

REVIEW

SOLAR VERSUS NUCLEAR—CHOOSING ENERGY FUTURES—A report prepared for the Swedish Secretariat for Future Studies by Mans Lönnroth, Thomas, B., Johansson and Peter Steen. Translated from Swedish by P. C. Hogg, Pergamon Press, Oxford, 1980, pp. xii + 174.

Energy has been occupying much of mankind's thoughts since the Yom Kippur war of 1973. The real possibility of oil running out in our life times has spurred a number of efforts at mitigating the possible adverse effects of this consequence. A number of futurological studies have been published which predict differing energy and social futures. The study under review is one such. It, however, is distinguished by an intelligence and incisiveness not usually found in other futuristic studies, most of which depend on abstruse mathematical equations for effect. Fortunately, this study does not contain a single equation, so that the authors' arguments are intelligible to anyone who has an interest in the subject. The study looks at two plausible futures for Sweden by the year 2015—one nuclear and the other solar. These futures are formulated in the most extreme way possible, namely, that nuclear would exclude solar and vice versa.

The study starts with an instructive chapter on 'Energy—some view points and general approaches'. This chapter sets out a number of basic questions that have to be answered before a viable future can be planned.

There is a very instructive section in the first chapter entitled 'what is the real problem?' The authors point out that it is not the energy policy which is a problem, but the consequences which different kinds of energy give rise to in relation to the environment and safety, freedom of action in foreign relations, forms of decision making, the ecology and population structure of various parts of the country, and so on. It is these effects which have to be weighed against the value of the supply of energy. Commenting upon the adjustments required for the future, the study goes on to say that 'the adjustment, therefore, has to be not between energy and economic growth or between energy and employment but between the utility of that to which the energy is applied and the negative effects of the use of the energy . . . The perspective is . . . important for another reason. What finally determines the demands on the energy supply systems are our evaluations of various aspects of our (future) standard of life . . . as against environment, foreign dependency, centralisation, etc. The relationships may be affected over a period of time. The fundamental problem remains: how are we to shape our society from an overall point of view in such a way that life fulfils our needs, our values and our dreams?' Once the problem is posed this way, mystification disappears and rational analysis can begin. It is to the credit of the study under review that such basic questions are raised and answered to the extent possible under existing levels of knowledge.

The second chapter looks at the interaction of energy and societal development. It contains a brilliant capsule history of Swedish developments in the energy sector. This chapter makes two very important points. One is that with the gradual dominance of oil as an energy source since the Second World War, the responsibility for Swedish energy supplies passed from the government to multinational oil companies. The dependency relationships that started with Swedish imports of coal in early years of this century were reinforced by oil. Further, Sweden became a society increasingly dependent on automobiles for transportation. The automobile industry and the oil industry are like siamese twins and dependency relationships were

deepened. The other important point is that pursuit of growth in GNP terms increased energy dependency of Sweden. The authors state that a one per cent increase in GNP lead to 1.5 per cent growth in energy consumption. In other terms current growth was bought at the expense of depletion of resources.

The chapter points out some interesting factors that are usually ignored in similar studies. It shows for example that private consumption consumed more energy than industrial production. It also brings into focus the nexus between time and energy. By faster modes of transport Swedes were able to save time at the cost of increasing energy consumption, *i.e.*, time had a cost in energy terms. The chapter also makes some very pertinent observations (p. 33 *passim*) on why certain trends were reinforced historically. It points out for example, that energy intensity increased in post-war years because energy (oil) and capital were relatively inexpensive but labour was relatively expensive. It points out that even after the post-1973 increases in oil prices, energy remained cheaper because inflation cushioned the impact of energy prices, *i.e.*, in real terms, the price of energy did not increase very much.

There is an instructive section on 'energy in politics' (p. 37 *passim*), which makes the point that though the need for energy conservation was well known even in earlier years, the reason for non-implementation was increased complexity of administering a conservation policy than a policy of increased supply. The section also makes the very valid point that undue belief in the efficacy of the so-called free market vis-a-vis administrative controls hindered conservation efforts. In general, the study is critical of the market mechanism in promoting suitable energy policy. It makes the rather obvious, but none the less important, point that governmental intervention is often the best way to ensure a future that is desired. It also emphasises, however, that till now governments have usually been content, in the energy sector, with smoothing out difficulties rather than setting up directions and guide lines for favourable developments.

The third chapter discusses 'Sweden's energy supply from an international perspective'. One very important point made in this chapter relates to dependency relationships of developing nations. As of now the major resource of energy, oil, is located in developing nations. If this resource is exhausted and the nuclear alternative is chosen, developing countries will come to a stage when their existing dependency on developed nations will increase as the latter have most of the uranium that is required for a nuclear programme (p. 43). This is a very important consideration when developing countries go in for ambitious nuclear programmes, as is evidenced by India's own troubles with uranium for Tarapur. The chapter contains a preliminary discussion of the nuclear and solar options for Sweden and reaches the conclusion that whether coal is used as a bridging fuel or whether Sweden goes nuclear, the fact that oil companies control much of these resources also, leads to a situation wherein Sweden 'could become strongly dependent on the administrative capability of oil companies and their abilities to exchange different fuels for each other' (p. 64).

The next chapter takes a detailed look at the two futures, under a set of common assumptions with regard to population, industrial capacity, number of households, etc. Nuclear Sweden is expected to cost 800 billion kronor and a number of economic, technical, environmental and political uncertainties of a nuclear Sweden are identified. There is a drawback in this discussion, however. The study quotes the Rasmussen report on safety of nuclear installations. But the report has been shown

to be a more or less lobbying effort for the nuclear industry after the Three Mile Island accident and the recent troubles with the nuclear plant at Indian Point II. A more pessimistic assessment of the probability of nuclear accidents would seem necessary.

While discussing Solar Sweden, the study asserts that despite popular belief to the contrary, a solar Sweden is possible with currently available technologies. Solar Sweden is estimated to cost the same as nuclear Sweden, and would combine a variety of energy technologies, including collectors, solar cells, biomass, hydro power, wind power, etc. The discussion does not assess some of the more recent technical developments in renewable energy, for example, the new wind tower concept developed by Grumman Corporation in US. None the less, the discussion is competent and illuminating.

A very important point made in this chapter relates to costs of the nuclear and solar options. Despite continual developments, the cost of nuclear reactors has been increasing over the past two decades. A nuclear future, therefore, would prove to be quite expensive. On the other hand, solar technology can be priced on the learning curve, and hence with improved techniques, the cost of a solar future would be much less than it is today. The importance of the present study lies in the fact that it shows that even with the most pessimistic assessment, a solar future is only as costly as a nuclear future, with the most optimistic assessment. The chapter ends with an analysis of the uncertainties of a solar future and a comparison of the two futures.

The fifth chapter, entitled 'where are we going?', is a brilliant analysis of existing political realities in Sweden. It shows that a series of apparently minor decisions over the past decade or so have already created a climate in which a nuclear Sweden is more likely than a Solar Sweden. The chapter rightly emphasises that the freedom to make decisions should also include the freedom *not* to make decisions, so that both futures could be given a fair chance. In the final analysis, the decision is political, and administrative history which pre-empts such an exercise of political will is something to be shunned. Despite this salutary warning, the authors may be too late and a fait accompli could be in the making. The chapter concludes with an intellectual exercise on piecemeal decision making (pp. 123-125) which makes a realistic prediction, based on plausible governmental decisions, as to how a solar Sweden can be undercut.

The sixth chapter on the transitional period between now and the year 2000, posits a number of important recommendations, which need to be accepted if choices are to be preserved though the 'Os. Some of the recommendations are to (1) buy time for longer term decisions, (2) stimulate technical development by larger R & D outlays, (3) create flexibility and (4) check on organisational and institutional structures. The authors make the point that R & D outlays in the energy sector are skewed in favour of alternatives like coal and nuclear and emphasise the need to allocate more resources to solar.

Chapter 7, on 'organization of energy policy' suggests sensible policies for organising the energy policy activities in Sweden. This chapter advocates greater policy-making role for local authorities, so that a solar option is made viable. The fundamental point is that a solar future would call for greater decentralisation of power and a nuclear future would call for greater centralisation. Existing democratic structures may not be able to cope with these conflicting pulls, and as a result either a decentralised village-based democracy or an authoritarian structure might

evolve, depending on which alternative is chosen. Unfortunately, current tendencies favour the latter alternative.

The final chapter on 'choosing a future—uncertainties and values' is a salutary reminder of the fact that values play a large role in determining a future. Mere technical competence and assessment cannot, and should not, be allowed to choose futures. The authors stress that 'the readiness of people to accept an overall view does . . . depend on whether they have trust in the people and the laws which regulate the course of events' (p 155). If this is accepted, then a future that works may be evolved with little pain. The costs of ignoring this fundamental fact could be horrendous. The authors also stress that they do not believe that 'choice of energy technique will *create* social relations—but on the other hand the choice can *reinforce* tendencies that already exist' (p. 155, emphasis in original). This obvious, but important point can be ignored only at our own peril.

Though the study is related to Sweden, this reviewer believes that every one interested in an energy policy for India should read it. It illuminates several murky areas which are usually ignored or subsumed in sophisticated mathematical models. It is precisely, the sort of policy discussion that this study undertakes that is important; equations should be subservient to such commonsense discussions. This study should be required reading for every one in the government who is connected with India's energy future.

The book is extremely well produced. This reviewer counted just about a dozen misprints and typographical errors. An extensive bibliography and a good index add to the value of the book.

ESCAP Regional Centre for Technology Transfer
49, Palace Road, Bangalore 52

C. S. G. PRASAD

SOLAR CELLS—THEIR SCIENCE, TECHNOLOGY, APPLICATIONS AND ECONOMICS—A new Journal by Elsevier: Published quarterly, Vol. 1, No. 1, November, 1979.

This is a quarterly journal dealing with a specialized topic, which is however of considerable current interest in view of the urgent need for the development of solar energy to supplement our fast dwindling fossil energy resources. Solar cells constitute the best solution for the conversion of solar into electrical energy and the present journal devotes itself to several facets of their development. These include the preparation, characterization and property measurements of existing and new materials, techniques relating to the optimization of their performance, and the decrease in their cost of manufacture, deployment and assembly under varying environmental conditions etc. Semiconductor theory and practice, principles of optics and their application for best optical coupling, property measurements and changes under particle bombardment and irradiation etc are the domain of the physicist and chemist. Review articles are of interest to the non-specialist and to workers who plan to initiate work in this field. A special feature of this journal is the inclusion of articles relating to market research, economics of production etc. This feature would be well appreciated by those associated with the actual production and marketing—who would need considerable rapport with the technical staff, in the larger interests. This journal is thus warmly recommended to all those associated with R and D work in solar energy and bordering areas.

Indian Institute of Science, Bangalore 12

V. S. VENKATASUBRAMANIAN