3 Fossil Energy and its Alternatives: A Problem Beyond Costs and Prices

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1 INTRODUCTION

By interpreting primary energy forms as commodities, competing worldwide, Marchetti (1977) has revealed a remarkably stable substitution process. Figure 3.1 identifies the historical shifts from wood and farm wastes via coal to crude oil and natural gas. It is important to note that the regularity of these structural changes was not really influenced by such exceptional events as the First World War, the Second World War or the economic crisis of the 1920s and early 1930s. The 35 years following 1914 limited the growth of total energy consumption (Figure 3.2) but they were not able to interrupt the striving for ever cheaper and easier forms of energy.

Around 1970 the very success of the technoeconomic strategy behind Figure 3.1 began to hit its own limits. Energy trade bridged global distances. The industrialised nations depended on the deployment of a continent-wide – and for oil a worldwide – energy system. An extrapolation of global economic growth trends, together with ongoing shifts in market shares from coal to crude oil, indicated that the giant oil deposits, accessible at production costs well below 1US$/bbl, would be exhausted very quickly. In fact, all crude oil and natural gas deposits, estimated around 1970 as being ultimately

P. Maillet et al. (eds.), *The Economics of Choice between Energy Sources*

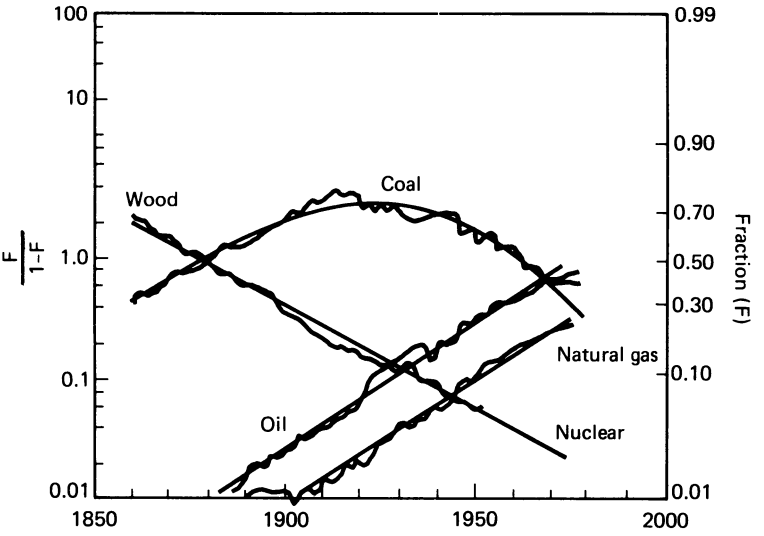

FIG. 3.1 *Historical contribution of various energy sources to the global energy balance*

recoverable, would not have sustained the world's growing hunger for energy for more than another 30 to 40 years (Häfele and Sassin, 1977). Inevitably the experience of the 1960s, the explosion of demand for oil imports of the booming economies in the USA, Western Europe and Japan, triggered an economic response. OPEC raised the price level, roughly by an order of magnitude between 1971 and 1975. Drastically increased prices are a sign of fundamental scarcity, but they are no solution. The critical question emerged as to how the world would meet its energy demand in the coming decades, recognising a limited speed of transition to new basic energy opportunities, quantified in Figure 3.1.

II THE OIL CRISES OF THE 1970s, AN INFLECTION POINT IN THE LONG-TERM EVOLUTION OF OUR ENERGY SYSTEMS

In an extensive seven-year study, the Energy Systems Program of the International Institute for Applied Systems Analysis (IIASA) considered the possibilities of balancing demand and supply of energy for