In some power stations, heat is produced by burning rubbish or the methane gas produced by the decomposition of waste in tips. Others use “biofuels”: waste matter from agricultural processes, or wood from the regular coppicing of purpose-grown plantations.

If the development of renewable energy is seriously pursued, it is likely that power systems of the future will consist of a diversity of small generating units using these varied technologies, rather than the cathedral-like power stations of today. *See also*Energy Conservation: *Electricity Generation*.

# 3.0 Electricity Supply

I INTRODUCTION

Electricity Supply is delivery of electrical energy from generating stations to consumers.

The supply system must provide the electrical energy to consumers at fixed voltage, with minimum transport cost, and with high reliability.

After gradual development over the last hundred years, the complex electricity supply systems of today are capable of satisfying these requirements most of the time.

## II CHOICE OF VOLTAGE

The electrical power delivered by a transmission line is proportional to the product of its voltage relative to earth and the current. The power loss in the line is given by the product of the line resistance and the current squared, $W = I^2R$. It follows that to transport a given amount of electrical energy over long distances as efficiently as possible it is necessary to do it at the lowest possible current and the highest possible voltage. However, the higher the voltage adopted, the further the transmission line must be kept from people and from the ground, the taller must be the pylons that carry the line, and the broader the right of way that the line occupies. This increases the capital cost of the line. Hence, as in all engineering problems, a compromise has to be sought between the rising capital costs as the voltage is increased and the rising running costs as the voltage is decreased. For a given power level there is a specific voltage that results in a minimum overall cost.

In the United Kingdom a range of specific voltages have been adopted to cover adequately various levels of power transmission. These include 11 kV, 33 kV, 66 kV, 132 kV, 275 kV, and 400 kV (1 kV, or kilovolt, is 1,000 volts).

At generating stations electricity is produced at a voltage in the range 20 to 30 kV. For long-distance transport this voltage is transformed up to 275 kV or 400 kV. In other countries, with very long transmission distances, the voltage may be raised to 1,000 kV. The power system component that steps up the voltage is a transformer, one of the most fundamental electromagnetic devices.

The remote end of the long-distance “supergrid” line terminates in a bulk-power sub-station some distance from the periphery of a large load centre, such as a city. At the sub-station the voltage is stepped down to a “sub-transmission” level of 132 kV (in the UK) and through multiple overhead lines is distributed over rural areas to a number of strategic points on the outskirts of the city. There the voltage is reduced further to the primary distribution level of 33 kV or 11 kV, and eventually to the secondary distribution level of 415 V for use by consumers. In Britain the distribution is through underground cables, freeing towns and cities of the pylons that are often seen on the Continent and in the United States. Industrial consumers, depending on their size, may be supplied at the 11 kV or 33 kV level.