8 Power Generation Technology Clusters: Present Status and its Potential[17]

This chapter presents a general discussion on the present state and likely future developments in a number of groups of related power generation technologies. These groups, or clusters, of technologies then form the basis of the technology scenarios presented and analysed in later chapters.

Apart from fundamental changes in technology, the other defining features of the scenarios presented later is the degree of centralisation of the ESI.

8.1 Nuclear Industry: a Paradigm in Crisis

Nuclear technology has experienced an important diffusion in the 1970s and 1980s, as a result of an important technology push, originally carried out by governments of the major industrialised countries. However, the importance of nuclear energy for the worldwide production of electricity (17% in 1995) cannot conceal the difficulties that its diffusion has undergone in the whole world.

According to the projections made at the end of the 1970s, the worldwide nuclear capacity should have reached 1,300 GW in 1990 and 3,600 in the year 2000. It was 325 GW in 1990 and will reach 366 GW in 2001, at best. It is important to assess the changes in the field of the selection of electric production techniques that would encourage a future boost in the diffusion of nuclear technology. It has been argued, that nuclear energy could provide a solution to the increase of world-wide energy needs, particularly in emerging, rapidly-developing countries. Also it

[17] The principal authors of this chapter are D. Finon of IEPE (Nuclear section), M.Witeley of ESD (Clean coal section), S. Mima of IEPE (Fuel cell section) and Ph.Menanteau of IEPE (Wind power section).

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its greater diffusion could help meet the limitations of greenhouse effect gas emissions agreements revive its development.

The development of nuclear technology has followed a "technology push" model. This model, less and less used, presents three main characteristics:

- it is linked to complex technologies;
- its projects are defined according to technological objectives, regardless of economic and commercial feasibility;
- due to nationalistic and military reasons only a very small number of large, national, industrial firms can appropriate the technology.

The selection of competitive nuclear technologies was realised quickly, with a characteristic "lock-in" phenomenon adaptable to American techniques for light water reactors, in spite of their rather poor performance. BWR and PWR techniques had benefited from a prior military impulse (submarine reactors, production of fissile material). They also benefited from US government support in the geopolitical arena (control over the risk of proliferation permitted by American supply of enriched uranium) (Bupp and Derian, 1978: Cowan, 1990).

The introduction of hybrid nuclear technology through steam turbines in the 1960s and 1970s led to a change in the electricity production paradigm. This required the exploitation of economies of scale, leading to ever larger size nuclear plants with substantial capital requirements. The capital intensity and large scale optimal plant of nuclear power generation have become weaknesses in recent years.

As a, that started at the end of the 1960s, the commercial diffusion of nuclear power slowed down after the mid-1970s in industrialised democratic countries, except for France and, to a lesser extent, Japan. This was the result of a crisis in social acceptance of nuclear power due to new societal values and priorities (e.g., safety, health, life quality, participation, etc.). Nuclear development has been a major focus of new social conflicts because it embodies different critical aspects of political control in industrialised societies, and also due the specific nature of its risks, from which particular fears can also arise.

Apart from reduced social acceptance, the nuclear industry also had to cope with the significant slackening of the growth in electricity demand, from a 7% in the 1960s to a 1-2% more recently. This has resulted in the appearance of significant over-capacities. The overall result was the cancellation of many orders for nuclear plants, especially in the United States (119 cancellations from 1975 to 1978).

In summary, the weaknesses faced by the nuclear industry are:

- technological complexity
- safety concerns