

## PREFACE

This book is concerned with the problem of producing the energy that we all need to sustain our living standards without at the same time harming the environment that makes life possible and worth living. There is no shortage of energy. There is enough coal to last hundreds of years, and the sun pours onto the earth far more energy than we could ever need. The problem is to make it available in useable form without devastating the earth.

To tackle this problem we have to consider all possible ways of obtaining energy and then see how they affect the environment. We have to take into consideration their capacities, their costs, their reliabilities and their safeties, because these considerations determine whether they will be accepted or not.

Nuclear power is included in the title because it is the most promising and at the same time the most controversial of all the energy sources, and evokes strong opposition. Its association with nuclear weapons, the hazards of nuclear radiations, the problem of the disposal of radioactive waste, the threat of nuclear accidents and the possibility of diversion of plutonium to make weapons all combine to produce such revulsion that nuclear power is totally unacceptable to many people. It is nevertheless desirable to attempt an objective survey of the advantages and disadvantages of nuclear power compared with other energy sources. Other energy sources are also studied, but the main question is whether nuclear power should be phased out as soon as possible or whether it is set to be the energy source of the future.

Other energy sources such as wind and solar are also controversial, with their optimistic supporters. It is not at all easy to evaluate the conflicting claims made and to decide what is the best energy policy. As I am myself a nuclear physicist, I am readily suspected of being pro-nuclear, and indeed in a sense this is true in that I have a keen appreciation of its potentialities. This does not, however, prevent me from describing its disadvantages as well as I can. For example, I remain somewhat sceptical about the reality of global

warming, although if it is established it provides a strong argument in favour of nuclear power. We are all inevitably influenced by our experiences, and mine include fifty years of research in theoretical and experimental nuclear physics, together with teaching physics in the universities of London, Reading and Oxford. For a long time I have been concerned about the effects of nuclear physics on our society, and was a member of the Atomic Scientists' Association for many years, serving on its Council from 1952–9 and editing its *Journal* from 1953–5. I have been a member of the Pugwash Conference on Science and World Affairs since its inception in 1955 and have written several books on the impact of nuclear physics on society including *Nuclear Physics in Peace and War* (Burns and Oates, 1961), *Our Nuclear Future?* (Christian Journals, 1983) and *Energy and Environment* (Bowerdean, 1997). I have drawn on my own experiences while participating in what is optimistically called the nuclear debate, particularly in the chapter on the political aspects of the energy crisis.

Like everyone else I obtain information from books and articles, but before accepting it as reliable I can ensure that the writers are well-qualified and are genuinely trying to establish the truth. I can also test what they write by the normal requirements of consistency, both internal and external, and also with the laws of physics. Being well aware that there are pressure groups that seek to influence public opinion by energetic propaganda campaigns makes it easier to assess their writings at their true worth.

One difficulty in attaining a balanced view of these complex problems is that most of the literature is strongly biased in one way or another. It is extremely easy to make a plausible case for or against a particular energy source by stressing its advantages or its dangers and ignoring all contrary considerations. The literature published by the various energy associations tend to be over-optimistic about the advantages of their particular form of energy, blind to its disadvantages and overly critical of the rival sources. Most of the writers on energy are employed by industry or by trade or environmental associations, and this is often (usually quite unjustly) held to affect their impartiality. The only people who can speak freely without these constraints are independent writers and academics, and so we have a correspondingly great responsibility to develop and share our knowledge. This freedom from constraint is a great advantage, though inevitably it does not remove the handicap of lack of knowledge and experience that afflicts us all.

Quite apart from these difficulties, many of the situations discussed are changing more or less rapidly. The estimate of future population growth or of

the reserves of various types of fossil fuel, to take just two examples, are all subject to inherent uncertainties. With the best will in the world, it is not possible to do more than to present what seems to be the best estimate, and to keep it under constant revision in the light of new developments. It is thus very easy for the discussion to become outdated, and so it is necessary to keep it constantly under review.

My aim is not to argue for a predetermined conclusion but to present the facts as objectively as I can and then leave the reader to draw his or her conclusions. I certainly have no easy solutions to the world's problems, and I doubt if there are any. But what is important is to base the energy debate on the acceptance of ascertained facts together with an estimate of the penumbra of uncertainty that inevitably attends any quantitative evaluation.

What is a cause of acute concern is that Governments are often forced by the pressure of (misguided) public opinion to take decisions that they know are not in the public interest. This is why it is vitally important that the debate on these problems should be based on accurate factual knowledge. Even with the best knowledge it is seldom clear what is the best course to take, but this is certainly better than taking decisions on the basis of ignorance and prejudice.

It is extremely important in all these discussions to express energy resources and needs, production capacities, costs and safety in a quantitative way, and to give some indication of the reliability of the numbers quoted. I have tried to do this as far as I can, but it is likely that some of those given are now superseded. To some extent this is inevitable in a changing world situation, and I would be grateful for corrections and improved data. Furthermore, it is not easy to avoid the uncertainties introduced by the advocates of some forms of energy who deflate their own costs and inflate those of rival sources.

The broad conclusion of the discussion of energy supplies is that providing the population growth is moderated we should have enough energy worldwide to provide our basic needs. A much more difficult question is whether we can do this without polluting our environment with serious detriment to our quality of life. This is the real question, and it should strongly influence our choice of energy sources.

I thank all who have, over the years, worked to improve the quality of the scientific information available to the public, in particular Professor Joseph Rotblat, who has been a continuing inspiration for many years, and indeed all my colleagues and friends in the Atomic Scientists' Association and the Pugwash Conference on Science and World Affairs. The publications of these

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