10 The electricity industry

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Introduction

Saudi Arabia is considered a developing country, and for this reason the achievement of both economic and social development remains a national strategic objective. The country's investments have depended largely on the availability of government revenues generated from oil exports. The declining oil revenues and budgetary constraints have limited the ability of the public sector to provide sufficient funding for competing obligations. Arguably, the objective of economic diversification could be attained more successfully with a greater contribution from the private sector. Hence the current challenging task for the country is to allocate its resources efficiently between its different priorities. The clarification of the boundaries separating the private and public sectors would enhance efficiency in the economy through increased specialisation.

Privatisation has been a government objective since the mid 1980s, with the main candidates being the telecommunication sector, the national airline and the electricity industry. What differentiates the electricity industry different from the others is the fact that it has been in the private domain since its inception and the government's involvement has been viewed as a transitional process relating to specific objectives. One objective has been the modernisation of that industry through the creation of a new infrastructure. This was followed by the aim of restructuring the industry to prepare it for privatisation and exposure to market forces. Ideally, it was hoped that such an approach would lead to an increase in productive efficiency, through a lowering of costs, and in allocative efficiency, by making prices reflect these costs. In addition, this industry has the ability to provide highly valued products and value-added services that could increase its contribution to the economy.

This chapter introduces the reader to the economic and institutional changes that the electricity industry – worldwide – is undergoing. It also sheds light on the actual experiences of reform of some developed and developing countries and the challenges affecting the introduction of competitive markets to this important industry. The restructuring process of Saudi Arabia's electricity industry is under way, but some aspects of the reform remain at the formational stage. Hence the issues raised in the chapter – and the international experiences

discussed – are extremely relevant and should serve as a useful lesson for the country's electricity industry.

Restructuring of the electricity industry

The traditional literature on electricity economics focuses on the issue of regulation, while the more recent writing explores the widely debated alternatives for restructuring the industry and how competitive forces are introduced. Although different countries may have the same objectives – namely the establishment of efficient markets and competition – Hadjilambrinos[1] emphasises that political and institutional traditions influence the restructuring direction that each country takes. Some governments may view privatisation not as a part of a broad reform programme with competition as the main objective, but as a way of improving the government's fiscal position. Newbery[2] points out that the term 'restructuring' and 'privatisation' are not synonymous, as restructuring does not necessarily imply a change of ownership and privatisation does not necessarily imply a change of structure. Yet, he believes that in the case of the electricity industry, restructuring usually comprises the elements of restructuring, privatisation and deregulation.

Most restructuring cases involve, simultaneously, both a horizontal and a vertical break-up of the electricity industry. Klein[3] describes horizontal restructuring as the situation where a number of companies are created within a single area of economic activity, such as power generation, while vertical restructuring involves the separation of the different stages of the electricity industry. The vertical separation normally includes regulation of the natural monopoly segments (i.e. transmission and distribution) and allows the introduction of competition to generation and supply. Arocena *et al.*[4] argue that some governments may chose to corporatise the industry instead of unbundling it, which would amount to the government's raising money through an implicit tax on future electricity consumption. Though this caution is well founded, a dilemma arises from the fact that when the electricity industry is losing money it is unlikely to be sold easily. Thus it is worth trying to expose the industry to the market forces at an early stage of the process.

Uncertainty in restructuring

Despite the changing organisation of the industry, coordination both within and among the generation, transmission, and distribution segments remains necessary. Thus the move towards deregulated markets has created its own sceptics. Joskow and Schmalensee[5] have expressed some doubts that the introduction of competition into electricity markets could accommodate, without a loss of any economic efficiency, the organised cooperation required for least-cost planning and operation. These are reasonable doubts, but it is essential to consider the fact that the introduction of competition is based on the assumption that the long-term benefits, such as an increase in efficiency, will be much

greater than short-term efficiency losses that might result form a reform of the industry.

Banks[6] believes that the unbundling of the electricity industry might only have created uncertainty without being able to introduce successful financial instruments to minimise the risks. Thus he thought it unwise for countries with successful electricity industries to rush into this process with no guarantees that it would be correctly applied. This argument might be accepted if the industry was performing well; however, many countries have been obliged to reform their industries precisely because of a failure to achieve the desired outcome. The policy dilemma, then, is to consider the expected benefits resulting from restructuring as opposed to the problems and costs associated with such a complicated process. The question of how this trade-off should be resolved is thus becoming one of the most interesting issues in electricity economics.

Competition in production and monopoly in delivery

Competition in generation

Although the notions of natural monopoly have influenced public policies and academic discussions for many years, they have become less relevant to certain activities of the modern electricity industries. Arocena *et al.*[7] argue that both static and dynamic (e.g. 'learning by doing') economies of scale do not exist in the generation segment. In addition, many empirical studies, such as Bernstein,[8] have examined the investment costs of power projects in the 400–600 MW range and reached the same conclusion. More recent studies, such as those conducted by Doyle and Maher[9] and Bayless[10] reveal that the new technology of Combined Cycle Gas Turbines (CCGT) has made it possible for efficient production in generation to be reached on a much smaller scale than ever before. According to Berrie[11] the prospects for Independent Power Producers (IPP) are greatly improved as these new technologies point downwards in scale, price and optimum size, away from 2000 MW and towards 200–500 MW power generators. This trend has obviously made market competition more possible, especially with the faster installation of these smaller generators.

There are continuous challenges to the claims about which segments of the industry remain natural monopolies. The potential for competition has been expanded and the extent of regulation limited. Trebing[12] indicated that the industry changes have made it possible to introduce competition into generation, while the natural monopolies of transmission and distribution have to remain under regulation. These changes in power generation have led Hyman and West[13] to emphasise that even if the industry is dominated by vertically integrated utilities, competition remains feasible. These utilities are able to choose between using their own generation or buying it from other utilities or private power producers. Regional utilities or independent producers are able to sell in the wholesale market, and customers able to choose either self-generation or purchase from the local utility or even from external sources.

New role of distribution and transmission

Armstrong *et al.*[14] point out that the distinction between these two activities is that the transmission network is high-voltage and national in scope, whereas the distribution network is low-voltage and local. When the electricity industry consists of vertically integrated utilities this distinction is less critical, but the breaking-up of that industry has highlighted certain significant practical and regulatory issues such as open access for competitors and customers. Sansom[15] argues that it is not economically or technically necessary for transmission and distribution to be operated by a single company in an unbundled structure. The option of regional separation is essential for yardstick competition, especially given the very limited economies of scope between distribution activities in different regions. A further advantage of this separation is the fact that retail-supply competition between regional companies become possible.

The move towards deregulation has enhanced the strategic role of the transmission network not only in terms of direct benefits from power exchange but also in facilitating broad competition. Bernstein *et al.*[16] examined the impact of transmission on competition in generation within the context of a model of two geographically separated markets, each dominated by a single supplier. The main finding of this investigation was that the availability of increased transmission capacity enhanced the potential for entry, in the form of electricity imports. Furthermore, even though there was no entry the mere presence of this threat discouraged monopolistic behaviour within each market. These findings reflect the role of transmission networks in creating competition between different sources of generation as well as providing the consumers with choices. However, the realisation of this advantage depends on the structural and regulatory approaches chosen to deal with this monopolistic segment. Tenenbaum and Henderson[17] emphasise that market power in the electricity industry is influenced by the ownership or control of the transmission network. The authors give the example of a combined generation and transmission utility being able to make use of its control over the transmission grid to block its competitors from reaching its consumers.

Functional transformation of the electricity industry

In the 1980s, Fred Schweppe and other colleagues at Massachusetts Institute of Technology anticipated a considerable transformation in the electricity industry. They envisioned the ideal of an unbundled marketplace for electricity to consist of the following three segments: (a) a regulated transmission and distribution company which functioned as an intermediary; (b) a number of private generating companies which sold electricity to the transmission and distribution company; (c) electricity consumers who bought electricity from the transmission and distribution company. Although Joskow and Schmalensee[18] expected the electricity industry to be restructured along lines similar to those outlined above, they did not agree that the transmission and distribution segments should

necessarily be integrated into one company. However, both visions conform to what it is called a single-buyer structure, which is nowadays considered a transitional stage. Hence, these early works did not anticipate the vast transformation currently in progress in the electricity industry.

Restructuring models

Tenenbaum *et al.*,[19] and Hunt and Shuttleworth[20] are well-known authors who provided a comprehensive analysis of the ways to restructure an electricity industry. Tenenbaum *et al.*[21] presented four restructuring models, each of which differed in the extent to which it introduced privatisation, as in the following:

Model 1: This model consists of one or more vertically integrated, privately owned companies with each one in a franchised market. In this model, privatisation is introduced without competition.

Model 2: This model maintains the traditional structure of Model 1 but allows competition in generation, with continued regulation of transmission and distribution segments.

Model 3: This model expands on Model 2 by emphasising the role of the transmission segment that must transmit electricity in a non-discriminatory way. In this model, the transmission owners are obliged to provide access to competitors and to other wholesale buyers and sellers.

Model 4: This model assumes that the whole industry is privatised and vertically separated. In this model, the independent transmission company owns the network and controls the dispatching of generators. Regional distribution companies are obliged to provide access to competitors and to their own consumers.

Hunt and Shuttleworth[22] identified four similar restructuring models. These models are differentiated not on the basis of ownership but rather in terms of the degree of competition and choice each provides to the participants. The first is described as a monopoly model, the second as a single purchasing-agency (i.e. monopsony) model, the third as a wholesale competition model and the fourth as a retail-competition model. Figure 10.1 illustrates the general outlines of these four models.

The figure shows that these models are not based on ownership; for instance, the first can be a government-owned or private monopoly, but it clearly does not provide competition between generators or choice of supply for consumers. The second is the single-buyer model that introduces competition into the field of generation, and is considered transitional in nature. However, some authors such as Lovei[23] caution that this brings with it certain problems, especially in developing countries, such as inviting corruption, weakening payment

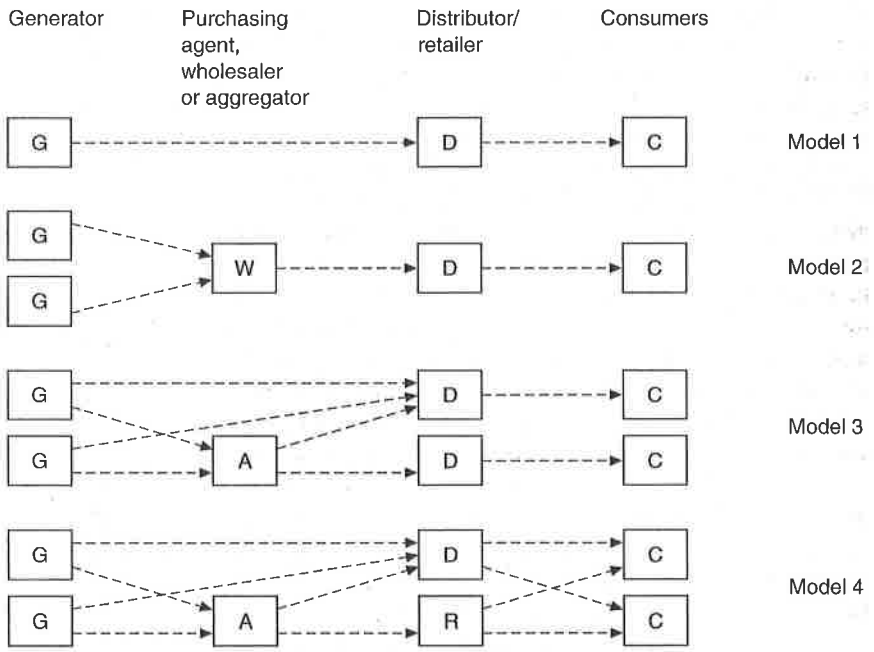

Figure 10.1 Restructuring models for an electricity industry

Source: Hunt, S. and Shuttleworth, G. (1996), Competition and Choice in Electricity, p. 24.

discipline and increasing government liabilities. The third model maintains competition in generation and introduces a choice of supply for distribution companies and large consumers. The fourth extends retail choice to small consumers, who might otherwise become captive to the distribution companies and hence end up subsidising large consumers. Thus the fourth model is considered the most efficient given that it has the most competitive market structure. However, applying these models to the real world revels that there is no single conform to the structure of a particular country, and that the distinction between them is really not always straightforward. Nevertheless the important point is that, regardless of which model is adopted, the technological changes and the dynamic nature of the industry reform has introduced many options.

Trading mechanisms in electricity markets

The cornerstone in terms of promoting competition in generation and within the wholesale electricity market is the structure of that market itself. Newbery[24] points out that this market should consist of both a spot (physical) market and a one for risk-sharing created through trading in financial instruments. The electricity spot market is normally described as a price-based pool where by

physical transactions are carried out through the power pool that relies on the central dispatching of the generators based on the ranking of their operating costs (i.e. the merit order). Thus the market price – or system marginal price – is determined by the marginal operating cost of the most expensive generator at a specific hour. Ideally, the dispatcher is in effect matching the bids submitted by the two sides of the market, which are generators (i.e. supply), and distribution companies and large consumers (i.e. demand). The alternative for the pool mechanism is the bilateral contracts where the generators and distribution companies sign physical contracts outside the market but have to be scheduled through the independent system operator.

Mork[25] emphasises that the decision to choose between a pool or bilateral contract should be based on such factors as price volatility and security of supply on the one hand and price transparency and market liquidity on the other. The emphasis is on the claim that the price transparency associated with pool-based markets can lead to increased competition and efficiency. Murray[26] also favours this approach over bilateral contracts, which, while they benefit the involved parties individually, produce suboptimal outcomes and incur higher costs overall. However, the price transparency of the pool requires information availability, which, due to the repetitive nature of the electricity market, can create an incentive for collusion among generators.

Hunt and Shuttleworth[27] and Green[28] provide a very useful comparison of the two ways in which the electricity wholesale market can be structured. While acknowledging the disadvantages of the pool system, especially in terms of price volatility, the authors point out that bilateral contracts include the self-dispatching of generators which results in inefficiency in production. Furthermore, the presence of large transactions requiring to be managed by the system operator can give rise to disputes and even litigation. Also, the authors point out that bilateral trading creates a balancing market that is necessary to clear the mismatch between supply and demand. Thus bilateral contracts eventually result in the establishment of a spot market. It is, therefore, important that the design of the market has to consider from the start the long-term merits of a spot market for electricity.

These arguments for or against the two schemes focus on the functioning of the market overlooking the equally important factor of generation mix. Sioshansi and Morgan[29] believe that while a spot market would be more suited to a system where generation was mostly thermal, a contract market would be more appropriate for a one in which the bulk of its generation was hydro-based. This argument is well supported by the case of the Brazilian electricity system, thus indicating a considerable degree of complexity associated with hydroelectricity. Estache and Rodriquez-Paradina[30] studied this case and showed that the pool mechanism faced challenges in the hydro system. First, it is difficult to ensure open entry for new generation, especially when existing generators own the water rights. Second, the optimal dispatch depends not only on the demand and the availability of generators but also on water storage. Third, the hydroelectric generation involves very high sunk costs which are

difficult to recover when marginal prices remain very low over a long period. These findings show that the choice between a spot or bilateral market is more relevant to a thermal system than to a hydro system and, more broadly, that what may prove workable solutions for one system may not necessarily be suitable for another.

Financial contracts in the electricity market

The new electricity industry has introduced new entities and an innovative trading climate. With the creation of electricity markets new players such as marketers, brokers and retailers have become visible participants. Thus it is not surprising that the development of the electricity market is also enhanced by the role of financial contracts. Hunt and Shuttleworth[31] emphasise that some type of mechanism such as contract markets is needed for the transition from one model to another. For example, the move from a vertically monopolistic structure to a single-buyer structure requires purchasing contracts such as Power Purchase Agreements. Graves *et al.*[32] look at the growing importance of contracts in the electricity industry from a different angle. They point out that electricity can be stored 'synthetically' through forward contracts, where buying power at a given time and selling it at another is the financial equivalent of the storing and reselling of power.

Moreover, the restructuring of the electricity industry introduces considerable elements of risk and uncertainty. Berrie[33] believes that the new structure for electricity markets requires the various parties involved to enter into financial contracts and agree in advance on the assumptions regarding the probable patterns of prices in the months or years to come. Consequently, the participants in electricity markets need to undertake high-risk financial hedging transactions to protect their contract positions. The volatile prices associated with electricity markets make it necessary for generators and distribution companies to employ various kinds of financial instruments. These instruments provide hedging against future purchase prices, especially for those distribution companies obliged to supply their customers at fixed retail prices.

International experiences of reforming the electricity industry

It is reasonable to assume that different countries normally pursue different reform objectives which reflect the variations in their electricity industries' structure. However, as the following review of some cases from developed and developing economies indicates, countries sharing the same geographical region and even the same economic structure are able to adopt different approaches and paces for their reform programmes. This could be indicative of several factors, including the orientation in policy toward privatisation, the historical development of the industry in each country, and the extent to which each country has progressed in resolving the debate on whether electricity is a commercial commodity or a social service.

Developed countries

The advantage developed countries have over developing ones is that the former have more advanced financial and regulatory systems which make the introduction of the ownership and regulatory reforms to the electricity industry much simpler. However, as the experiences of countries such as the United Kingdom and the United States have shown, the introduction of competitive markets to this critical industry is easier said than done. The electricity industry of England and Wales went through major reform, including the transfer of ownership from the public to the private sector. In 1990, the Electricity Pool of England and Wales was introduced, but its success was less than expected. Green[34] attributes this mostly to the fact that the structure of the wholesale market was inconsistent with the way a competitive market was supposed to be. The continuous high concentration in generation led to the market being manipulated by large generators, and the demand side was completely ignored. Despite falling electricity prices since 1990, these factors – as well as political pressure from the coal industry and major electricity consumers – have caused the abolition of the pool in 2001 and led to its replacement by bilateral contracts.

According to Kahn and Stoft,[35] the reform experience of the United States differs from those of the United Kingdom and many other countries – with the exception of Spain and Alberta in Canada – in that the industry moved to wholesale competition from a structure dominated by private, vertically integrated utilities. The presence of private ownership and institutional fragmentation complicated the restructuring process and increased the transaction costs (e.g. stranded costs) of introducing competition. Although the regional wholesale markets in the United States have performed well, the Californian power crisis of 2001 caused second thoughts both in the state and beyond. Yet it is important to realise that the crisis was caused not by the introduction of market forces per se but rather, as is widely believed, by the flawed design of the market in this state. Kee[36] and, Silsbee and Jurewitz,[37] among others, studied this market and summarised its problems as follows: (a) the shortage of new generation and transmission capacity due to the price cap imposed on retail prices and too many site requirements; (b) the inability of the distribution companies to use financial contracts to hedge against risk caused by the volatility of wholesale prices; (c) a demand side which is unresponsive to market prices because these prices are not observed by final consumers.

New Zealand is one of the countries that has had a relatively successful experience of industry reform despite the considerable amount of public ownership. The drive towards electricity privatisation was not completely implemented due to a change of government, but the commercialisation of state-owned companies was a major feature. Gunn and Sharp[38] draw attention to another important characteristic of this industry, where the non-intervention style of regulation has emphasised open access to distribution networks that has made retail competition possible. The European electricity market is a complex

one as it involves different countries with different industry structures. While the French system remains closed to outside competition as it is dominated by Électricité de France, the more open countries such as Germany and Spain, have a high concentration in generation. Arocena *et al.*,[39] for example, shows that the two largest companies control about 83 per cent of the generation in the Spanish market. Thus it is not surprising that cross-border trade in power is one of the contentious issues facing the European Union. Scandinavia, on the other hand, was successful in introducing what Hjalmarsson[40] calls *club regulation* whereby voluntary cooperation exists between vertically integrated national utilities. This arrangement was very useful for the establishment of the currently existing competitive market, known as Nord Pool.

Developing countries

Ironically, Chile – a developing country – is considered a world pioneer in the restructuring of an electricity industry. The reform process of its electricity industry began in 1978, but the unbundling of that industry and the introduction of a wholesale spot market took its clearest shape after 1982. The lesson to be learnt from the Chilean experience is that political will and strong conviction are essential to the implementation of such an ambitious reform, in view of the fact that the country had an underdeveloped financial system and a very limited experience of regulation. The same approach spilled into other neighbouring countries in South America in the early 1990s, but to varying degrees. Hammons *et al.*[41] show that both the gas-based Argentinean system and the mostly hydro-based Bolivian one include wholesale markets. On the other hand, the hydro-based Brazilian system remains in the process of formation, but currently most of the system is still state-owned with the exception of private distribution companies.

The Asian countries' interest in reforming their power industries was driven – especially prior to the Asian crises – by the high-demand growth for electricity. Caruso and Chen[42] studied these countries and found that they had also differed in their chosen path of reform. Vietnam and China transformed their power ministries into corporate structures, while Indonesia and Thailand created commercial subsidiaries for their power authorities. Pakistan divested itself of its state ownership in generation by selling to private domestic as well as to international investors. Malaysia can be considered the most advanced, as it went ahead with privatising its national electricity authority by floating its shares on the financial market. The trend of reforming electricity industries has also reached sub-Saharan countries. Turkson and Redlinger[43] argue that for these countries the motive is mainly to satisfy the structural adjustment programmes recommended by the IMF and the World Bank. Interestingly enough, these nations differ in the approach they have selected to reform their electricity industries. While Zimbabwe has chosen a slow approach through corporatisation, Ghana and Kenya have opted for privatisation and wholesale competition.

The Middle East has proved slower than other regions in catching up with the liberalisation wave of the industry, partly because there remains some of the confidence of past decades in the public sector's ability to provide electricity, a provision widely believed to be a social service. The Arabian Gulf states had, until recently, less urgency to liberalise their economies, including the electricity industry. However, the opening up of the Egyptian electricity industry for private power producers and the adoption of a single-buyer model by Abu Dhabi, Oman and Saudi Arabia show that this region is no longer an exception.

The Saudi Arabian electricity industry: regulatory and organisational development

The electricity industry in Saudi Arabia has passed through distinct stages of development in the last seventy years. The following is a review of these stages, based primarily on the regulatory and organisational transformation of the industry over the decades.

First stage

Saudi Arabia's electricity industry began as a private enterprise. The 1930s witnessed the introduction of electricity by some entrepreneur's needing this service for their businesses. They were also able to sell excess capacity to neighbouring houses and streets for lighting. In 1949 some Saudi citizens and businessmen cooperated in establishing the first private electricity company in Dammam. Other cities and towns followed suit until the early 1970s, when the country had over a hundred small commercial companies and cooperative projects.

During the period 1961–1974 the Ministry of Commerce supervised the electricity industry, which may reflect how this resource was viewed as a commercial commodity as opposed to merely a social service. The industry was not subsidised and was dominated by profit-making private companies. Yet, the monopolistic power of these companies resulted in prices that were very high and varied both across regions and even cities within the same region. This variation in prices may have been caused by the companies' inability to reduce their average costs by exploiting their economies of scale. In addition to limited markets (the small size of the population in their franchised areas), these companies had no access to transmission lines, which resulted in their losing the opportunity to export their excess output to other markets.

Second stage

The creation in 1975 of the new Ministry of Industry and Electricity (MIE) meant that the supervision of electricity was shifted to the same ministry responsible for the pursuing the strategic objective of industrialisation. This development may have influenced government policy towards the electricity

industry and the expected role of the private sector within it. Since the country claims to adhere to the philosophy of a free-market economy, this objective does not in itself justify direct government involvement in the electricity industry. Thus, it seems that practical considerations as opposed to ideological dogma may lead to government intervention in this area.

The discussion of this issue may be illuminated by the views of Ghazi Algosaibi, the first official to head the Ministry of Industry and Electricity. Algosaibi[44] indicated that he had discovered to his disappointment shortly after taking office how the electricity companies lacked any constructive response to the challenges facing their industry. It is possible, however, that this attitude on the part of the companies was based on rational justifications. The introduction of a nationwide price regulation during the period 1971–1975 may have adversely affected the profitability of these companies. This period witnessed a reduction in electricity prices of as much as 50 per cent compared with previous years, which may well have contributed to underinvestment in the industry. In addition, the required capital costs were immense, which made the private sector unable to invest in them, at least in an expeditious manner. Even if the private companies had been able to raise sufficient funds from the domestic and international markets, they would have lacked the incentive to undertake unprofitable projects.

It seems that the rush towards economic development and industrialisation made the public officials impatient with these companies, who needed to consider what all the sudden changes would mean to them. The technocrats' patience may have been somewhat limited, especially as at that time they had substantial public funding at their disposal. Yet such a pragmatic approach may have been based on two important justifications. First, the aim of nationwide electrification and of providing Saudi citizens with electricity at low and affordable prices and second, the intention to attain the capacity required to meet the growing demand of energy-intensive industrialisation without delay. Thus these factors enhanced the perception that the electricity industry was unable to meet these new, high expectations by relying on the private sector alone.

Third stage

This stage, which lasted from 1976 to 1999, was the one that saw the largest expansion in the industry's capacity, made possible with the aid of government funding. Between 1976 and 1982 the government gradually subsumed individual operators under four vertically integrated companies, one in each area of the country. This led to the formation of the Saudi Consolidated Electric Companies (SCECOs) in the eastern, central, southern and western regions. Also the Electricity Corporation (EC) was created in 1976 as a public enterprise with two objectives. The first was to have the responsibility of financing and supervising the operation and expansion projects of the scattered companies in the northern region. The second was to represent the government's ownership share in the electricity companies, including SCECOs. This extensive ownership allowed the

government to control day-to-day operations and decisions within the industry, and Table 10.1 shows that by the end of 1998 it was the major shareholder in these joint-stock companies, with about 84 per cent of total paid-up capital.

Fourth stage

This industry was singled out under the Sixth Development Plan (1995–2000) as the main candidate for full privatisation in the medium and long term. The Plan emphasises profit-making as the ultimate objective of this restructuring process. The government commitment to privatising the electricity industry has been presented within the context of providing the private investors in the industry with the opportunity to make profits on their investments. This notion is reiterated in the Seventh Development Plan (2000–2004), which places great emphasis on market-based pricing for such services. This official attitude is expected to contribute positively toward creating the conditions needed for the industry to raise finances based on its creditworthiness.

The restructuring plans announced in 1998 aim at preparing the industry for full privatisation when its institutions are developed. As a first step, in 2000 the regional SCECOs and the northern companies were merged into one holding company, the Saudi Electricity Company (SEC). The plan's immediate objective was to make the existing industry structure commercially viable and more attractive to private investors. The balance of ownership between the government and the private sector within the company reflects that which existed in the former companies prior to the merger, but this is expected to alter when further shares are offered for privatisation. The objective at this stage is to end direct government intervention in the industry's day-to-day affairs and make it operate on a commercial basis.

The setting up of this company is to be followed by that of a regulatory office, the Electric Services Regulatory Authority (ESRA), to be responsible for overseeing the industry's transformation into an unbundled structure. This reform is being carried out, not on a region-by-region basis but rather on an activity-by-activity one. The restructuring plan intends to make the industry ultimately a self-financing private enterprise, with the introduction of a market mechanism into its various segments. The plan's broad outline envisages the new structure to include:

Table 10.1 Government's shares in electricity companies (in million SR)

	Central	*Western*	*Eastern*	*Southern*	*Northern*	*Total*
Paid-up capital	8,000	7,350	4,151	3,564	37	23,102
Government share	5,742	6,281	3,764	3,513	21	19,322
Per cent	72	85	*91	99	57	84

Source: Council of Saudi Chamber of Commerce (1999).

Note: * Includes ARAMCO share of 41 per cent.

- An opening-up of the generation segment to competing private companies;
- a privately-owned transmission company;
- regional private distribution and supply companies;
- the industry's transformation from a single-buyer structure to a pool structure where electricity is traded in the wholesale market; and
- the establishment of an 'independent' regulatory body.

The implementation of this plan would result in important tasks for the regulator, which will be responsible for dealing with a number of issues after this decentralisation. Healthy competition in generation calls for the provision of well-thought-out rules and a regulatory system that is both fair and transparent. Thus the reform has to be made credible in practice by tackling directly some of the economic and regulatory issues likely to arise under the new structure. Reform of the industry should not result in a replacing of the public monopoly with a private one. This will be especially true during the time when SEC is the sole supplier of electricity. This situation requires detailed supervision on the part of the regulator to prevent any exploitation of its monopolistic powers. In addition, having a nationwide distribution company would have the effect of masking regional inefficiencies, which makes it essential to speed up the establishment of regional distribution companies. This step would make the job of the regulator much easier by facilitating yardstick competition. The unbundling of the industry will mean that the transmission grid plays a strategic role in linking consumption centres with generation sources. The benefits from competition in generation will not materialise unless this natural monopoly segment of the industry is well regulated. This becomes necessary at an early stage of the process in order to reduce potential disputes among the different participants, such as generators and distribution companies (or, indeed, major customers).

The gradualist approach taken by the reform plan could allow the necessary time for the institutional and legal reforms to take place. The advantage of having the Saudi Arabian state as the major shareholder from the beginning of the process is that reforming the existing structure becomes very flexible. The role for the government at such a stage has precedents in the experiences of other countries. For example, Yajima[45] contrasts the reform experience of the United States with those of countries such as Chile, where full-reform models have been easily realised with government engagement. This view indicates that the existence of large private interests in the industry prior to restructuring would complicate the process itself.

Salient features of the Saudi Arabian electricity industry

Operational features

The operational and financial issues are closely interlinked, and the following sections review the operational ones first. This is necessary in order to give the proper background for an understanding of the financial issues facing this industry.

Demand growth

In addition to industrialisation, urbanisation has been a major factor in the growth in electricity consumption in Saudi Arabia during the past three decades. The growth in demand between 1970 and 1990 reflects the time when the country was becoming more urbanised and was going through economic and social changes. The 1990s were a difficult time for the industry as it tried to keep up with the growth in electricity consumption, which proved faster than that in generation capacity. Although the country's infrastructure was then mostly completed and the economy beginning to slow down, the high population growth and diversification of the economy were the main driving forces behind the increase in demand. Figure 10.2, below, illustrates the growth in electricity consumption and generation over the last thirty years.

The annual growth in generated electricity, in MWh, since 1975 has been 13.8 per cent, insufficient to keep up with the 14.8 per cent growth in consumption. In 1999 about 106 million MWh were sold, while the industry itself was incapable of generating more than 94 million MWh. The by-product electricity generated by the desalination plants – owned by the Slain Water Conversion Corporation (SWCC) – covered the deficit of 18 per cent. This indicates the importance of SWCC plants for the electricity industry: their output has been crucial in closing this deficit since 1984. Furthermore, the very low costs of power they generated are likely to put additional pressure on the electricity industry by increasing generation competition.

Figure 10.2 shows the total energy losses, which represents the difference between total generation and total electricity sales. These losses declined in percentage terms from 13.4 in 1980 to a mere 7.9 in 1999. This percentage is very low, even in comparison with the electricity systems of many developed countries, which show an average loss of 9 per cent. This increase in efficiency in

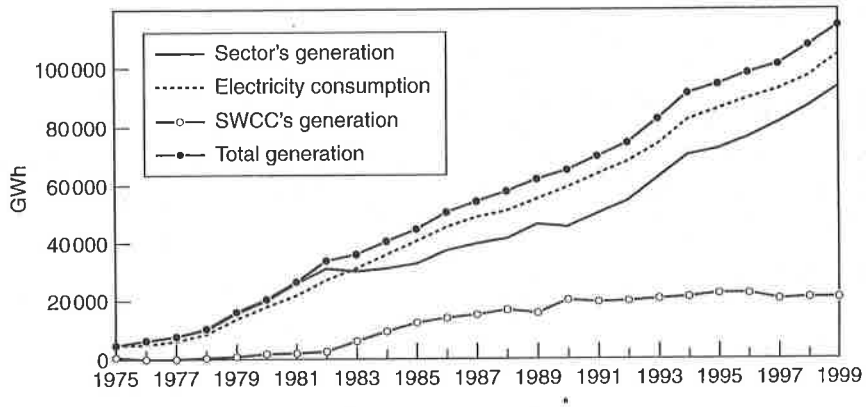

Figure 10.2 Development of electricity generation and consumption

Source: MIE Annual Report (1999).

transporting electricity is due to the establishment of modern transmission and distribution networks made possible with the help of public funding. However, as the industry moves into the private domain cost considerations rather than system reliability will become a determining factor for future investments. Hence economic regulation will be necessary to guarantee network expansion and prevent the occurrence bottlenecks likely to hinder the functioning of the market.

The factors behind the growth in electricity demand during the past thirty years may have become less vigorous, but they remain substantial. Thus, electricity demand is expected to grow at an annual rate of about 5 per cent, requiring the generation capacity to increase to 60,000 MW by the year 2020. In addition to this expansion the capacities for transmission and distribution will have to be proportionally available. Although these numbers – presented in the Long-Term Plan – have been considered an overestimate this Plan was nonetheless useful in drawing attention to future challenges. Figure 10.3 shows the estimated investment requirements up to the year 2020.

Demand characteristics

Storing electricity on a large scale is not economically feasible, which makes electricity a demand-driven industry. This would impose additional costs, as the generation and transmission capacities must be designed to meet the estimated demand at the peak hour. In the case of Saudi Arabia, the peak time for the country occurs during a number of days in the summer as the consumption – especially by residential customers – is closely influenced by the use of air-conditioning. The fluctuation of the electricity demand during the year, and even during the same day, has a considerable and direct effect on the system's capital

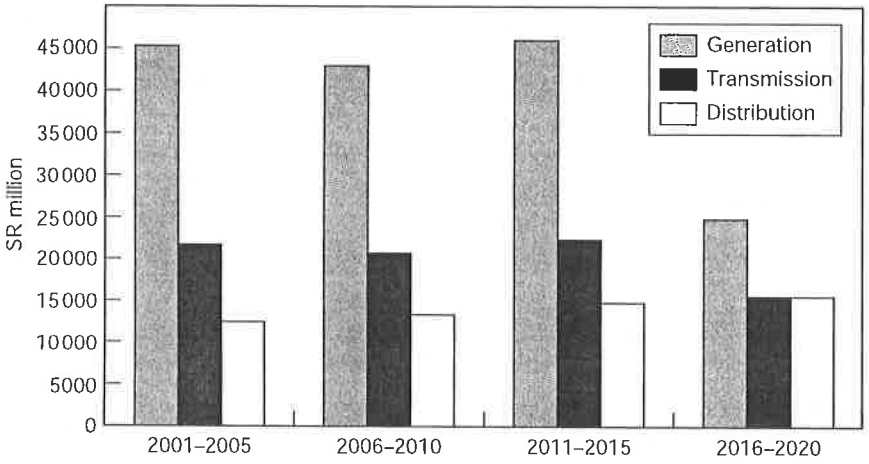

Figure 10.3 Investment requirements until 2020

Source: Long Term Electrification Plan, Electricity Corporation (1996).

costs. This would indicate a continuous need for installing additional generation units with high operation costs to meet the demand at its peak hour. Hence the shrinking of the large gap between off-peak and peak demand reduces the capital and operation costs significantly. This could be achieved through the implementation of efficient pricing which reflects the actual cost of production and utilising suitable demand-side management programmes (DSM). In addition, it is more economic to share generation reserves among the different interconnected regions. Table 10.2 reveals this potential by presenting the ratio of monthly peaks to the year peak for each of the five regions.

Although the peak load in Saudi Arabia usually occurs during the summer, there is a variation in terms of the peak times for the five regions. This would indicate the opportunity for cost savings as generation capacity in one region can function as a reserve for other regions. Table 10.2 demonstrates that the peaks for all regions do not occur in the same month and that for regions with the same peak month, the day of the month and even the time of day are different. These observations show the potential for utilising these regional differences and the urgent need to speed up the completion of the national transmission network. Thus this network and the expected interconnection with the other GCC countries are likely to produce financial benefits, including a reduction in capacity costs and higher system reliability, by meeting any unexpected increase in demand.

Types of consumption

The electricity industry provided its services to about three and a half million subscribers by the end of 1999, over 95 per cent of whom were in the areas

Table 10.2 The ratios of monthly peaks to the year peak for 1998

Months	*Northern*	*Western*	*Southern*	*Central*	*Eastern*	*Country*
Jan	0.86	0.55	0.81	0.59	0.66	0.65
Feb	0.74	0.56	0.85	0.52	0.62	0.62
Mar	0.67	0.69	0.93	0.52	0.61	0.66
Apr	0.61	0.88	0.97	0.73	0.76	0.84
May	0.78	0.9	0.95	0.85	0.85	0.89
Jun	0.93	0.92	1.00	1.00	0.96	0.96
Jul	0.91	0.91	0.94	0.87	0.92	0.93
Aug	1.00	0.96	0.96	0.93	1.00	0.99
Sep	0.99	1.00	0.95	0.94	0.98	1.00
Oct	0.81	0.96	0.96	0.86	0.9	0.94
Nov	0.53	0.76	0.87	0.51	0.7	0.7
Dec	0.64	0.66	0.76	0.5	0.63	0.64
Date	Aug-15	Sep-05	Jun-14	Jun-09	Aug-22	Sep-05
Time	n.a	4:00 pm	8:00 pm	3:00 pm	2:00 pm	4:00 pm

Source: Calculated from the MIE Report (1998).

supplied by the four SCECO companies. The following table shows the consumption types for the five regions of Saudi Arabia.

The type of consumers the company is serving affects its financial position through the impact on its revenues and its costs. Table 10.3 shows that, for the industry as a whole, more than 48 per cent of the consumption is by residential consumers and 24 per cent by industrial consumers, followed by the government at around 15 per cent. The situation varies between regions where SCECO-Eastern had the advantage of having 57 per cent of its electricity sold to large industrial consumers, which include ARAMCO, as well as SABIC with its large petrochemical companies. On the other hand, SCECO-Southern sold over 74 per cent of its electricity to residential consumers, but the disadvantage for this company is that it operates in the region with the lowest per capita income in the country. As the industry currently has only one nationwide distribution company, these variations not only conceal inefficiency differences but also could lead to cross-subsidisation between different types of consumers and different regions.

Fuel location

The location of any industry is determined by a combination of factors, but the most important among them is the proximity to consumption location (markets) and the availability of production inputs such as raw material including fuel. This is also true in the case of the Saudi Arabian electricity industry, where the fuel factor has a major influence on the location of generation. About 35 per cent of the industry's generation capacity is located in the eastern region, which contains the majority of the country's oil and gas fields as well as its petrochemical industries. Figure 10.4 shows the power generation usage of the different types of fuels by electricity companies situated in different regions of the country.

The availability of gas fields in the eastern region enables SCECO-Eastern to have 98 per cent of the fuel used in its plants coming from natural gas. Despite this company's high usage of gas, the industry as whole is still dominated by

Table 10.3 Electricity sold by type of consumption, %

Type	*Eastern*	*Central*	*Southern*	*Western*	*Northern*	*Total*
Residential	24.17	56.82	74.34	63.8	66.54	48.26
Commercial	5.74	9.12	7.67	12.36	10.62	8.7
Industrial	56.66	6.59	1.3	6.12	1.15	24.2
Agricultural	0.67	4.97	0.61	0.18	5.75	1.8
Government	11.94	19.05	13.03	14.48	13.23	14.6
Hospitals	0.54	2.2	2.12	1.15	1.64	1.25
Charties	0.28	1.25	0.92	1.91	1.6	1.6
Total	100	100	100	100	100	100

Source: Ministry of Industry and Electricity (1999).

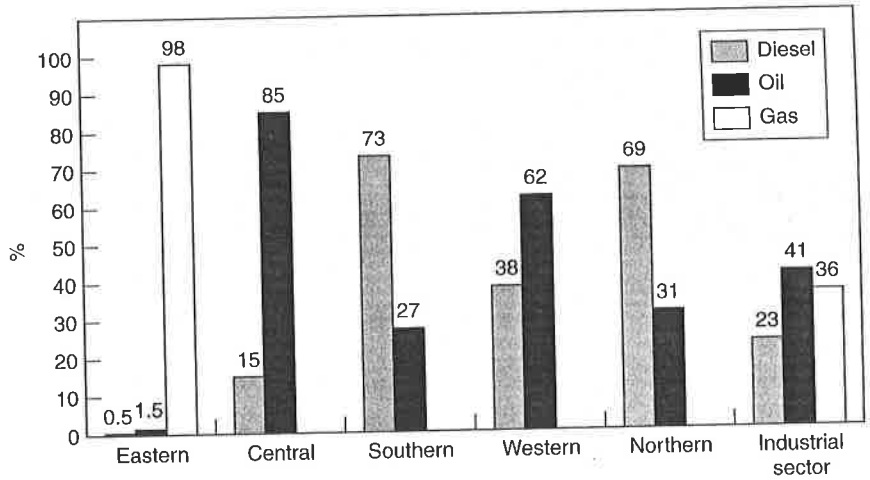

Figure 10.4 Relative usage of fuel types by each region

Source: Ministry of Industry and Electricity (1999)

crude oil and diesel. Most of the fuel usage in the central and western regions is of crude oil, while the bulk of the fuel usage in the southern and northern companies is of diesel. The difference in fuel usage could be explained in part by the transportation costs of these different types of fuel and the lack of a nationwide natural gas network. However, as the industry switches to natural gas in power generation and the national gas network is completed, the cost advantage of transmitting electricity relative to transporting gas may encourage more electricity producers to locate in the eastern region.

Financial features

Tariff structure

The prices for electricity consumption are set officially and uniform across the country. Although they distinguish between consumers based on their type and the level of their monthly consumption, the time of use is completely ignored. Table 10.4 shows the tariff structure for residential customers (commercial and government offices are also charged under the same structure) since 1995, which also includes the revised tariffs in 2000 as part of the restructuring plan.

The tariffs as presented in Table 10.4 could be described as inverted block tariffs. Under such tariffs the consumer is charged one price for consumption up to a certain number of kilowatt-hours per month and then charged a higher one for any additional consumption. These tariffs clearly exempt from the increase in tariffs groups of customers with any consumption below 5,000 kWh. These groups account for 75 per cent of total residential consumption or 93 per cent of consumers. This exemption reflects the attempt to protect lower and middle-

Table 10.4 Tariff structure for residential monthly consumption

Consumption Blocks, kWh	*1995-Apr-00 Halalah*	*Apr-00 Halalah*	*Increase %*	*Oct-00 Halalah*	*Decrease %*
1–500	5	5	0	5	0
501–1000	5	5	0	5	0
1001–2000	5	5	0	5	0
2001–3000	*10	10	0	10	0
3001–4000	*10	10	0	10	0
4001–5000	*13	13	0	12	7.7
5001–6000	*13	18	38.5	12	33
6001–7000	*20	23	15	15	35
7001–8000	*20	28	40	20	29
8001–9000	*20	32	60	22	31
9001–10000	*20	36	80	24	33
10001+	*20	38	90	26	32

Source: Ministry of Industry and Electricity (1999).

Note: * Includes the additional 5 Halalahs that go to the 'Halalah Fund'. 1SR = 100 Halalah.

income families. However, it remains to be seen whether revenues generated from the increase in prices for the highest 25 per cent of consumption will be sufficient. This depends on the price-sensitivity of the demand by high consumption groups as well as the efficiency in payment collection.

The table shows that the revised tariffs in April 2000 and October 2000 have nine and eight sets of prices respectively, in contrast to the previous structure with only four sets. Train[46] demonstrated that increasing the number of blocks led to welfare gains as prices reflected costs more and diminished the chance of creating what are known as 'collection points'. The collection points exist when the different consumers with different levels of consumption are paying the same price. So the existence of such points depends mainly on the size of each block, which means that the revised structure reduces these collection points for consumption levels above 5,000 kWh. Since the transaction costs associated with having a larger number of blocks are expected to be very small, it is economically justifiable to have a greater number of blocks even for consumption below 5,001 kWh.

It is worth noting that the table shows that the electricity prices were revised twice within six months in 2000. The first revision was in April as part of the new reform plan of the electricity industry, which aimed at improving the creditworthiness of SEC. The second revision came in October of the same year, as response to the complaints raised by consumers, many of whom were large commercial consumers. It seems that the timing of the April revision was inappropriate as it became effective during the summer and consumers were ill-prepared to adjust their consumption patterns to the price increase. This unexpected change may have pleased many consumers, but it increased uncertainty for potential private investors in electricity.[47] The uncertainty could

have been minimised if the industry's regulator had been established at that time, which would have given the concerned investors some insight into the economic basis for the price reduction.

Although it is reasonable to expect that low production costs combined with competition will result in low electricity prices for consumers, it is informative to view current prices within their historical perspective. Figure 10.5 shows that the current tariff structure sets prices at a low level, both in nominal and real terms. This is especially true in comparison with the price level prior to 1971, when the industry was not subsidised and was operated by profit-making private companies.

It might be expected that the electricity price would be low in Saudi Arabia due to lower fuel costs, but setting prices below production costs has increased unnecessary electricity consumption and reduced the companies' ability to have an adequate internal stream of revenues. Figure 10.5 demonstrates the changes in electricity prices for industrial and non-industrial (including residential) consumers over the past three decades. It is worth pointing out that industrial prices are expected to be lower than those for non-industrial consumers. The reason is that the costs for the system to supply one kilowatt to large consumers are much lower than that for supplying the same amount to residential consumers, due to the difference in their voltages.

The reduction in prices since 1974 has been complemented by government subsidies to cover the difference between the costs and revenues of the companies. The shareholders of these companies continue to receive from the government a guaranteed annual dividend of 7 per cent for each share despite the fact that the companies incur losses. This policy is intended to keep private investors interested in the industry and hence provide indirect subsidies to the companies. The direct subsidies were also intended to help the companies offset increases in fuel costs. However, the decline in oil and fuel prices during the 1980s was not reflected in a reduction in subsidies. This may indicate a continuation of the public policy of supporting this industry during the period of

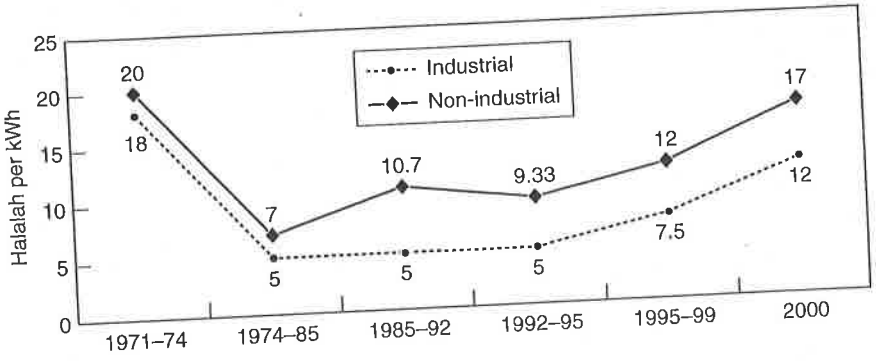

Figure 10.5 Development of electricity prices (1971–2000)

Source: Electricity Corporation (1996) and Ministry of Industry and Electricity (2000).

economic transformation. Nevertheless it is reasonable to assume that this well-intentioned policy has made electricity producers and consumers more dependent on these subsidies, which might result in inefficient decisions.

Financial losses

The lack of interest on the part of private investors in the electricity industry had been directly linked to its weak financial performance, due mainly to uneconomic prices. This performance had a negative impact on the ability of the electricity companies to expand their operations and on their ability to borrow. Table 10.5 shows the financial position of SCECOs for the last five years prior to their merger in SEC in 2000.

Table 10.5 shows that the four companies collectively had about 3.7 billion riyals in net losses at the end of 1999, which caused their accumulated debt since 1995 to reach 15.8 billion riyals. Some financial and organisational factors may have contributed to this negative outcome, but the most frequently cited factor is the tariff structure itself. Table 10.6 shows that a limited adjustment to the tariff structure could help significantly with the reduction, if not elimination, of these losses.

Table 10.6 also reveals that the average revenue per kWh for the SCECO companies is in line with the industry average of 7.1 halalahs. This can be explained by the fact that all these companies were selling their energy under the same tariff structure. The situation is very different on the cost side, which

Table 10.5 Financial losses of SCECOs (in billion SR)

Exhibit	*1995*	*1996*	*1997*	*1998*	*1999*	*Total*
Total Revenues	6.5	6.7	7.2	7.3	7.9	35.6
Total Expenses	9.5	9.7	10.1	10.6	11.6	51.5
Net Results	–2.96	–3.02	–2.89	–3.24	–3.69	–15.8
%	–31.3	–31	–28.7	–30.7	–31.8	–30.7

Source: SCECOs annual reports (1995–1999).

Table 10.6 Revenue, cost and loss per kWh sold by SCECOs in 1998 (in Halalahs)

SCECO Companies	*Revenue*	*Cost*	*Loss*
Central	7.88	11.5	–3.62
Eastern	7.2	8.8	–1.6
Southern	6.3	20.8	–14.5
Western	7.17	11.9	–4.73
Average	7.1	13.3	–6.2
Average (Excluding Southern)	7.42	10.73	–3.32

Source: Companies' Annual Reports (1998).

reflects the variation in the cost structures of these companies. The lowest average cost is for SCECO-Eastern which benefits from its location in a fuel-abundant region, as well as having the advantage that most of its output is sold to bulk industrial consumers. On the other hand, SCECO-Southern has very large residential consumers and is located in a region with very difficult geographical conditions, which places limits on its ability to generate enough revenues and/or cut costs. In general, an improvement in the industry's financial performance would result if the proposed reform and new tariffs were combined with reductions in generation costs, which account for about 60 per cent of the industry's costs.

Financing sources

Government support to the electricity industry in the past came through direct funding from the Electricity Corporation (EC) and interest-free loans provided by the Saudi Industry Development Fund (SIDF). This support, in addition to subsidies, has enabled the industry to meet its obligations but has also made the electric companies lack the incentives to be profitable. Azzam pointed out that the 'Halalah Fund', introduced in 1995, was very useful in attracting contractors to finance fund-backed projects.[48] The commercial banks' involvement clearly increased during the 1990s, which indicates the potential for further debt financing from domestic and international banks when the right schemes are used.

The innovative methods such as Build-Own-Operate (BOO), Build-Operate-Transfer (BOT) and Build-Own-Operate-Transfer (BOOT) are new concepts for the country. The first indication of interest in this method was in 1997, when SCECO-Western invited bids to build the Shoaiba power plant. According to Khoshaim,[49] two international groups were commissioned to study the feasibility of the BOOT scheme. By 1998 it became apparent that the scheme would not materialise given the existing tariff structure and the restrictive foreign investment laws, which needed to be liberalised to minimise the project risk. Nevertheless, this case should not be used to make a sweeping judgement on the potential of these schemes. The timing coincided with the merger of the SCECOs, as this long-term contract was expected to be arranged by the new company. Furthermore since then the government had approved many measures to improve the investment climate, likely to prove helpful for such risky projects. These changes mean that various forms of equity and debt-financing will remain relevant for the future. Internal cash flows also may benefit from revising the tariffs, but they will remain insufficient. Sufficient cash flows do not exclude the need for funding diversification, which is necessary for reducing the financing costs.

Policy issues and recommendations

The literature regarding the economic and institutional transformation of the electricity industry in the last two decades, and international experiences of

restructuring provide ample lessons for the Saudi Arabian electricity industry. Hence, there follows a list of useful policy issues and recommendations that have arisen from this chapter.

1) The consistency and continuity of the industry reforms are necessary ingredients of a suitable climate for private investors, as well as for the long-term success of the reform itself. More importantly, the industry restructuring does not take place in isolation from other reforms taking place in the Saudi Arabian economy. Thus establishing a successful competitive market for electricity is very much dependent on the presence of a developed financial market and regulatory system.
2) The international experiences of introducing market forces to the electricity industry indicate that this process is very difficult, but the setbacks are not sufficient reasons to halt it. The temptation for developing countries, including Saudi Arabia, is that the less risky single-buyer structure, which is designed to be temporary and transitional, may become permanent. Consequently, the industry may face similar problems to those that the reform is actually intended to correct, such as inefficient pricing and investment decisions that lack transparency.
3) Although there is no shortage of domestic private wealth, foreign investment would bring to the Saudi electricity industry not only finance but also know-how, managerial skills and expertise. This investment initially comes in the form of international private placements (IPP) and variants of BOOT power projects, which have the advantage of raising cheaper sources of finance than those arranged by the government or even local commercial banks. However, these schemes are associated with high prices, due mainly to their sensitivity to the foreign exchange risk and to the uncertainty about rules for setting electricity tariffs.
4) Privatisation with no credible competition may lead to higher electricity prices, which not only hinder the objective of industrialisation but also have a negative distributional effect. Hence, the reform of the industry should result in lower, but cost-based, prices through competition and choice in as many parts of the industry as possible. Saudi Arabia is in a fortunate position in that its thermal system could reduce the complexity associated with the electricity spot market. The current switch to natural gas as fuel could help the move to a competitive market for power generation. This replacement not only reduces production costs considerably but also increases pressure on competing generators to be more efficient as their production costs become very similar.
5) Restructuring of the electricity industry requires effective regulation, as there are strong incentives for rent-seeking behaviour and monopolistic power within this industry. Also, the opportunity that will be given to large consumers to choose their suppliers should be extended as soon as possible to small consumers, who as captive consumers may end up subsidising those large ones. As the move towards competition may take longer than initially anticipated, the immediate task of regulation should be dealing with the monoposony (i.e. a single-buyer company) facing generators and the distribution monopoly facing consumers.
6) An important lesson that Saudi Arabia can learn from international experiences is that not only should the market rules be predictable and transparent, but more importantly they should be announced in advance of the electricity market becoming operational. This is necessary to limit the potential sources of dispute, as changing the rules in the middle of the process would create objections and could even impede the creation of the market itself.
7) Having a single nationwide distribution company makes it socially unacceptable to have residential electricity consumers paying regionally differentiated prices. As the restructuring plan envisages that the industry will include regional private distribution companies, spatial differences can feed into retail prices. However, ignoring these differences would lead to overconsumption in some remote regions and underconsumption in others. Similarly, electricity consumption should be in line with production costs, which vary throughout the hours of the day and throughout the year. Consequently, neglecting consumers' responses to real-time prices, or at least time-of-use prices, would create an incomplete electricity market as well as resulting in inefficient decisions.
8) The electricity industry is a capital-intensive enterprise requiring highly skilled labour. Hence, while privatisation may improve labour productivity it may also have a negative impact on the employment of Saudi Arabian nationals. This would create a potential for a conflict between the objectives of Saudi-isation and privatisation. An incremental approach to the hiring and firing of employees – especially during the initial years of the process – and well-designed training programmes, would minimise this impact.
9) Saudi Arabia can benefit from the GCC interconnection on three fronts. First, additional sources of cheap generation could put pressure on the Saudi electricity industry to improve its performance. Second, the large market size for electricity would justify the transaction costs caused by the introduction of a wholesale spot market. Third, trading in an electricity spot market requires the use of a variety of financial instruments. Thus the establishment of a pool for GCC power would open the way for the participants in the Saudi electricity industry to have access to the more liberal financial markets, such as that of Bahrain.

Conclusion

The last twenty years have witnessed a clear turning point in the history of the electricity industry, due mainly to tremendous technical and economic changes taking place in power generation. Interestingly, these changes have coincided with a worldwide shift away from the direct involvement of the public sector in this industry and with the increasing popularity of economic policies involving

privatisation and liberalisation. However, the reform of the industry and the introduction of competition remain challenging tasks and involve overcoming many complexities and problems. The Saudi Arabian electricity industry can learn from the experiences of other countries, which shows that its restructuring can be carried out neither in haste nor in isolation from economic and social factors. Thus the adoption of a gradualist approach is a wise policy to follow, but it is equally important that prudence should not slip into excessive caution; otherwise the status quo will prevail and the long-term objectives of the reform may not materialise.