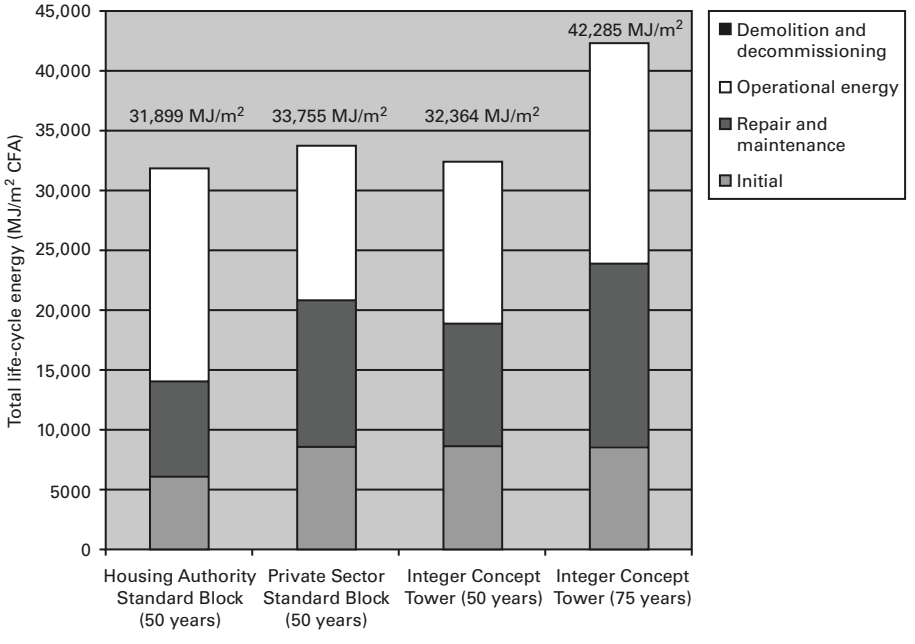
cooling and dehumidification. Once specific improvements have been identified, the best strategy can be selected to reduce environmental impact per unit cost.

Results

The results shown in Table 20.1 are a sample of the comparative data obtained from the modelling process. Comparative figures were obtained for energy and these showed that the Integer Concept Tower was very sensitive to the material-embodied energy for steel and to the overall flexibility of the building, in other words to check whether the building would actually last for 50 or 75 years (25 years longer was one of the primary assumptions put forward by the designers of the Integer Concept Tower). When considering the results it must be remembered that the Integer Concept Tower is just that, a concept, not a real building while the other two blocks are. Furthermore, the housing authority block is the end result of an evolutionary process of considerable refinement and there is no doubt that it is extremely cost and material efficient.

Table 20.1
Embodied energy for various life-cycle stages.



709 MJ/m²/annum	750 MJ/m²/annum	719 MJ/m²/annum	563 MJ/m²/annum
0.22 MJ/m²/ occupant/annum	1.16 MJ/m²/ occupant/annum	1.21 MJ/m²/ occupant/annum	0.95 MJ/m²/ occupant/annum

Nevertheless, the overall energy performance of the Integer Concept Tower lies between the housing authority block and the private sector block and when amortized over the 75-year life, its rate per annum is best. However, the initial embodied energy of the Integer Concept Tower emerges as the worst of the three.[4] The other noteworthy point is the significance of the operational energy figures, in relation to the initial and repair-and-maintenance figures; it is about equal to the total of both the construction of the building in the first place and repairing the building fabric during its life.

However, it would seem that the repair and maintenance regime of all the housing blocks is considerable. It is over 30% more than the construction of the building in the first place for the housing authority block, and while repair and maintenance for the Integer Concept Tower is only approximately 25% of the initial figure, interestingly it is almost 50% more for the private sector block. The question that emerges is why the repair and maintenance values should be so high in comparison with the initial values. This, and the explanations of why the figures should also vary considerably (from 25% to 50%) over the range of building types will be analysed comparatively with other international work in the future.

Finally, the buildings have very different occupancies and so at the end of each parameter the *annual rate per occupant* is shown. Clearly, the housing authority block emerges as being extremely efficient in this respect and the housing authority can take some pride in this achievement. However this does provoke a long-term concern about people's aspirations towards future standards and whether the desire for greater space and consumption standards will inexorably drive the occupants to demand a 'consumption level' that is more comparable to those enjoyed in the private sector. If this view is taken the Integer Concept Tower, over 75 years, does seem to offer the best long-term solution.

Similar results were obtained for waste (Table 20.2), where again the quantity of steel was significant, as this time the steel frame was recycled and reduced the total quantity of waste going to landfill. It should be remembered that at present, the waste figures are calculated by volume and not by mass, and greater differences might emerge between the Integer Concept Tower and the existing concrete housing blocks as steel has a greater mass than concrete.