ΔE is the energy difference between the top of the valence band and the bottom of the conduction band. Thus the temperature coefficient of electrical conductivity gives a measure of this energy gap. As mentioned above, it is possible to excite electrons across the gap by absorption of electromagnetic radiation of appropriate energy. By measuring the wavelength at which the very sharp increase in absorption due to this allowed transition begins, one has a second measure of the energy gap. In many practical cases there are complications in these measurements, due to impurities, due to complex band structure, and due to bound excited states below the conduction band, but the general picture still has definite experimental validity.

At room temperature these gaps can be as large as 5 to 6 electron volts (one electron volt equals 23 kilocalories) as in NaCl or in diamond. On the other hand, the gap can be vanishingly small. When the gap is small enough so that the resistivity is of the order of 10^4 ohm cm or less, the material is called a semiconductor. Both insulators and semiconductors are characterized by an exponential decrease in resistivity with increasing temperature (provided impurity concentrations are not too high).

Let us return now to our picture of the energy levels in the valence band. Consider a crystal made from atoms which do not have filled shells. (Typical examples would be copper, silver, gold, or the alkali metals.) The valence band would, in these cases, be only half full. Since there are now states to which an electron can easily move, an electrical potential results in a flow of electrons, and one thus obtains a typical meta. The electrons can no longer be associated at all with individual atoms but belong to the high molecule which is the piece of metal, much as the so called "pi electrons" in benzene