowing residents easy access to employment in the greater London region. As well, a fleet of gas and electric vehicles are available for all residents to share. Electric cars are powered by solar panels integrated into the development. Because of stiff carbon taxes on petroleum fuels, these solar panels are far more cost effective than if they were used to generate home energy (which is not so heavily taxed): the solar panels pay back within a period of fifteen years, rather than seventy-five if they were used for home energy. In addition, they help replace gasoline-burning vehicles, one of the most significant sources of carbon emissions. The photovoltaic panels produce over 300 kW of energy annually.

More significant than these less-polluting transportation choices is BedZED's long-term role in shifting the paradigm of commuting suburbs. The project balances residential and commercial spaces: 16% of the projects floor area is for live-work spaces; 7.5% are for commercial enterprises on site. The live-work spaces can

[1] Commerical businesses reap the economic rewards of their own efficiencies, and consequently have a rationale for taking any efficiency steps that will save money. Housing projects, however, are built for a speculative owner, and environmental measures may increase the first cost of the dwelling: little incentive is offered to the developer to undertake substantial environmental improvements.



BedZED section showing units and gardens
Source: http://www.bedzed.org.uk

be used by local residents, or by reverse commuters who might live further in the urbanized region of southeast England. In the latter case, commuters would take advantage of trains that would otherwise run empty as they run back to pick up more rush-hour commuters. (Dunster 2003). The commercial spaces include a organic cafe, pub and grocery shop and a healthy living center and nursery. Besides adding to the life and vitality of the place, these places reduce the need for residents to drive for goods and services.

The strategy to reduce "foodmiles" is similarly transportation-based and multi-pronged. Most foods travel thousands of miles from farm to distributor to grocery store before they end up on the dinner table. BedZED incorporates an organic grocery store onsite, making the choice to buy low-impact, healthy foods the most convenient option. BedZED also attempts to reduce this environmental impact by providing individual garden plots with each residence located, somewhat paradoxically, located on the north side of buildings along the sloping roof. The placement, though is intentional. Summer sun (during the growing season) rises

high enough to give the gardens at least partial sun during the day, and their placement facilities a deliberate shaping of the solar envelope to permit winter sun and passive heating.

BedZED gardens are located on the sloping north side of the buildings. Some are reached by sky bridges form units on the other side of the mews.
Source: Gregory, p. 47

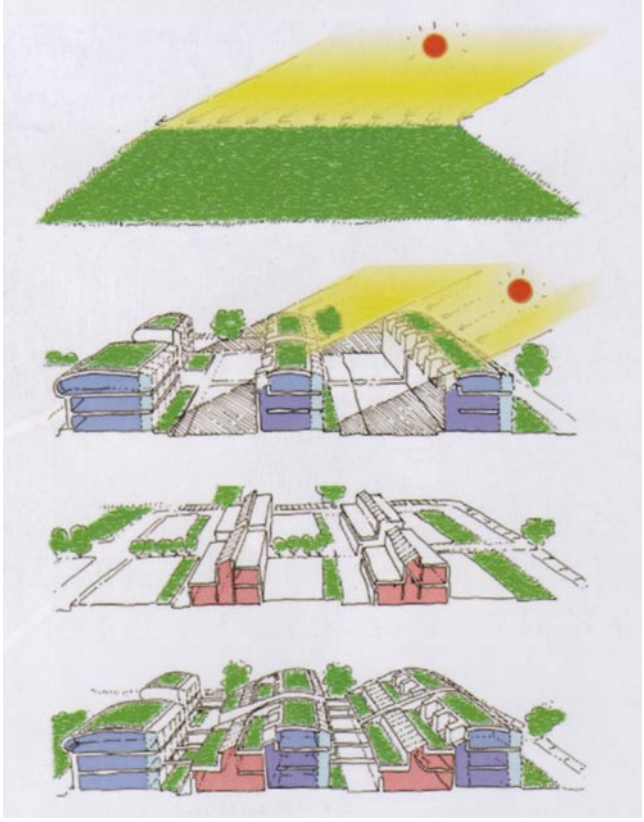
Arguably, though, the more radical step of providing individual garden space may be a less successful strategy than the organic grocery store. The grocery store/cafe/pub doubles as a social magnet. The gardens rely on the initiative of the residents (see illustration showing some rather untended gardens). A community garden might have better solar access; it might also benefit from some economies with the sharing of land, tools, and gardening techniques. Most importantly, perhaps, it could enhance the social interaction of the residents. Admittedly, though, the private gardens have different benefits: their placement allows a tapered building scheme to permit winter sun to reach every units southern sun room, and they provide a private, if small, outdoor space (and selling point) for each unit. Given that the BedZED was designed to succeed as a successful speculative development, and not as a cohousing or community housing scheme, the decision to incorporate private gardens makes sense. The roof top gardens permit private outdoor space while the project achieves substantial densities (20.1 dwelling units/acre, over the entire project area.

The south facade and sun rooms
Source: Gregory, p. 47

The decision to face the buildings south means that the main public facade is a series of building edges, rising and falling like waves and adding interest to the street.
Source: Gregory, p. 44

BedZED Site Plan
Source: Gregory, p. 44

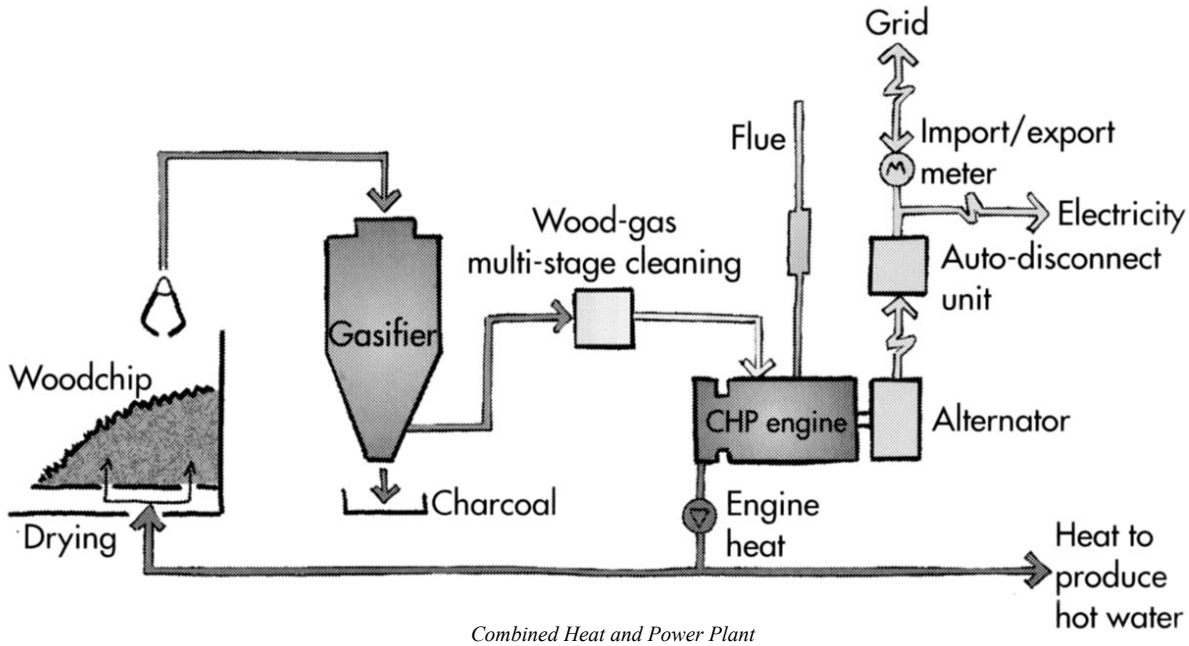
More important to the ecological success of the project is the its passive solar scheme; buildings are oriented along and east-west access, maximizing exposure to the sun. While the gardens might suffer slightly, the sculpted building form allows the sun rooms on the south side to substantially reduce heating needs. The passive solar colleectors themselves cut heating energy by up to 30% (Sommerhoff 2003). With smart detailing, including super insulation, triple-paned windows, and thermal mass, energy can be cut by 90% (Dunster 2003). Rather than traditional mixed use where work spaces are placed over residences, creating a barrier to the sun and privacy issues, residences are given the priority for south-facing light, while work spaces are tucked beneath on the north side. The decision to organize the project by solar exposure meant that the development could not face the main road, which runs along the western edge of the parcel. Colorful wind ventilators mark each unit; each hood roates in the wind, optimizing the passive cooling performance.



Maximizing Solar Potential
Source: Gregory, p. 48

Combined Heat and Power Plant
Source: http://www.bedzed.org.uk

Much of the heat and power needs are met on-site by a combined heat and power (CHP) plant. Cogeneration produces both electricity and heat (which is normally a wasted byproduct of electricity production). Heat is used to produce hot water and for radiant heating for each unit. The plant runs on coppice, vegetation



Combined Heat and Power Plant
Source: Dunster, 2003

grown onsite, as well as waste from a local milling plant. The overall carbon emissions per unit of generated energy are just over a quarter of what would be produced by a typical English fossil-fuel based plant (Dunster 2003). While there are carbon emissions produced by the plant, these are effectively offset by the carbon sink created when new plants are grown as fuel for the plant.

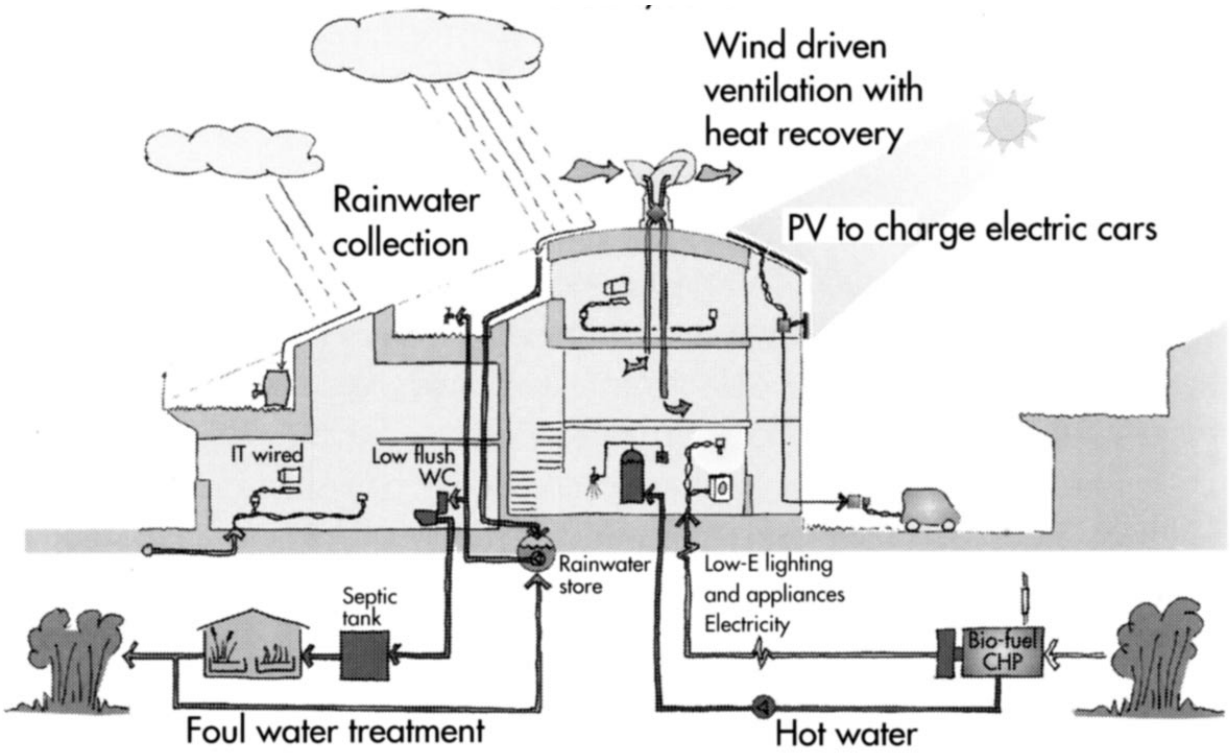
Initial documented results from energy operation are good, but perhaps not reaching idealistic expectations. Water heating is down 43% versus a UK baseline; electricity consumption 60%. These results do not factor in colder weather; they were also before the CHP plant was put in use (http://www.bedzed.org.uk).

BedZED Lifestyles

As mentioned earlier, the BedZED project is a speculatively designed-housing project. Units were sold individually; the success of the project is illustrated by the fact that the last unit was sold the day the first resident moved in. The sidebar

- Don't worry about finding a mortgage
- Don't have to worry about resale
- Don't live in dark gloomy houses with poor ventilation
- Don't live in flats without gardens – everybody needs to be outdoors sometimes
- Don't go out of your way to stay fit
- Don't worry about untried technology
- You don't need to live in a spaceship
- Don't spend two hours a day commuting – walk to work
- Don't worry about young children – walk to the nursery, and pop them home for lunch
- Don't spend a fortune on utilities bills – they can only get larger as carbon taxes bite
- You don't have to live in a completely new house
- You don't have to live in a dormitory with little sense of community
- Don't have to eat organic veggies flown in from the other side of the world
- Don't spend a fortune on expensive cars – simply borrow what you need when you need.

The BedZED lifestyle marketed
Source: http://www.bedzed.org.uk



BedZED systems
Source: Dunster, 2003

shows adapted marketing language from the website; the points are arranged roughly from the most mainstream (buying into BedZED is a good investment) to the most radical (you don't need a private automobile). It is evident from this presentation that BedZED is designed to appeal to the average UK resident; but it is also true that the project can help shift attitudes and lifestyles to the more ecological. Many of the technologies (passive venting and heating, rainwater recovery, etc.) operate with little or no input from the the resident. Other ecological options (gardens, organic vegetables, shared elctric vehicles) are presented as a matter of convenience. Ecological living will not succeed if it is more difficult than alternatives; BedZED makes this easy.

Replicating BedZED

Although BedZED is in many ways a unique projects, plans exist for many future sister developments. Indeed, many of the environmental technologies were first implemented in Hope House, a prototype residence that is the home of architect Bill Dunster (and designed when he was an employee of Michael Hopkins). Bill Dunster Architects have teamed up with the other members of the BedZED design team to form ZEDFactory. ZEDFactory, which is housed in one of the workspaces

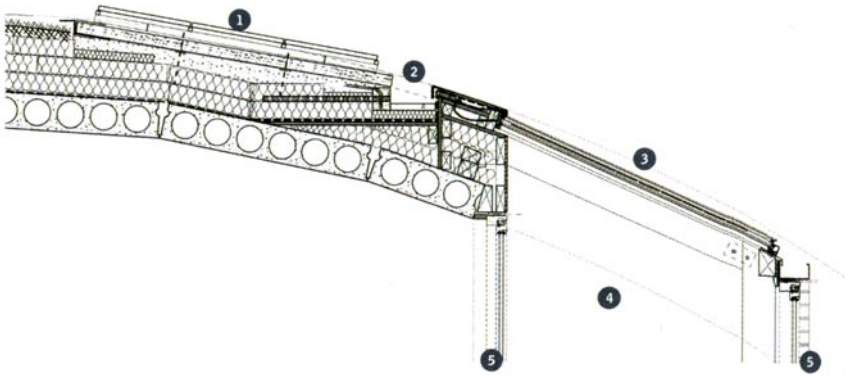
of BedZED, has as its goal the promulgation of carbon-neutral development.

Future developments are planned using using the tried and tested components and technologies employed in BedZED as a kit of parts. The ZEDFactory website cleverly lays out the palette of ZEDproducts "from A to Zed", illustrated in the sidebar.

Developing a palette of materials has a number of advantages. For one, the architects are familiar with the performance specifications of each material. Importantly for the ecological aspirations of their projects, this also means that they have a good idea of the relative environmental merits of these materials: embodied energy, particularly, is

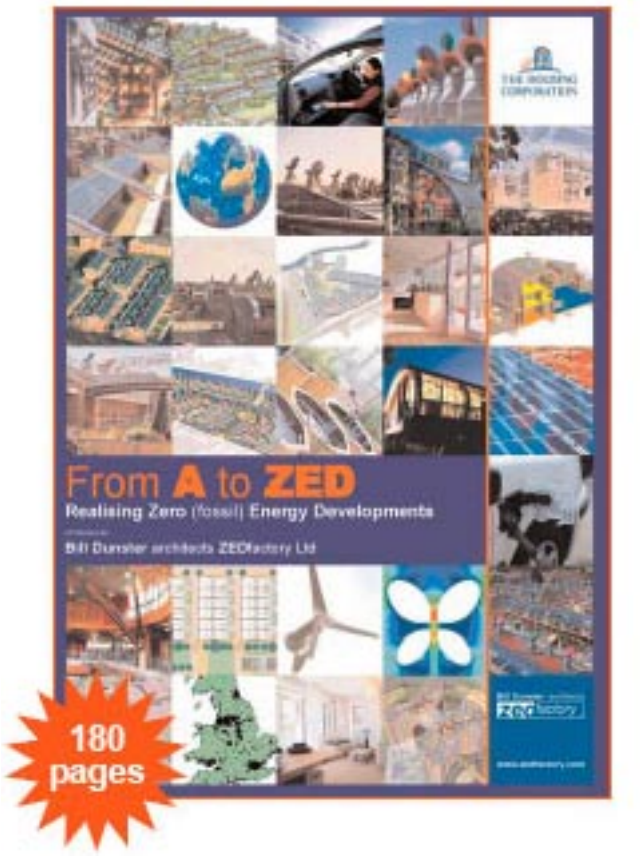
A: Substructure
B: Precast concrete floors and stairs
C: Inner leaf walls (concrete masonry units)
D: Steel frame - wide span option for large workspace units
E: "Waterproofing and superinsulated, irrigated skygarden"
F: Upper roof covering for non trafficked areas inc. mansafe
G: Rooflights - triple and double glazed thermally broken
H: South façade - double glazed timber structural curtain wall
I: Triple glazing - thermally broken windows with cavity trays
J: Outer leaf walls (brick cavity walls)
K: Aluminium copings and sills
L: Airtightness/acoustic isolation (sealing service)
M: Natural ventilation system
N: "Internal carpentry - partitions, doors, floorboards and stairs"
O: "Prefabricated hot water store, back up heating and plumbing connections, meters display and distribution board"
P: Plumbing
Q: External handrails and balustrading
R: Eco bathroom
S: Electrical distribution
T: Finishes
U: Eco kitchen
V: Renewable energy solutions
W: Wastewater treatment solution
X: Site wide public utilities installation
Y: Landscape and external works
Z: Green Lifestyle and communal activities
  Z1: Green transport strategy tailored to any site
  Z2: Food Service tailored to any site
  Z3: Waste reduction service tailored to local council recycling services
  Z4: Communal facilities
  Z5: Purchaser register

From A to Zed: The BedZED kit of parts
Source: http://www.bedzed.org.uk



Section through roof, showing the use of precast hollowcore concret slabs (ZEDproduct B) arranged transversely on the arched roof
Source: Sommerhoff, p. 89

dependent on many factors and can be difficult to estimate. Many of these materials cost more than standard components, so an intimate knowledge of the their relative advantages helps make the argument for the more environmental approach. Finally, the development of a palette that works together means that future projects can be designed with greater ease (and lower cost).



From A to Zed: The BedZED manual
Source: http://www.bedzed.org.uk

Lessons of BedZED

1) More and more people will choose an ecological living, provided that it is accessible and does not involve substantive sacrifices from generally accepted modern lifestyle "norms". BedZED success not because of its laudable environmental goals, but because it manages to achieve these goals within the mainstream housing paradigm. A project that explores a new type of housing or financing may not be able to implement a similar environmental agenda with such success. Arguably, European residents in general are more ready than their American counterparts to accept density and to adopt an environmental lifestyle; however, it is almost certain that demand in the U.S. will grow for this type of project in the coming years.

2) Zero-energy development is difficult, challenging, and within the realm of the possible. BedZED falls a little short of its goal, but it shows the way for such an endeavour (and its is far more worthy of the "zero-energy" moniker than many projects in the U.S. that cut energy use by a mere 10-50%). Ultimately, a sustainable architecture should have "zero-energy" as one of its core principles.

3) The sustainable living challenge of the twenty-first century doesn't stop at your doorstep. Given the extreme environmental challanges that we face (global

climate change, overpopulation, resource depletion, mass extinctions, etc.), the environmental lifestyle can no longer afford to be “alternative” lifestyle. Designers, planners, politicians, and and all trades need to work together to address the complexities and needs of modern life. BedZED is a great first step in the mainstreaming of an sustainable lifestyle; but to be truly successful, it will need to be replicated many times over.

Total area	4.1	acres
	178,080	SF
Number of dwellings	82	
Total loor area	111,816	SF
Average dwelling FA	1,364	SF
Sports area	46,673	SF
Village square	5,791	SF
Sports club and CHP plant	5,350	SF
Private garden area	22,152	SF
Primary circulation area	34,520	SF
Vehicle and pedestrian mews	5,813	SF
Car-parking	10,613	SF
# of residents	244	
# of habitable rooms	271	
# of workers	196	
# of car parking spaces	84	
Parking spaces/d.u.	1.02	
Work space area	18,245	SF
Commerical space	8,407	SF
Dwelling units/acre	20.1	per acre
Residential population density	59.7	per acre
Working population density	47.9	per acre
Total population density	107.6	per acre
Habitable rooms/acre	66.3	per acre
Parking spaces/acre	20.5	per acre
Parking spaces/unit	1.0	

BedZED site statistics
Based on information provided by Bill Dunster

Sources

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