The effects of outdoor lighting are related to the direct influence on society, more in particular on road accident and street crime reduction as well on the environment. This chapter deals with the methodological aspects of these. Several other influences on society, aimed at making the visual surroundings more effective or more agreeable, are discussed in detail in other chapters. The influence of outdoor lighting on living creatures, on the climate as well as other environmental effects are discussed in Chapter 4.

The major priorities for installing road and street lighting are the reduction of accidents and crime. This relates to the objective measure of the reduction, but the subjective aspects like e.g. the feeling of security are at least as important. Surveys show that the objective road accident risk is world-wide one of the major causes for premature death, whereas subjectively the fear of road crime is much greater than the fear of road accidents.

Vehicle headlighting has been an area of intensive research for many decades now. In the past, most research was carried out by road safety institutes, but in the last two decades or so, the research is almost completely done by the car lighting industry. New ideas and new products focus on the improvement of the visibility for the car driver. They all, invariably, increase glare for other road users. The influence on light pollution has not been studied at all. One may expect a considerable influence, because glare and light pollution increase when the light above, and close to, the horizon increases. Furthermore, the major astronomical observatories are almost all located in sparsely populated regions, where vehicle lighting usually is the predominant, and often the only, form of nighttime outdoor lighting. For these reasons, the car headlighting is discussed in detail in this chapter, concluding with an estimate of the quantitative effects of vehicle headlighting on light pollution. The conclusion is that vehicle headlighting may cause severe light pollution, particularly in directions close to, and above the horizon. In most cases, the headlighting will cause considerably more light pollution than a regular road lighting installation.
Many measures that would diminish the impact of light pollution have not been implemented simply because the costs are high, irrespective of the benefits. A wise government, however, decides to take any policy measure when the benefits exceeds the costs. For this, cost/benefit evaluations are needed, in which all advantages and all disadvantages of a measure are expressed in the same unit, usually in money-value. When a number of alternative measures are compared, a list of priorities can be established. Such lists are helpful to develop any sort of policy, e.g. for the reduction of accidents and crime, but also for the reduction of light pollution.

The total light that is emitted upwards by outdoor lighting, is more than the light emitted upwards by the luminaires. There is always light reflected upwards by the surface of the lit area. Some misunderstanding of the physics of light propagation as well as a lack of understanding of the technical and optical restrictions of outdoor luminaire design, did give rise to the ‘flat glass controversy’. Some people believe that using a flat cover glass will reduce the upward flux, and thus the light pollution drastically, whereas other believe that a shallow bowl is better, because the luminaires can be placed further apart. When installations with luminaires with different cover shapes are compared, it seems that there may be considerable differences as regards the split-up between the direct and the indirect – or reflected – component of the upward flux. However, when luminaires were compared where only the shape of the cover was different, the differences proved to be marginal. There seem to be no serious grounds to keep the ‘flat glass controversy’ alive.

12.1 Road lighting

12.1.1 Accident prevention

(a) Introduction to accident and crime studies

It has already been explained in detail on several occasions in this book, that, when considering light pollution from outdoor lighting, it is, obviously, essential to know the need for lighting, as well as its effect. More in particular, the crucial questions are, on the one hand, what the relation is between outdoor lighting and traffic accidents, and, on the other hand, what the relation is between outdoor lighting and crime.

As is explained in great detail in several chapters of this book, extensive research has been done on these two relationships. Unfortunately, most research is tinted heavily by the interest – often the commercial interest – of the parties involved in the research activities, and, more in particular, in the reporting of the results. Additionally, it must be stated that in both areas of research, most studies suffer from methodological flaws. Unfortunately, in many cases the flaws are so severe, that it is difficult to estimate what is the significance, if any at all, of such studies. As mentioned earlier, the interest of some parties involved