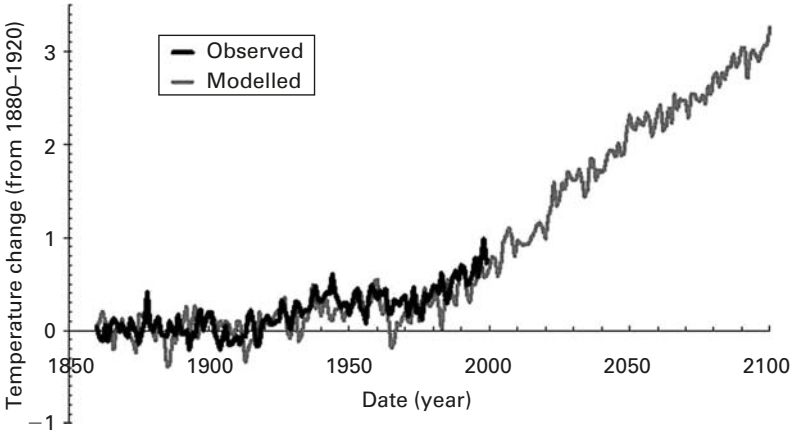

Figure 18.1
Observed and predicted global temperature change. (*Source*: IEMA, 2000; DETR, 2000.)

The atmospheric concentration of CO_2 has increased by 31%, since 1750 and has probably not been exceeded in the last 20 million years (IPCC, 2001).

The extent of the CO_2 problem was recognised by the UK Royal Commission on Environmental Pollution, which argued for the need to halt the rise in CO_2 concentrations produced by burning fossil fuels in order to reduce the risks of catastrophic alterations to the climate (RCEP, 2000). For the UK this implies a reduction of 60% of CO_2 emissions by 2050 and 80% by 2100, relative to 1997 levels (RCEP, 2000).

For industrialised countries, the most effective actions to effect reduction of CO_2 emissions lie in the building sector, largely because buildings, in use or construction, are the biggest single indirect source of carbon emissions generated by burning fossil fuels. They account for over 50% of total emissions (Shorrock and Henderson, 1990; Watson *et al.*, 1996; Smith, 2001). The building sector can most realistically accommodate fairly rapid change without pain (Smith, 2001). Studies have demonstrated that, it is not difficult to reduce carbon emissions from houses by 60% or more through energy efficiency measures, but it is only possible to reach the 90% level of reductions required by using renewable energy technologies (Roaf *et al.*, 2001). Even the Government's Interdepartmental Analysts Group (IAG) and Performance and Innovation Unit (PIU) conclude that to achieve a 60% reduction in CO_2 emissions, there is a need for a combination of energy efficiency improvement and carbon-free electricity generation (IAG, 2002; PIU, 2002). The Carbon Trust too believes it is technically possible for the UK to meet the 60% target with a combination of energy efficiency measures and new low-carbon technologies (Carbon Trust, 2001).

In addition, with the relatively short fossil fuel horizons that are predicted (40 years left for oil and 65 years for gas), humanity needs to move rapidly away from the use of greenhouse gas producing fossil fuels towards a greater dependence on clean renewable energy. In fact, reducing carbon intensity (carbon per unit of energy) can occur independently of a reduction in energy intensity (energy per unit of economic activity), for example, through use of renewable energy. Sustainable energy supplies require a reduction in both carbon- and energy-intensity (Shackley *et al.*, 2002).

For these reasons, renewable energy systems (RES) must become the major source of the world's energy supply sooner rather than later, and a shift away from conventional fossil fuel energy systems must begun as soon as possible (Roaf *et al.*, 2004a). It is also recognised that to minimise greenhouse gas emissions during the transition it is important to improve the efficiency of energy use, that is, through the rational use of energy (RUE). In order to achieve such a rapid transformation from fossil fuel to renewable energy powered built environments, the concept of the Solar City has been developed (Droege, 2002).

The concept of a Solar City

A working definition of a Solar City is a city that aims at reducing the level of greenhouse gas emissions through a holistic strategy for the introduction of RES and the RUE to a climate stable and thus sustainable level in the year 2050 (Kates *et al.*, 1998; Droege, 2002).

Some of the stated goals of the emerging Solar Cities concept include:

- **Lowering of greenhouse gas emissions by the year 2050 to an amount equal to a city's 1990 population level multiplied by 3.3 tonnes of CO_2 (Kates *et al.*, 1998; Droege, 2002). This target is based on fundamental equity calculations that each person has only an annual 3.3 tonnes emissions 'allowance', in order to allow oceans and forests to neutralise excessive carbon emissions (Byrne *et al.*, 1998)**
- **Identifying near- and medium-term milestones for greenhouse gas reductions according to a schedule for the years 2005–2050**
- **Identifying corresponding improvements in the transformation of energy production to solar and other renewable systems, reduced energy consumption, reduced consumption of natural resources, protection and improvement of urban environmental quality, improvement of social equity and improved quality of life**