INTERNATIONAL ENERGY AGENCY

ENERGY MARKET REFORM

ELECTRICITY REFORM

Power Generation Costs and Investment

OECD
OCDE

1974 · 1999

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The International Energy Agency (IEA) is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme.

It carries out a comprehensive programme of energy co-operation among twenty four* of the OECD's twenty nine Member countries.
The basic aims of the IEA are:

■ To maintain and improve systems for coping with oil supply disruptions;

■ To promote rational energy policies in a global context through co-operative relations with non-Member countries, industry and international organisations;

■ To operate a permanent information system on the international oil market;

■ To improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;

■ To assist in the integration of environmental and energy policies.

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Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

■ To achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;

■ To contribute to sound economic expansion in Member as well as non-Member countries in the process of economic development; and

■ To contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996) and the Republic of Korea (12th December 1996). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

FOREWORD

Electricity markets within the OECD and around the world are being rapidly reformed. After decades of structural immobility in electricity supply, governments are allowing market forces to play an increasing role in the operation of supply systems and the allocation of investment in new generating capacity. Most OECD Member countries have already introduced competition into their electricity systems or plan to do so soon. The main goal of these changes is to improve the economic performance of electricity supply, but other goals such as security of supply and environmental protection remain very important.

The prospect of lower electricity prices is a key motivation for reform. The first part of this booklet examines how electricity reform is expected to reduce generation costs. It confirms the scope for cost improvements, although it is the market which ultimately will determine their extent.

The second part considers how investment in the power sector will be affected by market liberalisation. Some observers fear that the additional uncertainties to which the transition gives rise will result in inadequate investment in new generation capacity or an inappropriate plant mix. Our analysis suggests that these issues will not deter investment, provided reform is well designed in the first place and effective regulation is put in place. Other markets, including other energy markets, have proved capable of sustaining adequate investments. A residual responsibility rests on governments, however, to monitor market developments and maintain an adequate regulatory framework. Governments must ensure that adequate incentives are in place to attract new investment well before capacity shortages appear. In the end, experience will demonstrate how well electricity reform measures up to expectations, but our analysis provides good grounds for confidence.

The principal authors of this report are John Paffenbarger (costs), Gudrun Lammers (investment), and Carlos Ocaña (investment). The Appendix on Energy Investment was prepared jointly by the Energy Charter Secretariat and the IEA for the G8 Energy Ministerial in Moscow in 1998.

This book is published under my authority as Executive Director of the International Energy Agency.

Robert Priddle
Executive Director

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EXECUTIVE SUMMARY

Governments throughout the OECD are restructuring their electricity supply industries to reduce the direct role of the state and to introduce competition. Key objectives of these changes are to increase the economic efficiency of electricity supply and to obtain lower prices for electricity consumers. Maintaining security thanks to timely and adequate investment in new generation capacity with an adequate plant mix remains an important objective as well. This booklet confirms that market liberalisation is likely to lead to reduced generation costs, while preserving security of supply in terms of system reliability and adequacy of investment.

Impact of Market Liberalisation on Generation Costs

Although the introduction of competition in electricity supply is relatively new, preliminary results from those countries implementing reforms show that there is pressure to reduce investment and operating costs. One effect of market liberalisation is to expose the cost of meeting public policy objectives. Examples are the cost of supporting uneconomic domestic coal mining, or supporting domestic equipment suppliers. Market liberalisation requires governments to shift such expenses from within the internal accounts of power generation companies to explicit, publicly accessible accounts. Generation costs should decrease as the cost of meeting policy objectives is allocated to other accounts.

In a competitive electricity market electric utilities cannot automatically pass costs through to all consumers, since revenues are determined by market success and not by regulatory formulae. This has the effect of increasing uncertainty and risks borne by investors in the electric supply industry and increasing the cost of equity and debt finance. On the other hand, utility business risks can decrease as a result of a reduction in certain regulatory risks and a better allocation of risks to parties able to take action to mitigate them.

There can be, therefore, opposing influences on the cost of capital (and total finance costs) as electricity markets are liberalised. In the general case, it can be expected that the cost of capital for new generation capacity will increase as it approaches its "normal" market level reflecting the cost of capital in other, similar industries. Regardless of the direction of variation, investment choices should better reflect the full costs of alternatives.

Investments costs will decrease in liberalised markets through a greater emphasis on economic designs, improved use of generating capacity, repowering, and competitive procurement. There are new incentives to avoid over-building and over-designing power plants. Operations and maintenance costs will decrease due to greater labour productivity and operating productivity. These results were some of the first observed in electricity markets that have been liberalised to date. Fuel costs should also decrease due to improved fuel management, better use of fuel supply contracts and markets, and a reduction in the consumption of high-cost, domestic fuels.

In summary, market liberalisation is likely to focus attention on the costs of generation and provide strong incentives for generators to reduce their costs. For publicly owned utilities, a key factor in improving cost performance is the greater transparency in implementing public policy measures brought about by corporatisation or privatisation. For utilities with supply monopolies, the loss of captive customers and price competition are the essential drivers. Markets, rather more than governments, will allocate costs between customers and utility investors, providing generators with new motivation for efficient operation.

Investment in Generation Capacity in Competitive Electricity Markets

Adequate, timely and appropriate investment is essential to ensure security of electricity supply. The analysis concludes that investment in electricity generating capacity can be undertaken effectively in the context of liberalised electricity markets. Provided that effective competitive markets are established, which includes empowering end-users of electricity with choice, more efficient investment can be expected and long-term system reliability can be sustained.

■ Determinants of Investment

Before the onset of competition, investment decisions were generally taken by the state or other public authorities, directly or indirectly, taking account of the whole power generation system. Whilst this approach was intended to minimise total system cost, high reliability levels and over-optimistic demand forecasts resulted in large amounts of excess capacity in some countries. This was partly due to unexpected economic circumstances, including a slowdown in the rate of economic growth. However, it was also a result of planning incentives which biased investment decisions toward over-investment.

In competitive markets, investment decisions are largely determined by current and expected prices. Many prices influence investment decisions in generation assets. To understand how investment decisions will be made under competition it is useful to consider the impact of three sets of prices that are likely to be the main determinants of investment decisions. These are the price of electricity, the cost (or price) of capital, and the price of input fuels. Prices, in turn, depend on supply and demand factors like the willingness of users to pay for electricity and security of supply, or electricity demand growth. At an economy-wide level, prices fluctuate with the business cycle.

■ Prices in Oligopolistic Electricity Markets

So far, the evidence is that significant market concentration is a feature of most OECD countries' electricity supply industries, at least in the early stages of the market reform. This "oligopolistic" market structure generally has the effect of maintaining prices at a relatively high level, which allows firms to earn above-market profits. This, in turn, encourages investment.

■ Minimising Risk in Electricity Investments

Increased business risk in competitive electricity markets would, in theory, tend to reduce total investment in electricity generation.

In practice, this effect can be expected to be small and can be generally compensated by other factors. Greater risks are matched by greater potential rewards, notably higher profit margins. Furthermore, various financial techniques available in competitive markets allow companies to reduce their investment risks. Indeed, evidence suggests that investment in merchant plants is accelerating in markets open to competition; it could be expected that an explicit valuation of security would further increase the attractiveness of merchant plants.

■ Input Fuel Prices and Diversity

The relative prices of input fuels also play a critical role in shaping investment decisions and are among the main determinants in the choice of fuels. In the past, there have been significant fluctuations in fuel prices which have resulted in large shifts in investment from one input fuel to another. Most recently this has been mostly in favour of gas, helped by technology developments in combined-cycle gas turbines. The overall result of past investment patterns is a higher (although unintended) degree of input fuel diversity. The same pattern may continue under competition as relative prices continue to change over time. Currently, in many regions of the world, gas-fired generation is the most economical option. As a result, the share of gas-fired electricity generation is growing at the expense of oil and coal, resulting in more diversity.

■ Dynamics: the Impact of the Business Cycle on Investment

An often debated issue is the impact of the business cycle on investment. Electricity prices may be expected to follow a cyclical variation along the business cycle reflecting the relative scarcity of generation capacity relative to electricity demand. The question is how will investment react to the variability of electricity prices. If investors are too concerned with short-term price levels, or "myopic," then investment could well go through pronounced cycles. If, more plausibly, the expectations of investors are rational, then investment cycles may be less pronounced or even negligible. Appropriate incentives, such as financial penalties in case of non-delivery, could reinforce this. In any case, this is an empirical issue that can only be resolved after some years of experience. During this transition period, it will be up to the governments to monitor the situation and to intervene if they judge it to be necessary.

More importantly, there are factors that can mitigate any investment lags. These factors include new technology which shortens construction times, the options to re-power existing plants, and the "demand smoothing" potential of peak-load pricing.

■ Reserve Generating Capacity and Capacity Payments

Some governments have been concerned that reserve capacity may be at risk in a more competitive market and that ad hoc mechanisms, such as capacity payments, might be needed to ensure an adequate reserve capacity. The principal argument against the need for such mechanisms is that prices in a competitive market should reflect the value to the buyer of reserve capacity, as well as any other component of security. In particular, contracts between providers and buyers of electricity should include the characteristics of the security of supply to be provided and the penalties for failing to deliver. This suggests that there are natural market mechanisms that can provide sufficient incentives to invest in reserve capacity. Such market mechanisms may either be set up by the regulators or by the market players themselves.

If, despite this, there is concern about future reserve capacity, or if policy makers want an explicit market for capacity, there are a number of policy tools available, including capacity payments. However, at least for as long as some generators enjoy market power, capacity payments carry some disadvantages and may result in significant market distortions.

■ Transition Issues: Regulatory Risk

The transition from regulated to open electricity markets often involves significant uncertainties. The end point of reform is not always clearly defined and reform often proceeds gradually. In addition, the implicit regulations that often pervade the old arrangements have to be made explicit in a process that takes time to complete. As a result, there may be considerable regulatory risk in the transition to competitive electricity markets. Regulatory risk, like other risks, may discourage investment. Although this effect is transitory, it may be significant, especially where additional investment is needed at the time of opening the market to competition. Governments have a key role in minimising regulatory risk. A credible and clearly defined regulatory framework for electricity markets is essential to facilitate investment.

The Role of Governments

In the short to medium term, changes in security of supply conditions (investment, input fuel diversity) can be expected to evolve slowly. Power markets are unlikely to become fiercely competitive in the near future. Many countries have opted for gradual liberalisation. Nevertheless, governments still have an important role in this new environment to mitigate potential problems. Governments should:

- Ensure as far as possible that an effective market, including competition in generation and end user choice is established. Address market entry barriers to generation.
- Monitor the market structure and possible anti-competitive behaviour of market participants to sustain effective entry into the market and effective consumer choice.

- Establish well-funded, well-staffed and competent regulators and anti-trust enforcement agencies to prevent the emergence of barriers to new generation entry.

- Monitor system reliability and investment in generation. However, unless the monitoring indicates real problems, governments should refrain from interfering. The monitoring needs to be adapted to the size of the market. In some cases, it might have to be done at international level, in others at national or subnational level.

- Monitor input fuel diversity and estimate the extent to which security of supply is ensured by the market. If remedial action is needed, measures at economy-wide or energy market level are potentially more effective. Measures restricted to the electricity market are a second-best solution because they ignore alternative fuel uses. If they are the only feasible solution, they should be market-based.

- Create a favourable investment climate by providing a credible and clear regulatory framework and streamlining the administrative process for construction permits as far as possible without jeopardising other important regulatory concerns (e.g., compliance with safety and environmental regulations). Many OECD countries have cumbersome procedures that considerably lengthen lead times.

Global Energy Investments

Ensuring adequate investments in electricity supply is part of the larger issue of ensuring adequate energy investments in general. This larger question was considered by energy ministers of the G8 countries[1] at their meeting in Moscow of 1 April 1998. A paper written jointly by the IEA and the Energy Charter Secretariat for this meeting is given in an appendix to this booklet.

1. Canada, Germany, France, Italy, Japan, Russia, the United Kingdom, the United States.

The ability of countries to mobilise enough capital for their energy investment needs depends on the quality of their investment, fiscal and regulatory policies. This in turn crucially affects the rate of economic growth and living standards in those countries.

One of the most important considerations for potential investors is a country's political and economic stability. Companies also evaluate other market, financial and legal risks. The main areas are market access, including market structure, discrimination and bureaucracy and market operation, including the legal framework, the financial environment and market conditions.

Companies want assurance that they can obtain authorisations needed for new investments. Procedures must be based on clear and consistent criteria and should minimise bureaucratic complexities and delays. Foreign investors will be particularly deterred if there is discrimination on nationality grounds. Companies will want to be sure that they can, if necessary, protect their investments by recourse to law, including whenever necessary access to international arbitration.

Traditionally, in many countries, the scope for private sector activity in the energy field has been limited by the involvement of government and State enterprises. There is now widespread recognition that liberalisation, including privatisations and reduction of monopolies, improves the economic efficiency of energy markets. Governments need to ensure fair competition, including control of monopoly behaviour, and avoid distortions in energy prices.

In countries where appropriate legal and/or fiscal regimes are still being developed or have not long been in place, governments need to take positive action to create investor confidence through strong and stable legal guarantees. Features of the national environment that are important to companies investing in the energy sector are a stable and effective legal environment, a pattern of legal and fiscal stability, proper taxation rules, and secure access on fair terms to trade and to energy transport systems, such as electricity grids.

IMPACTS OF ELECTRICITY MARKET LIBERALISATION ON GENERATION COSTS

Introduction

This chapter describes how liberalisation of electricity markets is likely to affect the costs of electricity generation. Market liberalisation refers to the world-wide trend which aims to improve the economic efficiency of electricity supply industries by introducing elements of competition and moving toward market-based pricing. It shifts decision-making from government entities to the market. A basic objective of market liberalisation is to reduce prices paid by consumers for electricity. Where prices do not reflect the full costs incurred in supplying electricity, as is the case in some developing countries, market liberalisation aims to bring prices up to fully cover expenses. Related key objectives of market liberalisation may be to reduce government funding of state-owned utilities and to improve the international competitive position of domestic industries (and utilities).

Market liberalisation affects not only price levels, but the underlying cost structure. It generally provides incentives for a more efficient cost structure and will affect profit margins on costs of supply, costs of transmission and distribution, and costs of generation. Generation cost is the focus of this chapter.

Today there are few quantitative results on the cost effects of electricity market liberalisation because the movement to liberalised markets is a relatively recent phenomenon. Within the OECD, about three quarters of countries now have national or state-level competitive generation markets covering at least a portion of total electricity demand. In the remaining OECD countries without competitive electricity markets, non-utility generators are allowed to sell electricity to the monopoly utility or directly to large consumers. Most countries began the process of liberalisation in the 1990s, although the US legislation dates from 1978. The European Union Directive on electricity market liberalisation was agreed only in 1996. Therefore, the reasoning presented in this chapter rests primarily on economic expectations, but has not yet had the time to be tested or observed widely in national markets. Some observations of cost trends in markets that have been liberalised are given below.

Market Liberalisation

The term "market liberalisation" covers a number of related reforms to electricity supply industries which are not necessarily all pursued at the same time. They are:

- corporatisation – placing state-owned utilities into commercially structured and commercially oriented companies;
- privatisation – transfer of assets of the electricity industry from state to privately owned organisations;
- deregulation – reducing direct state control or oversight of various aspects of industry operations;
- introduction of competition – allowing more than one electricity supplier to compete for customers in a given market.

Transmission and distribution of electricity are commonly considered today as monopoly system elements not subject to competition. Introducing competition in generation has therefore been the focus of many reform efforts to date. The marketing of electricity to end-users is also potentially a competitive component of the electricity supply industry.

The approach to market liberalisation in each market depends intimately on the starting point of the industry. This is defined by ownership, horizontal and vertical structure of sub-sectors, and existing regulation of the industry. State ownership of the industry is common. Beyond this generality there is an enormous variation in different electricity systems. In some countries there are many privately owned electricity generators and/or suppliers, while in others there is one dominant utility, owned by the state in nearly all cases. Regulation ranges from no formal control whatsoever, as is common in systems with large, state-owned utility companies, to independent, adversarial regulation as in the United Kingdom or the United States.

The type of reforms pursued to liberalise electricity markets have different effects and provide different incentives to electricity generators to change their economic behaviour. Clearly, however, a primary focus is to reduce power generation costs ($/MWh). Corporatised state-owned utilities may reduce costs as more transparent accounting procedures reveal any existing sub-optimal or politically constrained spending patterns. Privatised utilities may reduce costs in order to increase profits for their new owners. Generators in newly competitive markets will try to reduce costs in order to compete effectively. In all cases, market liberalisation is expected to:

- increase efforts to reduce expenditure on generation and maximise returns to plant owners;
- re-orient decision-making to incorporate private rather than public economics;
- lead to more transparent and effective pricing to better reflect costs.

The potential for cost reduction varies by country and utility. Some systems are relatively efficient already, while others have large scope for cost improvements. There are wide variations in cost structure among utilities. For example, the average accounting value of thermal and nuclear plant capital costs vary by factors of 4.5 and 4.8 among UNIPEDE member countries (Olarreaga, 1993: p. 8). Among OECD Member countries, system losses vary from 2% to over 15%, and nationally averaged efficiencies of thermal power plants vary by over 10 percentage points (IEA, 1997). Not all such system cost and performance variations are due to uncontrollable, local factors such as accounting conventions, plant mix, or plant ages. Some are attributable to real variations in the efficiency of use of factor inputs. One study of US utilities suggests that efficiency of operation accounts for 60% of the variations in average system prices (Haeri, 1997).

Short-term actions taken in response to market liberalisation differ from actions possible in the long term. In the short term, the capital stock is not changeable, so generators tend to focus on reducing operations and maintenance expense, improving asset management, and improving capital (financial) management. In the long term, new investments and new technology will be sought to provide a new generation plant mix having lower total cost.

Transparency of Public Policy Objectives and Costs

One effect of many approaches to market liberalisation is to expose the cost of meeting public policy objectives. In non-competitive environments, governments have had a number of mechanisms at their disposal to accomplish public policy objectives without incurring any identifiable public or private expense. This was achieved by assigning responsibility for executing policies to utilities, which bore the costs through state ownership, regulation, or in a "co-operative spirit." The expenses could be passed on quietly and diffusely to ratepayers. In the case of state-owned utilities, the costs could be recouped by reducing contributions to government treasuries (low or no dividends) or by obtaining larger yearly operating funds from the government. Regardless of ownership, the mechanisms have often not been transparent.

Examples of public policy objectives implemented by governments via electric utility companies are given in Table 1.

All of the mechanisms noted in Table 1 can result in the selection of generating capacity on non-economic criteria. The cost of using more expensive generation options may thus not be discernible within the cost of the overall generating mix.

Table 1

Examples of Public Policy Objectives Implemented by Utilities

Policy Objective	Mechanism via Requirements on Utilities
Support domestic coal mining	■ domestic coal purchase agreements ■ utility ownership of un-economic coal mines
Promote energy security	■ selection of particular fuel sources for power generation ■ prohibition on specific fuels
Support domestic equipment suppliers	■ use of non-competitive procurement procedures ■ selection of non-commercial generation technology
Support employment	■ over-use of labour by state-owned utilities
Reduce pollutant emissions	■ selection of specific environmental control technologies (not necessarily needed to meet environmental regulations) ■ selection of particular generation technologies
Promote renewable energy	■ selection of renewable technologies ■ required purchase of power produced using specific renewable sources ■ favourable pricing for purchases of electricity produced using renewables

Note: Example mechanisms are actions utilities may be required or encouraged to take even in the absence of specific regulation or legislation.

In markets where generation becomes open to competition, individual decisions on generating capacity will no longer take into account non-economic requirements unless they are made explicit by regulation and all potential competitors are subject to them. Instead, individual plant developers will aim to provide electricity at the lowest possible cost by minimising cost of fuel, equipment, and labour within the set of environmental regulations applicable to all competitors (note parallel with examples in Table 1). Any potential generator required to fulfil certain objectives from which others are exempt can justify a claim of discriminatory treatment and will call attention to the effects of the policy requirements. Policy costs previously borne by the generation sector in non-competitive systems will thus be made transparent with the arrival of competition.

State-owned companies are apt to benefit from special financial advantages which help them to fulfil a policy role. For example, they may pay no income taxes, may have access to less expensive debt through government bond markets, or may have access to certain government services at no cost. Corporatisation or privatisation of state-owned electric utilities, even without introducing competition, may expose some of these off-book financial benefits. This in itself is a major impact of privatisation.

Although the advent of competition can expose the cost of public policies administered through electric utilities, many of the policy goals remain valid. Long-standing policy objectives, such as security of supply, environmental protection, and social objectives, must be explicitly considered in new arrangements for the electricity sector (IEA, 1999; Tonn, 1995).

Allocation of Risks

Market liberalisation has the effect of increasing risks borne by investors in the electric supply industry and decreasing price risk to consumers. In the non-competitive model, many mis-calculations of future costs can be passed on to electricity consumers in higher prices. In state-owned systems, the state can choose to accept lower returns from its utilities or provide direct financial support in order to compensate for mis-calculations. In contrast, it is the investors in electricity utility companies who bear more of the overall business risk in liberalised markets. Electricity generation becomes more like any other business, where consumers reward companies that are well managed and avoid companies that err.

Examples of the types of risks faced in generating electricity are given in Table 2. These risks exist regardless of the regulation and organisation of the industry. What varies is the actions utilities take to protect against these risks, and who ultimately bears the cost of these risks should they materialise.

Table 2

Typical Risks Faced by Electricity Generators

Type of Risk	**Outcome Compared to Expectation**
Construction	
cost overruns	■ construction costs more
schedule delays	■ long construction time; purchased replacement power may be needed to meet shortfall
technology	■ poor plant performance, especially when using new technology ■ low plant efficiency; low plant availability
financial	■ high plant financing costs
Operating	
market	■ low electricity sales, leading to excess capacity ■ major customers find alternate supplies ■ low electricity sales price
operations and maint.	■ high labour or material costs
fuel	■ high fuel price ■ inadequate fuel quantities
financial	■ returns are lower than expected ■ capital is poorly structured
Policy	
regulatory	■ regulations result in higher costs ■ administrative procedures cause delays ■ tax burden increases
environmental	■ environmental laws become stricter ■ environment assessment criteria change
siting	■ land purchased for a plant becomes ineligible

Since expenses reasonably incurred could be passed on to consumers or borne by state owners, the tendency in traditional electricity markets has been for utilities to avoid risks through extra investment to mitigate possible problems and to avoid negotiating too aggressively in plant procurement, particularly with equipment suppliers. The balancing of potential risk and actual expenditure to avoid risk did not necessarily seek to minimise costs of generation, but rather sought to minimise risks (financial, political, or other) to the utility itself. The conservative or "risk-averse" attitude of many monopoly supply utilities is well known. As a result, many argue that utilities have probably spent more on generating assets than they would have in competitive markets by over-designing and over-building plant capacity. "Over-designing" refers to incorporating power plant features which increase the unit cost of electricity without satisfying a fundamental design constraint such as performance or safety. "Over-building" refers to providing amounts of plant capacity to meet conservative (high) estimates of growth in electricity demand. The result has been relatively high reserve margins in many electricity supply systems.

Utilities may have also spent more on plant operations than they would have in competitive markets. Costs that might have been avoided through, for example, contractual means were not necessarily considered carefully, unless they were ultimately borne by the utility owners. Examples include accepting ambitious construction schedules without builder guarantees, using unproved technology without vendor guarantees, or accepting long-term fuel supply contracts at premium prices.

The development of independent power producers (IPPs) has, in many electricity supply systems, made the nature of electricity supply risks particularly evident (see Paffenbarger, 1997a). Being outside the traditional supply system, IPPs were not able to pass on risks through the monopoly regulatory arrangements and instead generally relied upon a series of contracts to allocate risks explicitly. Fixed-price construction contracts transfer some construction risks to the architect-engineer. Operations and maintenance agreements transfer operating risk to a separate operating contractor. Most importantly, a power purchase agreement often transfers market, fuel, regulatory, and environmental risks to the monopoly utility which purchases the electricity produced. This utility has normally been required to purchase the electricity from a defined set of eligible producers at regulated prices, and has been allowed to pass the cost of these electricity purchases to its own customers. Ultimately then, many of the risks faced by IPPs have been passed on to electricity customers through the purchasing utility, but through explicit contracts. These arrangements are not feasible in competitive electricity generation markets.

Private owners of electric utilities have historically enjoyed stable returns on their investments due to the traditional allocation of risks. In the United States, for example, return on utility bonds have been only slightly higher than those earned on US Treasury bonds, an essentially risk-free investment. The variability of returns on US utility assets has been among the lowest of any industry (Brealey, 1984). In Spain, returns to private utility owners have been essentially the same as on government securities.

In liberalised electricity markets, investors are likely to face greater variability in their returns, which should move toward the average for similar industries. Unexpected costs can be passed on to consumers only to the extent that all utilities face the same costs and attempt to reflect the costs in their prices. Utilities that do not make adequate provisions for minimising risk, or which over-spend to avoid risk, will not be able to recover costs in their prices, which are set by the market rather than by regulation. Utility investors must absorb such costs.

Investors include two broad categories: debt holders and shareholders. Of the two, shareholders face the most risk. Shareholders are not guaranteed fixed dividends, but obtain their returns from the profits of the company. On the other hand, debt holders have invested in loans and bonds with defined rates of return. In the case of severe business difficulties, debt holders have first right to the assets of the utility, and so are more likely to recover their investment than share holders. Both classes of investor will face increased risk in liberalised markets.

There is some debate as to what increased investor risk will do to overall costs of capital for electric power generation. It is clear that increased risk will translate into higher cost of equity since shareholders will seek a higher return in compensation. This is an implication of all financial models, such as the capital asset pricing model or the discounted cash flow model of dividends. However, the size of the increase required to compensate for the increased risk is not easily predictable. It depends on expected industry performance over a period of years, which is in turn influenced by the nature of industry competition and regulation. The cost of debt may, on average, increase, but this also is difficult to predict. Even under non-competitive systems electric utilities face financial difficulties and bankruptcy. The arrival of competition will not necessarily lead to lower average quality of debt in the industry and, as a result, higher average costs of debt. The effect of cost of capital on investment costs is discussed further below.

Market liberalisation is likely to reduce costs of generation by better allocating risk to those parties that can take action to mitigate it. In non-competitive systems consumers implicitly absorb risks because they can take no organised action to reduce them, such as switching to a different electricity supplier with a better risk management strategy. In liberalised markets, that option may be open to them. In competitive markets, utility investors have stronger incentives to reduce risks cost effectively. They are in the best position to allocate risks through such measures as establishing better contractual arrangements, entering into new business relationships, purchasing financial hedging instruments, and purchasing insurance. They are under competitive pressures to avoid incurring excessive costs, so over-designing and over-building are less likely to be successful business strategies.

The above discussion assumes that the period of market liberalisation is complete and operation of the market has reached a stable, long-term pattern. However, regulatory and market risks may be different during the initial transitional period of market liberalisation than in the long term. On the one hand, some risks borne by investors are likely to be greater during the transition period. The political and technical decisions needed to finalise all the arrangements for the new system take time to develop, and initial paths may be subsequently changed. Business arrangements and existing contracts take time to re-establish, and there is uncertainty as to the best choices for the future. The behaviour of customers during an initial period of market opening is also difficult to predict with certainty. On the other hand, the inherited market structure and some transitional arrangements, such as payments for stranded costs and gradual market opening, are likely to reduce risks. These points suggest that at least some risks borne by investors will be greater during the transition period, but not all risks. In the short term the largest risks and areas of greatest uncertainty could tend to delay or reduce the potential for cost reductions due to market liberalisation.

Investment Costs

The debate on whether or not utilities should be compensated for "stranded assets" in liberalising markets has shown that investment costs under traditional electricity markets have not always been as low as possible. Stranded assets are those unamortised costs of prior investments that would be recovered by monopoly supply utilities but which would not be recovered under competition due to lower electricity prices. High capital costs are not the only source of stranded assets, but they are a significant component. The US Department of Energy estimated stranded assets in the United States would range from US$ 72 to 169 billion, out of a total asset value of about $400 billion (EIA, 1997) if regional competitive markets had been in place at the beginning of 1998. The 1996 privatisation of the nuclear generating utility British Energy brought in £1.4 billion, even though the company's newest generating station, Sizewell B, was completed in 1995 at a total cost of over £3 billion. This is not to suggest that only traditional electricity markets are subject to problems of stranded investments. Liberalised markets cannot avoid losses in plant investment values either, but it is true that they will provide stronger incentives to avoid *excessive* investments.

■ Emphasis on Economic Designs

As noted above, there are strong disincentives to over-designing power plants. Liberalised markets focus attention on the choice of power plant features and technology which result in lowest product cost. Extraneous design features or design constraints which may be common, but which do not provide a clear economic advantage, are therefore likely to fall from use. Utilities in turn put pressure on equipment suppliers to rationalise designs and cut costs of major equipment.

There is some evidence of this in the United States, where most states have been preparing for or debating the introduction of competition for several years. Costs for coal-fired power plants have declined by one third since 1993. Capital costs for combined cycle power plants in the United States have declined from over 600 $/kWe in the early 1990s to below 400 $/kWe in 1996 (Hansen, 1996). Designs of combined-cycle plants have become simpler over time and manufacturers have responded to cost pressures by developing standardised plant designs.

Admittedly the precise influence of competition is difficult to discern because of parallel developments in technology and among power equipment suppliers. Technological developments in gas turbines have certainly aided the world-wide decline in turbine prices in the last decade. Equipment suppliers have been under pressure to cut prices, not only from generators facing the prospects of competition, but also from equipment manufacturing overcapacity, particularly among boiler manufacturers.

■ Improved Use of Generation Capacity

Capacity utilisation is likely to increase in liberalised markets. That is, generators will make every effort to ensure that capacity factors of generating plants are as high as possible, that plant production is maximised when electricity prices are highest, that unplanned outages are minimised, and that rarely used capacity is minimised. Higher capacity factors can dramatically lower the final cost of generation as capital costs are spread over more units of electrical output.

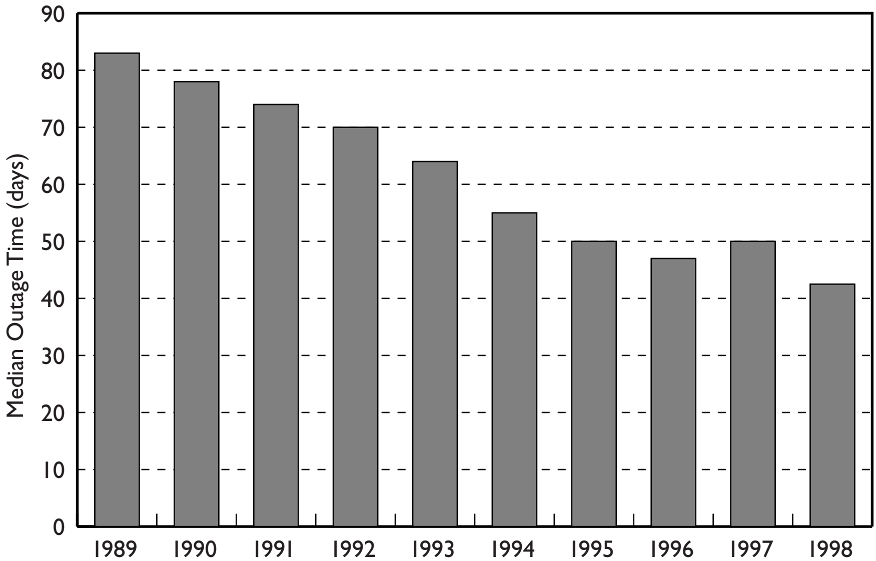
Again the United States provides an indication of the trend towards higher capacity utilisation in liberalising markets. From 1984 to 1993 in the United States, the average availability of coal-fired plants increased from 76 to 81% (EIA, 1997: p. 16), and from 1991 to 1998, the average capacity factor of nuclear plants rose from 70 to 80% (NEI, 1999). In Australia, the percentage availability of the Yallourn 1 and Hazelwood coal-fired plants operating in the competitive Victoria power market increased from the low 60s in 1991/92 to the 80s in 1995/96 (Dillon, 1996). A third plant, Loy Yang A, increased its availability from 78% to over 90% in the same period. In the United Kingdom, the availability of National Power's power stations increased by 3 percentage points in the five years following privatisation (NP, 1995).

There has been a world-wide trend in recent years towards improved utilisation of nuclear plants. Part of this improvement is due to technological progress and accumulation of operating experience, but part may also be attributed to competitive pressures in some nuclear markets (Finland, Sweden, United Kingdom, United States). Outage times for both refuelling and other common procedures such as replacing steam generators have been steadily declining. In the United States, nuclear refuelling outages have dropped steadily since 1989, as shown in Figure 1, and the record time continues to fall at individual plants.

System reserve margins are likely to fall in competitive markets, as generators strive to minimise unused generation. Depending on how the electricity market is structured, demand-side bidding for

Figure 1

US Median Nuclear Plant Outage Times, 1989-1998



Source: Institute of Nuclear Power Operations

capacity can promote this. Demand-side bidding provides a means for customers to sell capacity into a spot electricity market by reducing load during periods of peak demand. This effectively reduces the requirement to provide infrequently used peak capacity. Another feature of liberalising markets which tends to reduce the need for peak capacity is "time-of-use" pricing. This sets electricity price over time periods (hourly, daily or seasonal periods) to better match the marginal costs of production. When production costs are high, prices will be higher, for example during the peak demand period of the day. Electricity consumers thus have an incentive to reduce demand when production costs are highest. This pricing scheme is by no means unique to competitive markets, but may be introduced or strengthened at the same time as market restructuring. In systems with spot markets for electricity, the wholesale electricity price automatically follows the variations in production cost through generator price bids. The development of less expensive, more sophisticated metering might lead to real-time pricing and help to reduce peak demand from domestic and commercial consumers.

■ Repowering

Repowering of old facilities can provide a means to increase the effectiveness of existing capacity and minimise capital investment in new capacity. Repowering means the replacement of a significant portion of the plant to improve its performance and reduce costs. Old facilities are typically dispatched infrequently because of high marginal operating costs or operational constraints. Thermal efficiency may be low. Repowering can in some cases effectively provide new capacity at lower installed cost and thereby take advantage of existing investments in infrastructure, manpower, and fuel supply.

■ Competitive Procurement

Liberalising markets can result in a weakening of links between national or state-owned utilities and domestic equipment suppliers. Monopsony buying of power generation equipment and services has been raised as an issue by equipment manufacturers who have felt excluded from some markets and by international bodies concerned with trade. Monopsony markets are markets in which there is only one major buyer or a few buyers. In power generation equipment, a dominant national utility may rely on higher-priced domestic equipment as a matter of government policy or guidance. It can be argued that governments have explicitly encouraged reliance on domestic equipment suppliers as an element of industrial or regional development policy, employment policy, or technology policy. The US turbine manufacturer General Electric argued in a highly publicised 1993 court case (now resolved amicably) that the German utility VEAG unfairly excluded it from a supply contract in favour of a domestic supplier. The Italian competition authority criticised the state supplier ENEL in 1996 for relying almost exclusively on Italian equipment suppliers

(PIE, 1996). These domestic suppliers not only provided 99% of ENEL's equipment from 1991 to 1994, but also tended to offer very similar prices, indicating a lack of competition.

In procurement of capital-intensive assets, there are only small inherent advantages in working with local firms. They share the same language, business practices, and technical standards and are often the closest geographically. These are matters of convenience rather than substantial economic value compared to the value of power plant equipment. As liberalising markets introduce transparency and emphasise cost-effectiveness, utilities will put pressure on domestic equipment suppliers to compete more squarely on price. This is likely to reduce equipment costs in some electricity markets. The drop in equipment prices in recent years is thought to be due, at least in part, to the pressure arising from deregulation and privatisation of electricity markets around the world (Wagstyl, 1997).

■ Cost of Capital

There can be opposing influences on the cost of capital as electricity markets are liberalised. The cost of capital can increase or decrease, depending on the starting regulatory and institutional arrangements. In the general case, it can be expected that the cost of capital for new generation capacity will increase as it approaches its "normal" market level reflecting the cost of capital in other, similar industries. Regardless of the direction of variation, any change in cost of capital would reflect an adjustment in the broad allocation of capital resources within the electricity supply industry. Under competition, investment choices should better reflect the full costs of alternatives.

It was noted above that utility owners will bear increased commercial risks in generating electricity in liberalised markets. Private owners of generating capacity may require higher returns on their equity investments than public owners. Increased commercial risks tend to increase the cost of raising both equity and debt for utility companies. They could possibly induce a decline in the share of debt used to finance new investment. The reallocation of risks under competition thus tends to increase the cost of capital for new generation capacity.

Newly privatised utilities would typically see increases in their cost of capital. In addition to having access to debt at low interest rates, state-owned utilities may be able to provide minimal or no return on the state's equity investment. Whereas government owners may expect no income stream from the utility, or may allow substantial variations depending upon the utility's annual financial results, private owners insist upon a regular stream of dividends on their equity. Therefore, formerly state-owned utilities would face higher cost of equity and debt.

The cost of capital will not necessarily increase in all markets undergoing liberalisation. The opposite development could occur in markets where public owners use the electricity monopoly to fund government activities. This is a well established situation among municipal or local utilities in some OECD countries. Public owners may be able to withdraw more cash through high profit requirements than would be possible by private owners or owners operating in a competitive market. In such situations, market liberalisation might tend to decrease returns on equity and decrease the effective cost of capital.

Another factor mitigating increases in the cost of capital is a potential reduction in certain regulatory risks faced by utilities. Under some regulated monopoly supply systems, there has been increased business risk in recent years from unexpected regulatory actions. Some regulatory authorities and governments have more critically evaluated costs incurred by monopoly supply utilities. The dis-allowal of certain expenditures for nuclear power plants has been a visible example of this. Some utilities in Germany, Spain, the United Kingdom, and the United States faced considerable uncertainty as to their ability to recover costs for construction of nuclear power plants which were subsequently cancelled or not allowed to enter into operation. Some US utilities approached bankruptcy before the issues were resolved fully. So-called "prudency reviews"[2] in the United States dis-allowed other costs thought to be reasonable by the utility but unreasonable by state regulatory authorities. Regulatory risk has increased uncertainty and raised the cost of capital in some markets.

Competition in generation could reduce this component of regulatory risk, since generators are responsible primarily to shareholders to see that expenses are incurred wisely. The market, rather than government, determines which expenses may be passed on to consumers and which must be borne by investors. The reduction in regulatory risk (at least for generation costs) could partially offset the increase in business risk introduced by competition.

In the United Kingdom the real rate of return of the electricity industry increased dramatically following privatisation, beginning from a value of less than 3% under state ownership. In the five years following the corporatisation of the New Zealand state-utility, its rate of return on equity increased from 4% to 12% (Culy, 1996: p. 347).

Higher costs of capital increase the relative importance of the capital component of generation cost. If generators in liberalised markets find the cost of capital to be higher than previously, both the capital component of generating costs and the total generation cost will increase. There could be some effect upon the choice of technology and fuel as well. Higher costs of capital tend to favour less capital-intensive technologies and those with shorter construction times. For example, in moving from a 5% to a 10% cost of capital, nuclear plant levelised generation costs will typically increase by about half, whereas those of gas-fired plants will increase by less than 15% (see OECD, 1998).

2. Prudency reviews are financial examinations carried out by state or local electricity regulatory bodies to determine whether or not certain expenses incurred by utilities can be considered prudent and, therefore, recoverable from electricity consumers. See discussion in Chapter 3 under "How investment decisions were made".

The magnitude of the effect due to changing cost of capital is difficult to assess. In cases where a state-owned utility enjoyed a low cost of capital, say 3%, private generators are likely to arrive at quite different choices in investment and design. Without access to capital at low, government-backed interest rates, private utilities will have a greater incentive to minimise capital costs. However, it is not clear whether many systems will see large enough changes in cost of capital to result in changes in investment decisions. In recent years the trend towards the selection of gas turbines and combined cycles, particularly in the United Kingdom and the United States, is often cited as evidence of the use of higher discount rates and shorter payback periods by generators. However, gas-fired plants in these markets are often the most economical choice over a range of cost of capital used by incumbent utilities, independent power producers, and autoproducers.

Operations and Maintenance Costs

Non-fuel operations and maintenance expenses are typically the largest single cost element of utility operations. They are a variable cost tied to output to a lesser degree than fuel, and so are the object of particular scrutiny in utilities operating in liberalised markets. Utility labour and operating productivity have risen in many markets undergoing liberalisation.

■ Labour Productivity

Table 3 summarises decreases in electricity utility employment in systems undergoing market liberalisation. The decreases stem mainly from improvements in labour productivity and not decreases in electricity production. Utilities facing competition have not only significantly improved the use of labour for technical tasks, but have also improved personnel management practices. The latter can be expected to minimise non-productive time such as from shift scheduling conflicts, absenteeism, or sickness. Some utilities have developed multi-discipline training and more flexible team formation to cut labour costs. They have reduced their work forces and lowered payroll expenses through attrition, layoffs, and early retirements.

Table 3

Average Annual Decrease in Utility Employment Due to Market Liberalisation

Country	Form of Liberalisation	Decrease (% of initial value)	Time Period
Victoria, Australia	privatisation, competition	10%	1989-96
Hungary	privatisation	4%	1995-97
New Zealand	corporatisation	10%	1987-92
United Kingdom			
National Power	privatisation, competition	13%	1990-95
PowerGen	privatisation, competition	10%	1990-95
British Energy	privatisation, competition	7%	1996-98
*United States**	impending competition	3%	1990-96

Sources: Dillon, 1996 (Victoria); OECD, 1998, Annex 2 (Hungary); Culy 1996: p. 348 (New Zealand); corporate annual reports (United Kingdom); EIA, 1996: p. 87 (United States).

** major investor-owned utilities.*

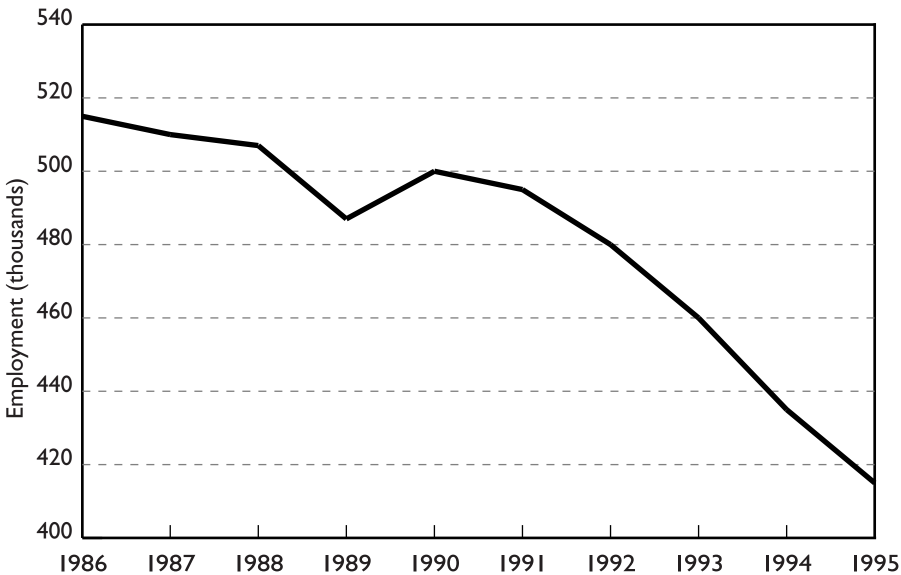
Other deregulated industries provide indications that liberalisation typically improves labour productivity. In the United States, deregulation of the trucking industry led to a 25% drop in labour costs. In commercial passenger air transport, yearly earnings of flight attendants and pilots dropped by 40% and 20% respectively following deregulation (EIA, 1997: p. 68). In the US electricity industry, the real value of salaries and wages decreased by 28% from 1986 to 1995 as the industry prepared for the arrival of competition (EIA, 1996: p. 86). Figure 2 shows the marked trend towards decreasing employment by investor-owned utilities since

1990. Staff reductions and salary pressures are likely to continue as competition emerges in individual state markets.

In nuclear power generation, staffing represents a relatively high proportion of non-fuel operations and maintenance costs. Improvements in labour productivity are particularly likely to occur in nuclear utilities entering liberalised markets.

Figure 2

Employment Trend in US Investor-Owned Utilities, 1986-1995



Source: EIA, 1996: p. 87

■ Operating Productivity

Non-labour improvements in operating productivity are also likely to occur in liberalising markets. This includes, for example, reductions in expenses for supplies, tools, or materials, more efficient use of equipment, and increased maintenance effectiveness. Preventive maintenance is likely to be relied upon more effectively to balance maintenance costs with costs due to unplanned equipment failures.

In New Zealand following the corporatisation of state-owned generators, unit operating costs in power stations decreased by 13% over the period 1987 to 1992 (Culy, 1996: p. 347). In the United States, anticipated competition has contributed to a 50% reduction in expected operating expenses for new coal-fired plants compared to 1993 values.

In nuclear plants, there has been a world-wide trend in recent years toward improved operations and maintenance cost performance. The trend towards reduced time for maintenance activities requiring plant outages was noted above. At least part of these trends may be due to the arrival or imminent arrival of competition. In the United Kingdom, for example, the nuclear utility Nuclear Electric reported that it cut the cost of its per unit operations and maintenance expenses by 40% from 1989 to 1994 at the same time as competition was introduced beginning in 1990 (NW, 1994). In the United States, among other areas of improvement in recent years, the volume of low level wastes has decreased and fuel reliability has increased (NN, 1997).

Fuel Costs

In most monopoly supply systems, fuel costs are passed on to final consumers. There is often little incentive to change the fuel mix or minimise fuel costs once plant technology/fuel choices have been made. In contrast, market liberalisation is likely to promote the use of the most economic fuel for local conditions, while complying with the relevant local constraints such as meeting environmental standards. Fuel costs can be reduced by a variety of means: examples are increasing plant efficiency, changing the plant fuel mix, and improving fuel contracting.

In the United Kingdom, National Power reduced its fuel costs per unit of electricity by 13% in the four years following privatisation (NP, 1995). Part of this was due to a shift from relatively expensive domestic coal toward greater use of natural gas. In the United States, real operations and maintenance costs decreased by 22%

from 1986 to 1995, mostly due to a reduction in total fuel expenses (EIA, 1996: p. 86). Lower fuel prices and transportation certainly played the most important role, but part of the pressure on prices and transportation costs came from utility awareness of impending competition. US coal-fired power plants have increasingly sought low-cost fuels compatible with coal co-firing. The use of petroleum coke has increased dramatically in US utility boilers in recent years (Paffenbarger, 1997b: p. 38) because of its low price and compatibility with existing plant systems. In addition, automobile tires and palletised wastes have been tested in a number of coal-fired boilers.

A move to shorter term fuel supply contracts is also likely to occur, coupled with strategies to secure price stability. For example, some utilities may find it advantageous to take financial stakes in fuel suppliers. It is likely that a greater variety of contract forms and pricing structures will emerge in liberalised electricity markets. The parallel movement towards liberalised gas markets in Europe will provide opportunities for utilities to revise their fuel purchasing strategies.

There are potential pitfalls to changing fuel purchase arrangements. Focusing too much on minimising short-term fuel costs while not taking adequate precautions against longer-term or sudden price rises could lead to higher total fuel bills for individual utilities. For example, the use of interruptible gas supply contracts without making provisions for an adequate backup fuel supply could lead to this result. The skill with which utilities balance short-term fuel bills and price risk will determine the extent of real savings.

Fuel costs may be lowered in multi-fuel power plants by taking advantage of relatively brief changes in relative fuel prices. For example, if there is a seasonal or short-term increase in the price of natural gas relative to fuel oil, a generator with access to both fuels may switch a plant from natural gas to fuel oil to obtain a lower fuel cost. The reverse sequence is equally possible if it is fuel oil that increases in price. Dual firing allows a plant operator to reduce the economic risk of changes in fuel prices and to minimise total fuel costs. The capital investment required for such capability is less than 5% of boiler investment cost for dual gas/oil firing.

An additional economic advantage for owners of dual-fuel plants with firm fuel supply contracts is the ability to profit from differences between contract and spot market fuel prices. Take the example of a dual fuelled plant supplied under a non-interruptible natural gas contract. If the spot price rises relative to the contract price, and fuel oil is available from the spot oil market or in the plant's storage tanks, the plant could switch from natural gas to oil and sell natural gas on the natural gas spot market. The utility will profit when the difference in price between spot and contract gas prices is greater than the extra cost of operating on fuel oil. Price differentials of this sort are normally of short duration because supply contracts are typically indexed to spot market prices with some time lag and averaging calculation. The technical ability to switch rapidly between fuels is therefore key. The ability to realise arbitrage gains of this type depends on competitive gas supply markets.

The increased policy transparency characteristic of market liberalisation is likely to reinforce the trend of reduced support of domestic coal mining industries through electric utilities. France, Germany, Japan, Spain, Turkey, and the United Kingdom have all had policies which effectively encouraged or required utilities to purchase certain amounts of expensive domestic coal. These policies have been recognised as undesirable and all the countries above have taken steps to reduce such implicit subsidies in favour of explicit government support and eventual phase-out. In the case of the United Kingdom this process has been accelerated by the move to a competitive electricity market. When the state-owned utility was privatised, its successor companies decreased the use of domestic coal, largely by increasing the use of natural gas. When long-term domestic supply contracts expired in 1998, coal costs for United Kingdom plants decreased further.

Separation of Functions

In markets where competitive generation is introduced, responsibility for electricity network functions traditionally borne by generating plants may be assigned to a network operator or another party. As generation and supply of ancillary functions are separated, the total cost of generation and supply of ancillary network functions is likely to increase, but generating costs may decrease.

Ancillary services are bundled with electricity generation in traditional electricity supply systems. These services include functions which ensure the stable operation of the network as loads shift in size and location on the grid:

- controlling power flow and frequency;
- supplying reactive power;
- providing reserve capacity.

When ancillary services are provided jointly with generation, individual plants may not be operated in the most efficient way for power generation alone. By separating generation and system functions, the costs of providing each will become explicit in financial accounts. It seems reasonable to expect that generators, by focusing on minimising "raw" generating costs, will be able to better minimise generating costs while drawing in a separate revenue stream for providing system functions. Still, the actual effect on generating costs is uncertain (Hill, 1996).

Conclusions

Market liberalisation is likely to focus attention on the costs of generation and provide strong incentives for generators to reduce their costs. For publicly owned utilities, a key factor in improving cost performance is the greater transparency in implementing public policy measures brought about by corporatisation or privatisation. For utilities with supply monopolies, the loss of captive customers and price competition are the essential drivers. Markets, rather more than governments, will allocate costs between customers and utility investors, providing generators with new motivation for efficient operation.

There are some indications of these trends in liberalising markets, although they are early and not conclusive. The anticipation of competition, notably in the United States, appears to be a driver for improving efficiency of utility operation and generation in particular. Generators in the United Kingdom, Australia, and New Zealand have shown substantial gains in productivity as competition has been introduced. Cost improvements have been seen in other markets moving towards liberalisation and this will accelerate as liberalisation takes hold in more countries both in OECD and around the world.

INVESTMENT IN POWER GENERATING CAPACITY IN COMPETITIVE ELECTRICITY MARKETS

Introduction

The liberalisation of the electricity supply industry in most OECD countries has profound implications for investment decisions in power generating capacity. Under competition, investment decisions and the associated risks are primarily borne by investors. Before competition, investment decisions tended to be in the hands of the public sector, and risk was borne by consumers. In fully liberalised electricity markets, demand — consumer preferences — will determine the amount and nature of investment.

This chapter considers the implications of the new investment conditions for security of electricity supply. A central public policy objective for the electricity sector, whether under competition or not, is to ensure security of supply, both in the short and long-term. Security of electricity supply may be characterised in terms of three elements: short-term system reliability, long-term system reliability through adequate investment, and long-term system reliability through diversity/availability of input fuels. Security of electricity supply is a public policy objective in most, if not all, OECD countries because of the relatively limited substitution possibilities of electricity for other forms of energy linked to the fact that some of electricity's uses are essential components of modern life. Box 1 defines electricity's key characteristics for policy making.

This chapter focuses on investment, that is, on long term system reliability. It confines itself to investment in power generating capacity. Although investment in the electricity transmission and distribution grids is also essential, and decisions concerning the latter are relevant to decisions on generating investments, these matters are outside the scope of this study.

The basic question examined is: what are the implications of more competitive electricity markets for investment? This requires consideration of whether the new conditions could create problems and, if so, what should be done about it.

Box 1

Defining Electricity for Policy Making

Electricity can be defined as a composite good made up of energy which is (generally speaking) a non-storable commodity; transportation of electricity when required and the related co-ordination of transportation services (i.e., system operation); and value added services (e.g., metering and billing) which, together with the commodity and transportation, make up supply to the end-users.

***Energy:** The commodity component of electricity is similar to many other commodities, but has some important particularities. Electricity demand fluctuates in the various time horizons (within a day, year, or business cycle) both randomly and non randomly. In addition, electricity cannot be economically stored. This means that generating (and transmission) capacity needed to cope with peak demand is partly unused in periods of lower demand; reserve capacity may be required to cope with random demand fluctuations; and a diversified portfolio of electricity generating technologies is needed to provide electricity at least cost. Linked to that, electricity generation is characterised by a merit order of generating plants. In varying degrees, generating technologies are also characterised by their relatively high capital intensity, and technical and economic longevity, including long lead and construction times. Nevertheless, some recent innovations are dramatically lowering capital intensity and shortening lead and construction times for some technologies.*

***Transportation:** Transportation services have some natural monopoly characteristics. Electricity networks exhibit significant economies of scale and* *there are so-called "network externalities" (investments may benefit all interconnected parties). It is customary to distinguish between two types of transportation: transmission is transportation at very high voltage levels and distribution is transportation at lower voltage levels. Transmission covers transportation over an interconnected network, which is shared by all end-users, whereas distribution covers transportation from the interconnected network to some end-users; a transmission line thus provides security of supply to all end users while a distribution line benefits only some.*

System Operation: *For technical reasons, co-ordinating transportation services requires a centralised system operation. This intrinsically monopolistic function can be unbundled from transportation, in which case an independent system operator is in charge of this function.*

Value-added Services: *These are the services that (together with the commodity and transportation) make up supply to end-users. They include an increasing number of activities like metering, billing, differentiation (e.g., green energy) and packaging electricity (e.g., with other utility services), supplying differentiated reliability and quality, energy efficiency services, demand management etc. These activities do not have any special features from the point of view of regulation and policy making.*

The regulatory changes taking place in the electricity supply industry consist of the unbundling of the components of electricity, and the liberalisation of the commodity and value added services components, which are potentially competitive.

Investment in the Past

■ How Investment Decisions Were Made

Under the past model of vertically integrated utilities enjoying a statutory monopoly, investment decisions were, at least in theory, taken through an approach that optimised the entire supply system — i.e. that minimised total system cost — rather than simply assessing the profitability of one single power plant project. The former UK Central Electricity Generating Board (CEGB) provides one example of this approach. For "essential" investment, the procedure was roughly the following:

The CEGB based its plant-ordering decisions on two-stage investment planning models. In the first stage, a global programming model was used to develop a background plan. This background plan would set out, in very broad terms, an optimum pattern of system development for forty to fifty years, taking into consideration expected demand growth, capital costs, operating performance, economic lifetime of alternative types of generating capacity, and price forecasts for the input fuels.

In the second stage, marginal or incremental studies were prepared for individual investment projects. These studies were used to represent and evaluate the economics of investment projects in much greater detail than was feasible in the background studies. For example, the background studies did not appropriately reflect technical progress and its impact on plant performance, i.e., did not take into account that later commissioning dates meant that technical improvements could potentially be exploited, a factor that is significant in practice.

The incremental studies began by forecasting future load (electricity demand) duration curves. These curves were integrated, yielding the amount of electricity (the number of Gigawatt hours) needed along all points of the load duration curve, and eventually the number of hours each type of plant capacity would have to run. Various types of power plant were then ranked according to their running cost, and, in comparison with the utilisation hours just derived, the optimal plant mix was determined. This allowed optimal investment in types of plant capacity to be determined (e.g. coal-fired, steam boiler or single-cycle gas turbine etc.). Taking into account other, plant-related factors such as economies of scale, expected plant availability, expected operating lifetime etc., and using a 5% real discount rate, a plant's net present cost in Pounds per kW, per annum, was determined. The resulting figure, called the net effective cost (NEC), was the key indicator of which investment project was to be undertaken. The investment project(s) with the smallest NEC would then be realised.

Separate calculations were carried out to determine whether a plant could be replaced on cost saving grounds. In this case, the present value of the cost saved by the replacement, called net avoided cost (NAC), was subtracted from the NEC. Whether to replace the plant was determined on the basis of the lowest remaining figure. Table 4 illustrates the CEGB's estimates of NEC for two types of power station, that were to be commissioned in the early 1990s.

Table 4

CEGB Estimates of NEC of Future Power Stations (Pounds/kW, 1982 prices)

	PWR	Coal-fired
Capacity-related (C): Capital charges, provision for transmission equipment, decommissioning, interest during construction	91	49
Fuel costs (F)	28	112
Other operating costs (O)	12	8
Fuel savings from displacing less efficient plant (S)	160	143
NEC (C + F + O - S)	- 29	+ 26

Source: Jones, 1989.

This type of overall system optimisation is, under ideal circumstances, equivalent with the outcome of an equally ideal competitive market. In this highly theoretical sense, total system optimisation attempted to "mimic" competition. The reality can be rather different.

Utilities' demand forecasts often erred on the high side due to a number of factors. First, there was a requirement to maintain a very high level of system reliability. Second, the planning mechanism did not penalise upward biases in demand forecasts. Third, the high electricity demand growth rates of 7% or more per annum that prevailed during the 1960s were not adjusted quickly enough to the depressed growth rates of GDP and electricity consumption after the two oil shocks of the 1970s. The IEA's own energy and electricity demand forecasts had, in fact, continuously overstated GDP growth and electricity demand growth, and were revised downwards in subsequent issues of the World Energy Outlook. Fourth, as discussed in the previous chapter, there was little or no incentive to keep costs down since they could be "passed through" to consumers.

Utilities' own investment decisions were also in many cases influenced or revised by government action. See Table 1 for examples of government policies having an influence on investment decisions. Government influenced investment decisions not only through technical, safety and siting control, but also often directly through investment control in the interest of consumer protection. This was the case of the so-called "prudency reviews" in the United States. Investment control was also a means to influence utilities' choice of primary input fuels in order to achieve environmental goals or to favour indigenous energy resources.

Investment prudency reviews were part of the widespread use of cost-of-service regulation in State Public Utilities Commissions. Utilities had to submit detailed investment plans to prove that their investment was "prudently" incurred and would be "used and useful". Only in such case would the plant be included in the rate base. Multiplied with the allowable rate of return on capital set by the regulatory authorities; the rate base determines the average revenue utilities may charge their consumers, and therefore their absolute levels of profit. Thus, an investment project not included in the rate base would not be profitable for a utility, and would therefore not be undertaken. For an overview of price regulation see Bonbright, Danielsen and Kamerschen, 1988.

In fact, it is this very mechanism which has created much of the present problem of stranded generation assets in the United States.

Investments that were incurred in a prudent manner, and approved by regulators as such, are becoming economically obsolete in a competitive environment due to radically altered framework conditions, notably higher discount rates and an unexpectedly large potential for cost reduction. Other elements have also contributed to stranded investment such as over-investment in the 1970s, or the US Public Utility Regulatory Policies Act of 1978 that required utilities to purchase electricity at relatively high prices from independent power producers.

In the past, government or regulatory influence, often direct, on the type of generating capacity chosen and the input fuels used was exerted in a majority of OECD countries. The actual implementation mechanisms varied across the OECD. Some governments continue to exert such control.

■ Investment in the Past: Results

Electricity generating capacity grew steadily in OECD countries from 1980 to 1996. On average, capacity grew at rates in the 2%-3% range over the period. Capacity additions have been roughly in line with peak demand growth, thus yielding relatively stable reserve margins over the period (See Table 5).

Security of supply as measured by national reserve margins shows large differences among OECD countries (See Figures 3 and 4). The smallest reserve margins (not including emerging economies) are close to 20% (Belgium, Finland, Norway, Sweden, United Kingdom, and United States). At the other extreme, some countries have reserve margins above 40% (Denmark, Italy, Spain, and Switzerland). However, cross-country comparisons of reserve margins can be misleading as differences in the technology portfolio (e.g., more or less hydro capacity), international electricity exchange capacity and, perhaps, demand patterns mean that different reserve margins would be needed to achieve the same "effective" security of supply in each country. Even so, the fact remains that reserve margins differ significantly among OECD countries and that, under most reasonable standards, some of these values seem to be large.

Table 5

Capacity Growth and Reserve Margins in OECD Countries

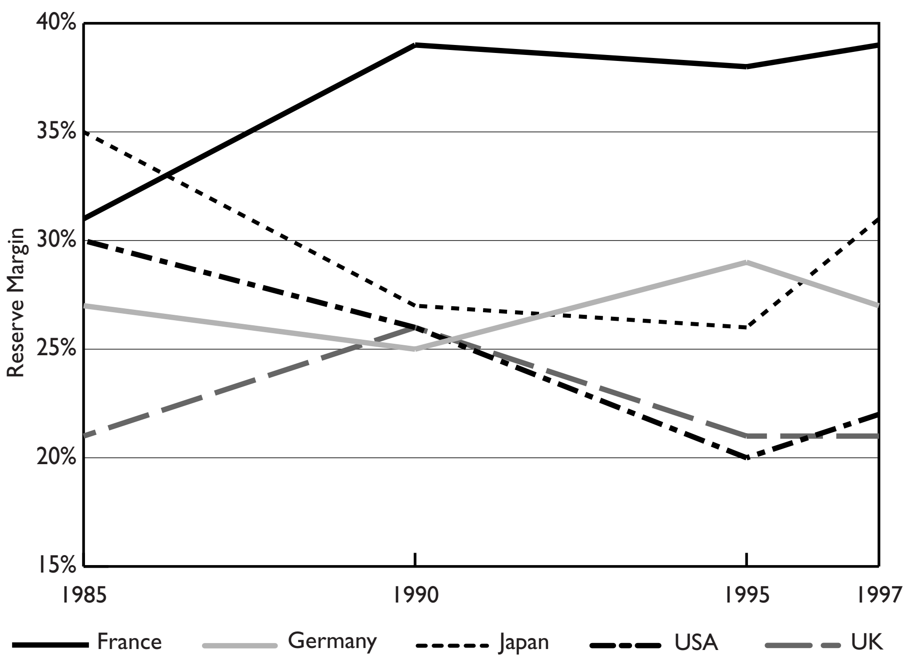
	Average Annual Capacity Growth (%)				Reserve Margin (%)			
	81-85	86-90	91-95	95-97	1985	1990	1995	1997
Belgium	6	0	1	-1	38	26	21	19
Canada	4	1	3	-1	26	19	24	n.a.
Denmark	3	1	4	3	36	36	46	45
Finland	1	3	2	4	30	44	29	26
France	5	3	1	2	31	39	38	39
Germany	2	1	0	-1	27	25	29	27
Greece	5	3	0	3	42	42	32	30
Iceland	5	0	3	3	42	29	32	22
Ireland	-1	1	2	3	34	32	24	22
Italy	4	0	3	3	n.a.	36	40	41
Japan	3	3	3	3	35	27	26	31
Netherlands	-1	0	2	3	43	39	41	31
New Zealand	6	-1	2	1	37	29	32	28
Norway	2	2	1	1	27	37	27	31
Spain	6	2	1	3	46	42	44	44
Sweden	3	1	-1	1	27	32	27	27
Switzerland	2	0	1	0	49	45	46	47
Turkey	13	13	5	2	37	44	32	23
United Kingdom	-1	2	0	2	21	26	21	21
United States	1	2	1	1	30	26	20	22

Source: IEA Electricity Information 1998.

A significant feature in the evolution of reserve margins in OECD countries is that, while most countries show some degree of variation over time, there are no instances of low (e.g. significantly below 20%) reserve margins. This supports the idea that regulated investment regimes have been effective in ensuring that enough generation capacity was available. It also suggests that planners have not taken any risks of under-investing in generating capacity since otherwise occasional episodes of relatively low reserve margins would be expected. The asymmetry of the incentives built into the investment planning system suggests an obvious explanation for this pattern. Forecasting errors leading to over-investment may have resulted in higher electricity rates without generally carrying penalties to the electricity supply industry or its regulators. On the other hand, forecasting errors leading to under-investment might have well resulted in social and political pressures to allocate responsibilities.

Figure 3

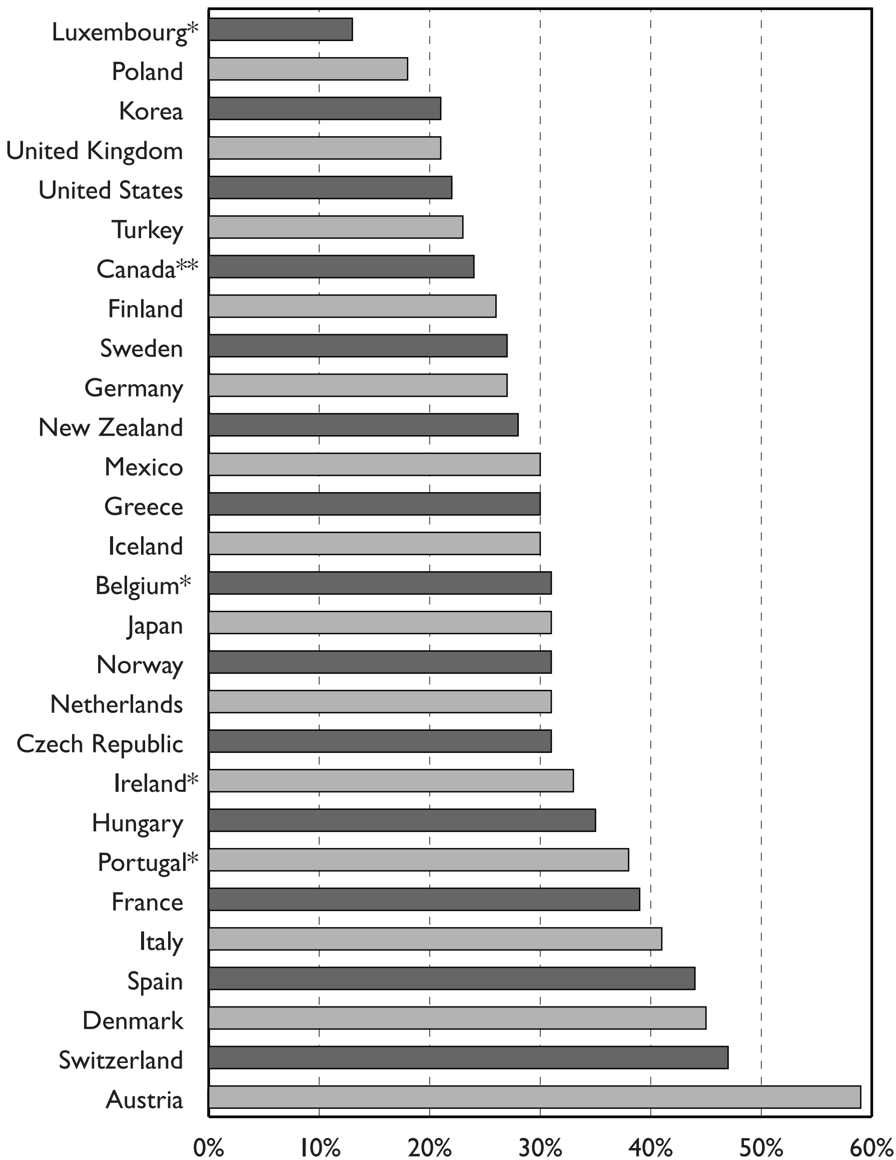
Evolution of Generating Capacity Reserve Margins in Selected OECD Countries



Source: IEA Electricity Information 1998

Figure 4

Generating Capacity Reserve Margins in OECD Countries (1997)



Source: IEA Electricity Information 1998
*Notes: * 1996 data from UNIPEDE (1998). ** 1995 data*

Figure 5

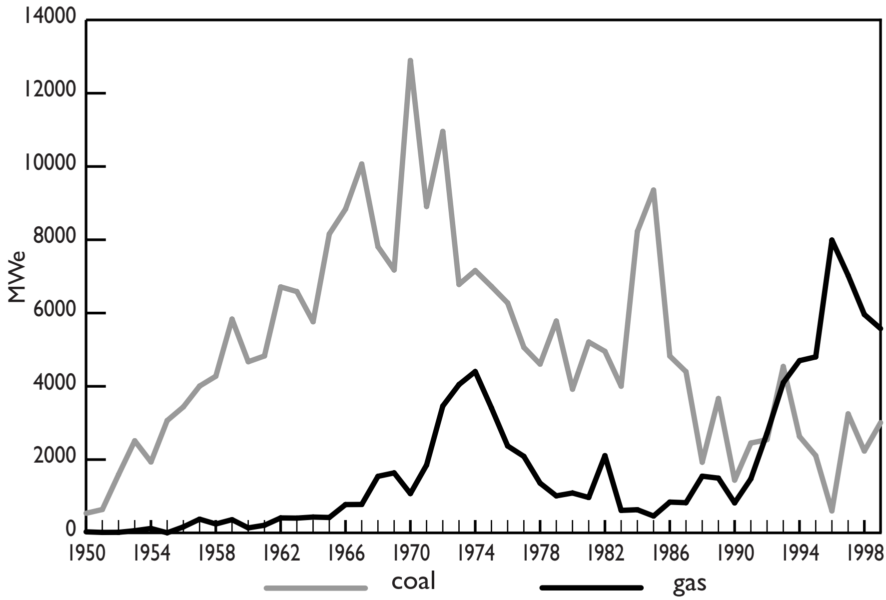
OECD National Fuel Shares in Electricity Production (1997)

Source: IEA Electricity Information 1998

Fuel shares in electricity production also vary widely among OECD countries (see Figure 5). In several OECD countries generating capacity is fairly diversified among fossil fuels and nuclear. The importance of hydro generation varies greatly depending on each country's natural resources, while the weight of other renewable fuels in the fuel portfolio is uniformly small in all OECD countries.

Figure 6

Coal- and Gas-Fired Capacity Additions in OECD Europe, 1950-1999



Source: UDI/McGraw-Hill, World Electric Power Plants Data Base, February 1999

Over time diversification of the fuel portfolio seems to have been achieved in a rather discontinuous way. Figure 6 shows the pattern of capacity additions in OECD Europe for coal-fired and gas-fired power stations since 1950. The irregular path followed by these two series suggests that the choice of fuel for electricity generation goes through cycles. Furthermore, the timing of events suggests that investors have tended to favour the fuel that appeared to be more promising at the time the decision was made. To sum up, successive changes in expectations may have induced fuel diversity in the past. Even if more work would be required to test this hypothesis empirically, it suggests that changing expectations may also be a factor in determining fuel shares in a liberalised market, as technology, fuel reserves and other factors evolve over time.

Investment under Competition

■ A Framework for Understanding Investment Decisions

How much generating capacity is needed?

Optimal generating capacity for an electricity system is determined by the willingness of consumers to pay for security of supply. If consumers are willing to pay for an extra kilowatt of capacity more than it costs to provide it, it is optimal to invest in this extra kilowatt. If it costs more to expand capacity than the value consumers attach to it, it is optimal to not invest. If neither more nor less investment is needed, then generating capacity is defined to be optimal and is said to be "adapted" to demand. Of course, there is no way of knowing a priori how much capacity would be needed to have it adapted to demand. The real issue, however, is whether markets — through price signals — will drive investment to the optimal level.

Prices are the key determinant of investment decisions

Once competition is introduced into the electricity supply industry, the framework for undertaking investment decisions changes dramatically. Decision-making shifts from the state to investors and risk bearing shifts from consumers to investors (as costs can no longer be automatically passed through to consumers). As a result, investment decisions in a liberalised market are based on profitability. Revenues depend on expected electricity prices while costs depend on the price (or cost) of capital. Thus, investment depends positively on the price of electricity and negatively on the price of capital.

Electricity prices must reflect the cost of producing electricity. This generally requires prices to fluctuate over time; for example, prices should increase during periods of peak demand when high marginal cost units must operate. The role of financial markets is to finance investments at prices (return on equity, bond interest rate, or loan interest rate) which provide adequate returns, taking into account the risks of the investments. In setting an appropriate price, capital markets need to forecast the return on the investment. The future price of electricity is a key element of this forecast. A much debated question is whether financial markets are able to forecast electricity prices without bias.

There is concern that investors may be "myopic" basing decisions on current electricity prices alone. Myopic investment could result in investment cycles as high electricity prices would induce investment that would eventually depress electricity prices. This, in turn, could cause investment to halt. Over time, generating capacity could become scarce, again raising electricity prices. These price and investment cycles could be reinforced by the natural variation of electricity demand and prices over the business cycle.

The impact of competition

The main questions for policy-makers are whether any significant price distortions can be expected in electricity and capital markets and, if so, how the performance of these markets could be improved in order to give the correct price signals to investors. These questions are analysed below. The main findings are that distortions can be expected to be small in a competitive market and that a number of mitigating factors may generally reduce their impact.

Two main effects of liberalisation on electricity prices and the cost of capital can generally be anticipated:

- The average price of electricity will tend to decrease in a liberalised electricity market as costs are reflected more accurately.

- The cost of capital for generating capacity investments will tend to increase under competition, but the size of this effect may well be small. As investors assume more risks the cost of capital may increase, but, on the other hand, risk-mitigating strategies do exist. As discussed below, investors can manage risks through a variety of contracts; and regulators can implement policies which will reduce the risk borne by investors.

The trend toward lower prices and higher cost of capital suggests a gradual downward adjustment in the incentives to invest in generating capacity. However, this has to be seen in the context of past incentives to over-invest caused by high electricity prices, below-market cost of capital, or inadequate risk allocation. These causes of excess capacity in the electricity supply industry (see Figure 3) should disappear in the new competitive environment and it may therefore be expected that a more efficient level of capacity will be achieved under competition. That said, the longevity of generation assets and the slow development of competition suggest that these changes may take some time to materialise.

In addition, electricity prices may decline slowly. Liberalisation of electricity markets does not happen overnight. Many OECD countries are adopting a gradual approach to liberalisation. It is also likely to take time to establish effective competition in generation, which is often characterised by high seller concentration. The pace of reform depends much on a country's starting point and the restructuring path it chooses to take.

It has also been suggested that investment may be more sensitive to the business cycle in a liberalised market. However, the potential size of investment cycles is limited by a number of mitigating factors. In particular, the size of any potential impact is limited by the moderate electricity demand growth in most OECD countries, the shorter construction and lead times for some new power generating technologies, and the increasing responsiveness of electricity demand to price changes.

The following three sections analyse the issues of electricity prices, risk mitigation, and the business cycle in more detail.

■ Electricity Prices and Markets

Prices in a perfectly competitive market

Prices must satisfy two essential conditions to induce optimal investment. First, average prices must at least equal the long run average cost of generating electricity. Lower prices cannot be sustained because they would result in losses for electricity generators. Second, prices must equal the long run marginal cost of generating electricity at each point of time. Lower prices imply that generators would make a loss in at least some of their production and consumers would pay some electricity below its cost. On the other hand, higher prices would inefficiently depress consumption.

If generating capacity is adapted to demand, a "perfectly competitive" electricity power market can be expected to yield an efficient outcome. Specifically, there would be full cost recovery. In addition, a perfectly competitive market is characterised by prices that are equal to short run marginal costs during off-peak demand periods. However, if capacity is adapted to demand, prices have to rise during peak demand hours reflecting that capacity is relatively scarce. In equilibrium, prices must rise up to the point where generators' revenue equals their fixed investment cost plus variable costs incurred during this period. Thus, even if generators have no market power, prices would rise to balance supply and demand, thus reflecting long-term marginal costs.

Other market characteristics are helpful to induce optimal investment: consumers are empowered to choose suppliers and clearly understand what they wish and need to pay for; there is effective competition among generators; and suppliers internalise the costs of long-term security of supply. This set of characteristics is extremely challenging to achieve. The following sections consider some of the barriers to an optimal investment.

Market concentration (Oligopoly)

Most OECD countries embarking on reform have a fairly concentrated ownership of generation units. Concentration is also a feature of many "reformed" countries. Market concentration may give rise to price distortions and, in particular, inefficiently high price levels.

Market power in electricity generation markets is not helpful to maximising economic efficiency through lower costs, cost-reflective prices, and efficient investment. Higher electricity prices increase the profitability of investments and therefore generate a strong incentive to invest. From this perspective, oligopolistic behaviour is benign. The challenge for policy makers is to ensure that the incentives to invest result in actual investments being made. In particular, policy makers need to eliminate entry barriers for new entrants and need to monitor market players to prevent any anti-competitive behaviour that may discourage entry.

The problem needs to be addressed both in the early stages of reform and subsequently, through market monitoring. In the early stages of reform, the key policy issues that need to be addressed are barriers to market entry into generation, and the restructuring of existing generation activities, such as the unbundling of vertically integrated utilities. Conditions for effective competition in generation need to be established with particular attention paid to mid-peak load generation competition. Mid-peak load generators have a greater capacity to influence prices. Subsequently, careful monitoring of market players' behaviour and strict enforcement of general competition law are necessary to prevent anti-competitive and discriminatory behaviour (e.g., raising market entry barriers to new entrants).

In conclusion, market concentration is not a threat to investment itself as long as incumbent generators are not able to raise barriers to entry. Additionally, market concentration arises as a consequence of ineffective liberalisation, rather than because liberalisation itself is damaging to investment.

■ Investment and Risk Mitigation

The section on "Allocation of Risks" in Chapter 2 introduced the notion of shifting risk in competitive markets and its potential impact on the cost of capital. This section discusses the means available to plant investors to minimise or mitigate increased business risks as competition is introduced and, consequently, to ensure adequate access to capital for plant investments.

Greater risks are matched by greater potential rewards, notably higher profits. Higher profits may result from a variety of sources. First, under competition better management incentives generally result in lower costs. Second, subsidies to activities and groups outside the electricity supply industry — which are common in some regulated electricity supply industries — tend to disappear under competition, thus increasing profits. Third, the development of new and more diversified services creates new profit opportunities. And fourth, the possibility to enter new geographical markets also creates new profit opportunities.

Greater potential rewards "automatically" mitigate the possibly greater business risks, thus facilitating investment. The reason is that, other things being equal, investors are generally willing to take more risk in exchange for a higher potential payoff.

Financial instruments can provide risk-mitigating tools. Long-term contracts between generators and consumers can potentially reduce risk premia for investments in generating capacity. The use of long-term contracts illustrates how consumer choice allows consumers to influence investment decisions and risks.

To some extent, all competitive power markets allow generators and consumers or power retailers to enter into long-term contractual relationships. Most contracts currently take the form of forward contracts, option contracts, or power purchase agreements. The first two are sometimes described as financial contracts because they do not specify which plant will provide the power. Power purchase agreements are also termed "physical bilateral contracts" because they specify the plant that will provide the power.

Forward contracts work in combination with a competitive spot market. They are one of the simplest forms of derivative instruments used to transfer, or "hedge" price risk. The parties agree upon a price today (the so-called "strike" price), for "delivery" later. If the market price at delivery is higher than the strike price, the seller compensates the buyer. If it is lower, the buyer compensates the seller. There is a plethora of far more complex and advanced derivatives that can be used to hedge all kinds of price risk.

Option contracts have two prices, an option fee equivalent to a charge per kilowatt payable when the contract is signed, and an exercise price to be paid for each kilowatt-hour actually delivered. An option contract does not need the reference of a spot electricity price to be implemented. Compared to forward contracts, option contracts are advantageous to the seller in that they partially hedge quantity risk. The option fee can also cover fixed generating costs.

Power purchase agreements are similar to the financial contracts described above, but specify the plant that will provide the power and therefore require the generator to be excluded from any centralised pool. In countries with a mandatory electricity pool these contracts are either restricted or banned.

A growing number of investors do not view the risk of investing in generating capacity as excessive. An increasing number of power plants are developed as "merchant" plants. These are plants planned, built and operated without any type of long-term contract. On the other hand, many US electric utilities, which have in the past been rated as ideal debtors by credit rating agencies due to the predictable and stable revenue stream from captive consumers, have lost their "AAA" credit ratings as impending competition threatens their consumer base. At this stage, it is difficult to predict with certainty the stability and ultimate profitability of individual firms or individual merchant plants.

In conclusion, various risk-mitigating strategies exist. While financial instruments may not cover all risks completely, they do cover a very large element. In particular, consumer choice of supplier allows some investment risks to be ultimately borne by the consumers. Moreover, a small but growing number of investors are willing to risk investment in merchant plants, effectively "investing against a forecast" rather than investing against a contract.

Apart from these risk-mitigating options available to companies, governments may introduce risk mitigating regulatory policies, such as capacity payments in the spot market. These will be discussed later in connection with electricity market performance.

Investment, Reserve Capacity and the Business Cycle

This section analyses the potential impact of investment cycles on reserve capacity margins and security of supply. The overall conclusion is that this impact is expected to be small. A number of buffers can absorb cyclical variations of investment activity without allowing security of supply to deteriorate. Finally, this section considers how some policy tools — capacity payments — can be used to further protect security of supply. However, these tools generally have costly side effects.

Investment cycles?

Investment activity may go through cycles as a result of changes in a number of factors, including the cost of capital, expectations on demand growth and future electricity prices, and the electricity supply industry's own financial position. All these variables may affect investment even in the absence of competition. However, it is likely that investment in a liberalised electricity supply industry will be increasingly subject to the impact of business cycles as are other industries, particularly commodity industries. This impact is likely to be greater under competition because the large reserve margins common in non-liberalised electricity markets act as buffers against any temporary investment deficits. Also, government support of investments and monopolistic rights on electricity supply may have reduced the exposure of the electricity supply industry to wider economic fluctuations.

As noted before, it is sometimes argued that investment fluctuations could be even more pronounced due to myopic investor behaviour. This results in a tendency to concentrate investment in periods of relatively high electricity prices. In countries with access to well-developed financial markets investors are likely to take into account expected electricity prices over the whole life of the generating asset and thus not behave in this fashion. In any case, the actual performance of investment is essentially an empirical question that can only be totally settled on the basis of observation. The evidence is presented below in the Section "Diversity of Input Fuels."

How would security of supply be affected by investment cycles?

If there is no significant excess capacity, fluctuating investment activity may result in periods of reduced reserve margins. The less price-elastic are electricity demand and electricity supply, the longer might be the temporary imbalances caused by business cycles, and the greater the price increases would have to be to trigger new investment or prompt consumers to reduce consumption to cope with a capacity shortage.

In addition, it is sometimes suggested that investment in reserve capacity may be inadequate under competition at every point along the cycle. In particular, reserve equipment expected to run only exceptionally due to a lack of demand for its output may be a difficult investment as payments will be intermittent and unpredictable. The result could be a sub-optimal level of reserve capacity.

How plausible is either scenario? Several factors suggest that, in practice, competitive power markets should cope with unforeseen demand growth in a number of ways without jeopardising security of supply.

First, new technologies are shortening lead and construction times for generating capacity, thus effectively increasing the price elasticity of electricity supply. Electricity supply has traditionally shown low price elasticities, at least in the short- and medium-term. The long lead and construction times of base load power generating capacity observed in the past pointed toward comparatively low supply elasticities. The current trend is to invest in combined-cycle gas turbines, which, in addition to having low capital cost, can be manufactured on assembly lines, shipped to the site by train, and installed in less than two years. In contrast, typical lead time for coal-fired plants is around five years, and nuclear plants take roughly seven years to build, provided the process runs smoothly.

Second, the trend towards repowering generating plants is also shortening investment lags. Investors find it less risky and more profitable to buy an existing, even if the plant is not profitable, and to refurbish by substituting or adding a single or combined-cycle gas turbine for the old steam boiler. Since most of the existing facilities can be re-powered, total investment costs can be reduced and construction times significantly shortened.

Third, peak load pricing reduces the amount of reserve margin needed by "shaving" off the peaks of demand. Electricity consumption is becoming more price-sensitive with the introduction of time-of-use or peak-load pricing schemes. So far, peak-load pricing mechanisms have proved effective in smoothing out demand by shifting demand from peak periods, which are charged a higher price, into non-peak periods, which are charged a lower price. Traditional measurements of electricity demand elasticities that consistently rendered small estimates may be all but irrelevant in this context. These measurements, necessarily based on historic data, and carried out for electrical demand over several years or even decades, fail to capture the consumer's reaction to time-of-use pricing. The reason is that these pricing policies did not exist at the time when the elasticities were measured.

Fourth, power demand grows in a comparatively slow and steady way in most OECD countries, and there are no large year-on-year demand swings. This reduces the scope for unforeseen imbalances between generating capacity and electricity demand.

Fifth, increased regionalisation of electricity may enable individual countries to live with reduced national reserve margins. The creation of the EU internal electricity market is an example of this regionalisation through minimisation of national market entry barriers.

Capacity payments

If, in spite of the above arguments, there is concern about a cyclical deterioration of reserve margins, there are policy tools available. To counter this potential problem, some electricity pools use capacity payments to decrease the risk faced by generators and to induce investment in reserve capacity. These markets not only remunerate the electrical energy, i.e., kilowatt-hours generated, but also the established generating capacity which can be drawn upon in an emergency. This capacity is remunerated separately, provided the generator declares it available for potential production.

In some competitive power markets, notably in the United Kingdom, this capacity payment is related to the probability that a supply shortfall might occur (the Loss-of-Load Probability, LOLP), and to a theoretical measure of the damage such a shortfall would cause to the consumers (the Value of Lost Load, VOLL). Capacity payments are currently provided in the United Kingdom, although there are plans to abandon them there, Spain and Argentina. There are no capacity payments in the Australian national power market or NordPool.

There is no consensus at this stage on whether a capacity shortfall is a real risk and, if so, whether capacity payments are the correct tool to support investment. Some of the literature assumes that without capacity payments, the level of reserve capacity provided by the market would be suboptimal. However, many others disagree on the basis that consumers may be expected, in a fully liberalised market, to demand and pay for reserve capacity, and that such a market will put a monetary value on reserve capacity.

It is important to note that capacity payments are not a free policy. They generate significant market distortions, at least in markets in which some generators enjoy market power, and generators' behaviour may be distorted by capacity payments. In the short run, there may be incentives to manipulate the availability of plants to increase revenue and profits. In the long run, depending on their size, capacity payments may induce over investment in generating capacity. Additionally, capacity payments may interfere with efficient market design: in particular, they are difficult to handle if bilateral contracts outside the pool are allowed. In sum, capacity payments, in seeking to fix one possible problem of potentially sub-optimal reserve capacity, may create another problem, namely economic inefficiency. Overall, it can be argued that attempts to "put back in" artificially what the market may fail to provide will hinder, rather than help, the evolution of an effective and efficient market.

However, there is currently excess generating capacity in many OECD countries (see Table 5) and so the issue of adequate reserve margin is, for the foreseeable future, not a practical concern.

■ Transition Issues: Minimising Regulatory Risk

The transition from heavily regulated to open electricity markets often involves significant uncertainties. The end point of reform is not always clearly defined and, even if it is, learning by doing reveals options for improvement. The first wave of reforms developed in the United Kingdom and Argentina, among others, has given way to a second wave of reforms in these same countries in which substantial aspects of the regulation are being reformulated.

In addition, reform proceeds gradually in some countries. The timing of successive partial reforms may not be known. Also, implicit in the implementation of a gradual reform program, two regulatory systems are set to coexist, the old more heavily regulated regime and the new market oriented regime. The boundaries between two different regulatory are often fuzzy. As a result, there are disputes and the application of rules remains uncertain causing considerable regulatory risk in the transition to competitive electricity markets.

Regulatory risk, like other risks, may have the effect of discouraging investment and increasing the risk premium required by investors. While this is a transitional problem, it may be significant, especially where additional investment is needed at the time of opening the market to competition. Governments have a key role in minimising regulatory risk by providing a credible and clearly defined regulatory framework for electricity markets to facilitate investment.

■ Diversity of Input Fuels

Another fundamental security of supply issue is the diversity of input fuels to power generation. Other factors being equal, greater diversity tends to decrease the electricity supply industry's vulnerability to price increases in input fuels. The importance attached to diversity varies from country to country, depending on the extent to which a country has indigenous fuel sources and other factors. For example, Switzerland and Norway have chosen low diversity in their power systems because of the abundant availability of hydro power.

It is, therefore, difficult to generalise about the implications of competition on input fuel diversity. However, it is worth noting that diversity may be an issue and, if this is the case, government monitoring of investment developments may be appropriate. For instance, the current competitiveness of natural gas in combined cycle gas turbines may make some countries more reliant on imported fuels and more exposed to changes in natural gas prices. However, the trend toward investment in gas-fired generation may increase diversity, at least initially, as gas is introduced in the portfolio of input fuels and the long lifetimes of many power plants imply that fuel substitution occurs slowly.

To the extent that input fuel diversity is an issue for particular countries, it is important to ensure that markets integrate the value of diversity into the price of electricity. Supply contracts incorporating clearly defined supply obligations and penalties for non delivery would influence investment decisions by generators, thus effectively internalising the value of security. Alternatively, regulatory measures (e.g., obligations to buy electricity produced from certain sources) can be implemented to influence fuel choices in a competitive market.

■ Empirical Evidence

Comprehensive empirical evidence that could be used to compare investment before and after the introduction of competition in electricity does not yet exist. The majority of liberalised power markets started out with a fair amount of over capacity (see Table 5), which acts as a buffer against any problems, at least in the short to medium term. A possible example is Argentina, which was liberalised in 1992 with a considerable need of capacity investment, and where investors (mainly foreign) have invested US$ 4 billion in the meantime, mainly in fossil-fired capacity.

Since electricity does not provide much useful empirical evidence yet, it is interesting to look at other recently liberalised markets that share some of electricity's special characteristics. Insight may be gained from the experience of airline and telecommunications market liberalisation.

Air transportation

Air transportation shares some of the characteristics of electricity: they deliver a non-storable service; are subject to a peak load problem; are capital intensive; and show some network characteristics through their use of airport infrastructure dispersed in space, although this latter feature is much weaker than in electricity, gas or telecommunications. The US airline industry was liberalised in 1978, providing nearly two decades of experience with liberalisation in this industry. The following observations can be made:

- The airline industry entered competition with a very large over capacity. As a consequence, load factors on domestic trunk lines fell from 70% in 1956 to a mere 48% in 1970. After liberalisation load factors rose again to above 60% and there was enormous service expansion. Despite occasional phenomena like overbooking and delays, service has doubled, frequency has increased, and a much larger number of citizens have air travel access from nearby airports than before liberalisation.

- Prices came down considerably, in some cases dramatically, due to price wars caused by new entry in the early years. Alongside lower prices, intense price differentiation now dominates the industry.
- There was massive entry in the early years. But of 18 major new entrants between 1979 and 1985, only two had survived by 1988. The overwhelming majority of the others had gone bankrupt. This resulted in a "boom-and-bust" cycle, involved tremendous merger and takeover activity, and led to the accumulation of large debt.
- The fleet of aircraft is on average older than it was before liberalisation, and is the "oldest and most re-painted fleet of aircraft in the developed world" (Dempsey, 1992).
- However, and most importantly, despite the somewhat messy introduction of competition, some troublesome market outcomes and the huge demand growth and resulting air space congestion, safety (which might be equated to supply security in the electricity context) had not deteriorated.

Telecommunications

The telecommunications sector also allows an interesting comparison due to its service character, and peak-load and network characteristics. The following concentrates on the traditional, fixed-link telephony market in the United Kingdom and the United States, which were two of the earliest to liberalise their markets. The following observations can be made:

- Investment appears to be abundant, but this might not allow any direct conclusion for electricity competition since competition in telecommunications has in recent years been partly caused by technological change, which has so far played a much smaller role in electricity.
- Prices have declined slightly and pricing has become much more complex, as in the airline industry. Also, dramatic re-balancing between long-distance and local tariffs has taken place. Long-

distance calls became much cheaper compared to local calls, reflecting efficient removal of cross subsidies. Fixed charges have increased, whereas usage charges (charges per telephone call) have come down. The overall effect is a slight decline in (real) total prices for residential consumers and a slightly larger reduction for business consumers.

- The ranking of the United States and the United Kingdom in international service indicator comparisons provides clues as to the performance of competitive markets. The United Kingdom and the United States are among the seven countries with the lowest call failure rates in the OECD. The United States has the lowest, the United Kingdom the second-lowest number of faults per 100 lines and per year in the OECD.

To summarise, these experiences in airlines and telecommunications suggest that:

- Prices decline, but also become much more complex in competitive markets.
- Liberalised markets continue to meet or even improve on non-price objectives, such as service quality and safety.
- Investment levels remain adequate.

Conclusions

Investment continues in competitive markets. Incentives to invest in liberalised electricity markets are provided by profit opportunities as in any other liberalised market. Risk and macroeconomic fluctuations may have a larger impact on investment in competitive markets but mechanisms exist to deal with them.

In the long run, the large reserve margins often observed in the past may tend to disappear. Under competition there are no incentives to build excess capacity; this is a good thing in that it reflects a more efficient outcome than in the past; however, the evolution of reserve margins also depends upon the particular policies such as capacity payments adopted by each country. In practice, changes in reserve margins can be expected to proceed slowly in most countries due to the combination of a gradual policy approach and a continuing relatively concentrated market structure.

Is there a role for governments?

Governments still have an important role in the new environment and the following actions may help to mitigate potential problems:

- Ensure as far as possible that an effective market, including effective competition in generation and effective end user choice is established. Address market entry barriers to generation.
- Monitor the market structure and possible anti-competitive behaviour of market participants to sustain effective entry into the market and effective consumer choice.
- Establish well-funded, well-staffed and competent regulators and anti-trust enforcement agencies to prevent the emergence of barriers to new generation entry.
- Monitor system reliability and investment in generation. However, unless the monitoring indicates real problems, governments should refrain from interfering. The monitoring needs to be adapted to the size of the market. In some cases, it might have to be done at international level, in others at national or sub-national level.
- Monitor input fuel diversity, estimate the extent to which security of supply is ensured by the market. If remedial action is needed, measures at economy-wide or energy market level are potentially more effective. Measures restricted to the electricity market are a second-best solution as they ignore alternative fuel uses. If they are the only feasible solution, they should be market-based.
- Create a favourable investment climate by providing a credible and clear regulatory framework and streamlining the administrative process for construction permits as far as possible

without jeopardising other important regulatory concerns (e.g., compliance with safety and environmental regulations). Many OECD countries have cumbersome, lengthy procedures that considerably lengthen lead times.

APPENDIX: ENERGY INVESTMENT[1]

Joint Paper by the Energy Charter Secretariat and the International Energy Agency[2] presented to the G8 Energy Ministerial in Moscow, 1 April 1998

Executive Summary

Growing need for energy investment

All countries will need to assure a supportive climate for investment to meet their energy needs, enhance efficiency and improve environmental quality. Energy investment requirements will amount to 3 or 4% of world GDP over the next two decades. As a percent of GDP, the needs will be higher still in the transition economies, because of the need to replace or modernise obsolete and inefficient plants and infrastructure.

Investment competition

There is no shortage of capital for global energy investment — the problem lies in how to mobilise it. Energy projects will be in competition with other investment opportunities in both domestic and international markets.

Socio-economic benefits

Investments in the energy sector provide a range of socio-economic benefits in the regions and countries where they are made. These include job creation, increased tax revenues and competitiveness, as well as infrastructure, transfer of modern technology and managerial techniques, improved efficiency and the ability to reallocate government spending.

1. This is an abridged version of the paper. References specific to the Russian energy sector have been eliminated.

2. This paper, presented to the G8 Energy Ministerial in Moscow, 1 April 1998 was jointly prepared by Leif K. Ervik and Lise Weis of the Energy Charter Secretariat and Hans G. Kausch and Isabel Murray of the International Energy Agency.

Meeting energy investment needs depends on competitiveness

Countries' ability to mobilise enough capital for their energy investment needs will depend on the quality of their investment, fiscal and regulatory policies. This in turn will crucially affect the rate of economic growth and living standards in those countries.

Thorough assessment of market, financial and legal risks

One of the most important considerations for potential investors will be a country's political and economic stability. Companies will also evaluate other market, financial and legal risks. The main areas will be market access, including market structure, discrimination and bureaucracy and market operation, including the legal framework, the financial environment and market conditions.

Excessive bureaucracy or discrimination hinder market access

Companies will want to know that they can obtain any consent needed for new investments through procedures based on clear and consistent criteria and avoid bureaucratic complexities and delays. Foreign investors will be particularly deterred if there is discrimination on nationality grounds.

Attractive market structure

Traditionally, in many countries, the scope for private sector activity in the energy field has been limited by the involvement of government and State enterprises. There is now widespread recognition that liberalisation, including privatisations and reduction of monopolies yields major benefits for the efficient operation of energy markets. Governments need to ensure fair competition, including control of monopoly behaviour, and avoid distortions in energy prices.

A stable and effective legal environment

Companies will always look closely at the overall legal and administrative framework in a particular country. They want to be sure that they can, if necessary, protect their investments by recourse to law. This matters most in cases where agreements they have entered into are not being complied with by other parties, or where customers have defaulted on payments. Dispute resolution is an important aspect of this issue, including whenever necessary access to international arbitration. In a wider sense companies will want to feel protected against crime and corruption.

Pattern of legal and fiscal stability is needed

In countries where appropriate legal and/or fiscal regimes are still being developed or have not long been in place, governments will need to take positive action to create investor confidence through strong and stable legal guarantees. International treaties can provide a broadly-based, secure and stable foundation for large-scale investments with long pay-back periods. Examples are the Energy Charter Treaty (ECT) and its future extensions, bilateral investment treaties and production sharing agreements in upstream oil and gas investments.

Proper taxation rules

The viability of an energy investment will depend crucially on the relevant tax regime. Experience has shown that an unstable or unbalanced tax system can be the single most important factor in deterring investors. This has been particularly true where taxation is based on gross revenues rather than on profits, with allowance for incurred costs. A system which favours short-term government revenues can jeopardise long-term investment benefits.

Access to energy transport systems and trade

Companies will want to know whether they can move their future production to domestic or international markets. They will ask for secure access on fair terms to local and national energy transport systems, such as pipeline networks or electricity grids. They will also be sensitive to any likely restrictions on their ability to export or import energy, or on their purchases of energy equipment or services from abroad. A regime which follows World Trade Organization Rules will provide companies with considerable assurance in this regard.

Energy efficiency and the environment

Governments should ensure that attention is also given to investments in energy efficiency and in energy-related environmental projects, along with investments in energy supply.

Specific recommendations to governments

G8 Energy Ministers are invited to widen awareness of the importance of energy investments for world economic growth and trade by bringing the conclusions, and recommendations based on this paper to the attention of other governments. Proposed Recommendations on Energy Investment are found at the end of this paper.

Introduction

This paper assesses future energy investment needs and the benefits which national economies can gain from private sector energy investments. It identifies the policies needed to attract private sector investment, whether domestic or foreign. This paper draws on valuable studies carried out by or under the auspices of the World Bank and the European Bank for Reconstruction and Development.

Energy Investment Needs and Benefits

■ Energy Investment Needs

World energy demand to grow by 66% between 1995-2020

Projections of energy investment needs depend to a large extent on projections of supply and demand. The International Energy Agency's "World Energy Outlook" indicates that, in the absence of new policies to curb energy use, world energy demand will grow by 66% between 1995-2020. Fossil fuels are expected to provide 95% of additional global energy demand to 2020. The global distribution of world energy demand will change significantly, with developing countries more than doubling their energy consumption by 2020.

Energy forecasts in developing countries and transition economies are particularly uncertain with respect to the timing and rate of economic growth. There is also uncertainty about the relation between economic growth and energy demand, given the recent radical changes in economic structure and systems. Energy data in these countries is much less detailed and less reliable than in OECD countries. The timing of economic recovery and the rate of growth in GDP and energy demand will be influenced by investment patterns which in turn will depend on appropriate framework conditions. Environmental policies also exacerbate the uncertainty of global energy demand and supply projections; they are increasingly creating new energy related investment needs.

Uncertainty as to the timing of economic recovery is dependent on stable/ competitive investment environment

The World Energy Council (WEC) recently completed a study on global energy investment needs (based on demand and supply projections similar to those of the IEA). WEC concluded that annual investment requirements to 2020 will remain basically unchanged at about 3% to 4% of world GDP. Financing requirements vary by region depending on the level of economic development, industrialisation, motorisation, etc. The divergence in needs is especially great in the case of transition economies, where investment needs are almost 10 times those of OECD countries in terms of share of GDP. This difference is a function of their current low GDP levels combined with the need to invest to upgrade and renew old, badly maintained and inefficient infrastructure and technology.

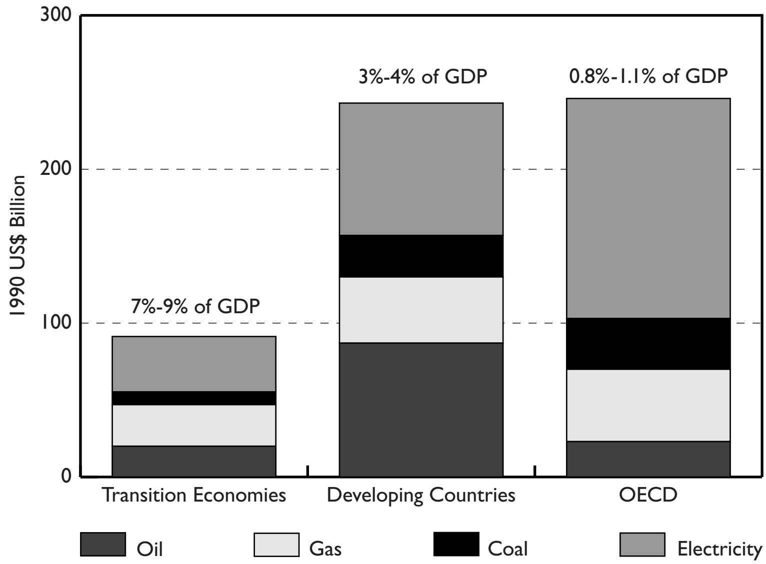
Global energy investment needs vary by region

Despite varying estimates of the level of investment needs, most studies conclude that there will be no shortage of capital resources to meet these needs. The problem is how to mobilise that available capital into investments in energy infrastructure.

There is no shortage of capital ... but it needs to be mobilised

Average Annual Investment Requirements by Fuel and Region: 1990-2020

Investment needs in transition economies are almost 10 times those of OECD countries as a percent of GDP



Based on WEC Case B "Middle Course", which projects more coal and nuclear based electricity generation in OECD countries than IEA projections, which assume much more gas-based new capacity. WEC estimates of cost of new power capacity in OECD countries are therefore higher than those of the IEA.

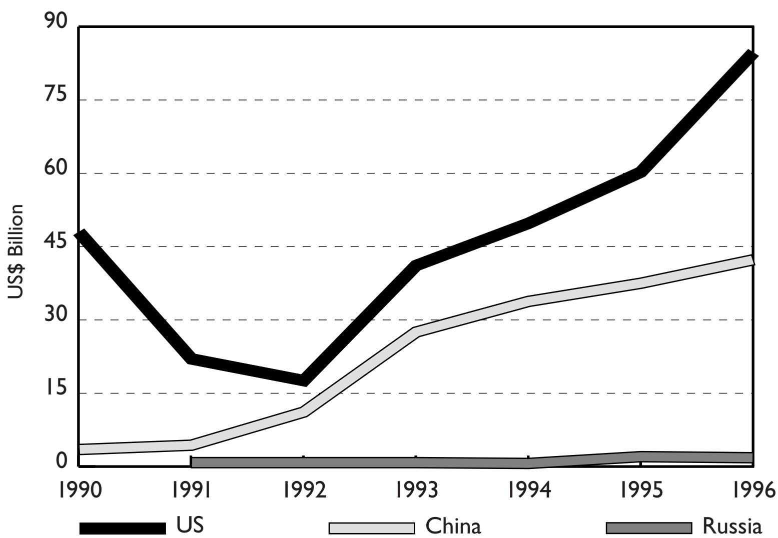
Energy investments compete internationally across sectors

Energy investment projects compete with other investment opportunities across the domestic economy and internationally as well. In the area of new power generation capacity alone, the World Bank estimates that Asia would require about $30 billion/year and Latin America about $15 billion/year and estimates the gap between savings and investment needs by 2005 at about $50 billion/year in both Asia and Latin America. In Russia and Eastern Europe the World Bank estimates this gap at about $10-15 billion/year. The crux of the issue is whether these countries will be able to attract enough private domestic and/or foreign investment to meet their energy needs.

Foreign direct investment acts as a supplement to domestic savings. The chart below compares the different levels of foreign direct investment inflows over the last 15 years in the United States, China and Russia. The United States attracts more foreign investment than any other country; US companies are also actively investing abroad and giving the United States its position as the largest source of foreign direct investment. Since 1990, China has created an investment environment which is increasingly attracting foreign direct investment to promote and help sustain its high GDP growth rates (in double digits by some estimates). The comparison between Russia and China is striking, with China attracting over $42 billion in 1996 compared to less than $2 billion in Russia. (In 1997, preliminary estimates show foreign direct investment to China and Russia at $32 billion and $3 billion, respectively).

Foreign direct investment acts as a supplement

Foreign Direct Investment Inflow Comparison ($US billion)*



**Poland/Hungary/Czech Republic combined attracted foreign direct investment in the order of $8.5 billion in 1996.*

■ Investments in the Oil and Gas Sectors

The upstream oil and gas business in most parts of the world is dominated by the private sector

The upstream oil and gas business is dominated by the private sector. Both large multinational oil companies and thousands of small to medium size companies compete to replace reserves at the lowest possible cost. Since 1983, global oil demand has increased at a rate of about 1.5%/year, and at 2.5% since 1995. The IEA projects oil demand to grow at an annual average rate of 1.8% to 2020.

In 1996, global investments in the upstream oil and gas sector reached about $80 billion

In 1996, global investments in the upstream oil and gas sector reached about $80 billion. In recent years, the industry has focused on cost reduction through advanced computer and engineering technology as well as the streamlining of company structure, both trends being driven by relatively low oil prices. Recently, investment in this sector has been increasing as companies have been forced to drill in deeper waters and in more technically difficult environments. Constraints are being felt on the service and equipment pool, as the large capital stock built in the period of higher oil prices reaches full utilisation. On the other hand, although day rates for oil rigs have increased significantly, that rise has been somewhat counterbalanced by improved technologies which have led to a net decrease in finding and production costs.

Most upstream oil and gas investments is financed ultimately by shareholders and lenders

Most upstream oil and gas investment is financed directly by the large multinational oil companies or by funds borrowed by the private sector. Ultimately, the investor's willingness to commit resources depends on a project's ability to meet the return expectations of shareholders and lenders. Banks usually base their project loans on the profitability of and control over assets/production and need to have confidence in the investor to operate and fund its share. They normally require a significant commitment of an investor's own resources. This requires that the private investors' expectation on the return meet the risks of the project.

Competition for private investment has increased

Over the last decade, there has been a marked increase in areas open for petroleum exploration and development. New prospects exist in Asia, Africa, Latin America and in Central Asia and Transcaucasia. Even a number of OPEC countries, facing shortages of capital and needing more advanced technical know-how, have begun to seek foreign investors in order to raise future production capacity. IEA analysis has shown that North African countries (Algeria, Egypt and Libya) have been successful in attracting foreign investment by improving their fiscal terms for oil and gas development. They have offered companies potentially greater profits while sharing the risks associated with hydrocarbon development. Similar developments can be observed in some countries of the Middle East and in particular in the new oil and gas producing countries in Central Asia and Transcaucasia. Competition for private investments has increased, as international oil companies assess the risks and returns available in each country.

Experience in the US and Norway

The United States has a significant level of foreign direct investment in its oil sector (especially through British Petroleum and Royal Dutch/Shell). BP is, indeed, the largest oil producer in the United States. Norwegian oil policy is based on a combination of government control and a market system which allows companies to develop the most profitable and efficient solutions. Norwegian companies have entered into co-operation agreements with foreign companies which have helped them to stay competitive and maintain a high level of technical know-how. On average, foreign participation in Norwegian oil production between 1971 and 1994 was 38%.

Experience of investors in the Russian upstream oil sector has not

The Russian economy as a whole requires a major infusion of capital. So far, however, the experience of investors in the Russian upstream oil sector has not been conducive to further investment, either domestic or foreign. As

been conducive to further investment

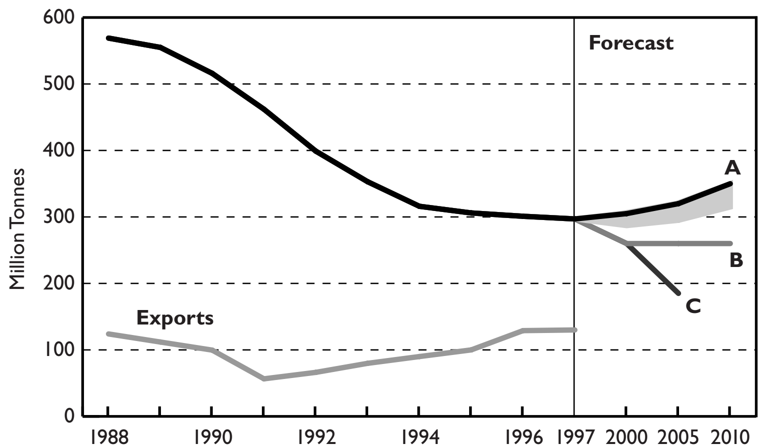
shown in the graph below, Russia's annual investment needs are estimated at a minimum of $5 to $7 billion and a maximum of $9 to $13 billion.

Russian companies' ability to mobilise capital will be limited until macro economic and market framework conditions are in place

Unstable and unbalanced legal, fiscal and regulatory conditions also create strong disincentives for portfolio investment. Basic problems still exist in the overall structure and regulation of the stock market, but also with respect to principles of corporate governance, lack of transparency and insider shareholding.

Russian oil supply down 50% ... The decline could resume unless there are significant investments

Russian Oil Production and Exports
History and Forecast Dependent on Investment



A - Maximum Case with Investment needs: $9.5-13 Billion/y
B - Minimum Case with Investment needs: $5-7 Billion/y
C - Possible Case with no new Investment
Production with foreign Investment

* *Source: New Energy Policy of Russia, Mintopenergo, 1995*

Investment needs for natural gas are much the same as for oil

Estimates of global investment needs in the gas sector to 2020 range from a low of $900 billion to a high of $2.6 trillion. Investment needs for natural gas face much the same situation as those for oil. Both require large upfront capital investments and often long term payouts. The transport of gas through pipelines or via LNG facilities is a critical part of investments. In a significant recent development, GazProm has been able to borrow $2.5 billion from a consortium of 57 international banks to help finance the world's largest gas transport project.

Need for stable, transparent framework

IEA projects world gas demand to double by 2020 with much of that increase forecast in the CIS and developing countries. Meeting such increases in demand will be challenging and will require particularly suitable investment conditions especially for capital-intensive distribution networks, pipelines or LNG plants.

■ Investments in the Coal Sector

Potential financing problems relate to restructuring

Annual global investment needs for coal, the second most used primary fuel after oil, are estimated by the WEC at $13 billion. Investment in coal is financed by private companies in the key coal export countries. Potential financing problems relate to the restructuring necessary in many markets, including the closure of uneconomic mines (at least 100 of 250 mines in Russia). There may also be a need for investment in coal import facilities. In addition, investment is necessary to rehabilitate those remaining mines which have prospects of achieving international competitiveness. In all producing countries continuing investments are necessary to lower costs and increase labour productivity.

Increasingly, environmental related investments will be needed

Increasingly, investments related to environmental aspects of coal use and production will be needed. This is also the case in China and India, where more advanced technology and efficient use will be a focus of investment needs; more than 50% of these two countries' projected increased energy needs will be met by coal.

■ Investment in the Electricity Sector

Electricity sector represents the biggest financing challenge

Electricity is the fastest growing energy sector and the biggest challenge for financing in the future. The power sector is the most capital intensive and the scale of its investment needs is greatest. The IEA projects global requirements for new power capacity over the period 1995-2020 at some 3475 GW, about half of which is projected for China and the other developing countries and a third is required in OECD countries. Total investment needs to meet this projection are estimated at $3.3 trillion (1990 dollars). As a percentage of GDP, investment needs are highest in the transition economies.

Capital expenditures on new generating plant (billion $US, 1990 values)

					% of GDP
	1995-2000	2000-10	2010-20	1995-20	**1995-2020**
OECD Europe	76	117	174	367	**0.16%**
OECD N.Am.	54	99	155	308	**0.14%**
OECD Pacific	45	149	180	375	**0.41%**
FSU/ECE	25	153	210	388	**0.75%**
China	97	253	385	735	**0.37%**
Rest of World	167	409	509	1085	**0.31%**
World	463	1181	1613	3257	
% of **GDP**	**0.28%**	**0.28%**	**0.29%**	**0.28%**	

In many countries, the electric power industry does not operate profitably

In many countries due to the structure of the electric power industry and to government tariff policies power generation projects have relatively low rates of return. Frequently significant government subsidies are granted to maintain artificially low electricity prices. Under these conditions, private investors have been reluctant to enter these countries, and most investment has been financed by governments.

The situation is slowly changing with a focus more on private sector involvement

Strained public resources cannot cope with looming electricity capacity needs especially in developing countries where increases in demand are greatest. The need for power sector financing, along with a desire to increase economic efficiency has led many countries to seek private sector involvement in electricity supply systems. This corresponds with a world-wide trend in the electricity sector toward privatisation, deregulation, and commoditization and an increased focus on private sector financing. Private sector involvement brings not only financing, but also market-oriented management skills, access to the latest technology, and usually quicker implementation than would be the case under public sector management. Private investment may also allow governments to redirect public funds to other needs.

Governments are turning increasingly to private sources of investment

Governments are turning increasingly to private sources of investment through Independent Power Producers (IPPs) or even the introduction of competitive generation markets. In the case of IPPs, power purchase agreements effectively commit distributors to purchase electricity at cost-based prices over a long-term period. Power purchase agreements are a basis on which IPPs can obtain financing. Success of IPPs could be enhanced through the implementation of basic "best practice" principles like those put forward by the Asia-Pacific Economic Co-operation (APEC) in 1997. This document deals with basic investor needs such as transparency, predictability and reduction of risk. It encourages competition in institutional and regulatory structures, tender/bid processes and evaluation criteria, power purchase agreements and associated tariff structures, as well as clear taxation and foreign exchange regimes.

In transition economies inadequate investments could seriously hamper economic growth

In transition economies, investments in the electricity sector are of primary importance; inadequate investments could seriously hamper economic growth. However, the structure of tariffs is a major barrier to investment, as some industries are charged higher than normal rates in order to cross-subsidise households and other industries that cannot pay. Changing such policies is a sensitive and politically charged undertaking. In Russia, much progress has already been made. The Federal Energy Commission has strengthened its control of electricity tariff setting and methodology. The United Energy Systems (UES) has increased transparency and is phasing out cross subsidies, thus laying the basis for competition in this sector. Independent generators could usefully start investing and competing in this sector if UES manages to transform itself into solely a power transmission and distribution company. Such a development would allow generators to compete and sell to the transmission grid directly or transport electricity through it to regional energy companies.

Few opportunities for new nuclear plant construction in the near term if a number of long-term issues are not resolved

Nuclear power is one among other possible choices of generation plant. A number of countries, particularly in Asia, have firm plans for new nuclear projects. However, few other opportunities for new nuclear plant construction are seen in the near term, because there are a number of long-term issues that must first be resolved, notably waste disposal and non-proliferation. In many markets around the world nuclear power is not demonstrably the least-cost alternative, when all relevant costs for the fuel cycle and safe generation plants are taken into account. There is increasing international concern about projects to upgrade plant safety and to extend plant life and whether they will ensure that international levels of safety are upheld. This is now becoming a concern in transition economies where such investments are being made.

Investments in Energy Efficiency and Environment

The world-wide focus on energy efficiency is increasing

Concerns about climate change and other environmental consequences of the production and use of energy focus attention throughout the world on energy efficiency. Various international fora, most notably the Conference of Parties under the United Nations Framework Convention on Climate Change (UNFCCC), emphasise the need to promote and implement actions that enhance energy efficiency and limit greenhouse gas emissions. The forthcoming Ministerial Conference "Environment for Europe" under the auspices of the UN/ECE and with support from the IEA and the Energy Charter Secretariat, is expected to adopt guidelines, strategies and policies to improve energy efficiency and international collaboration.

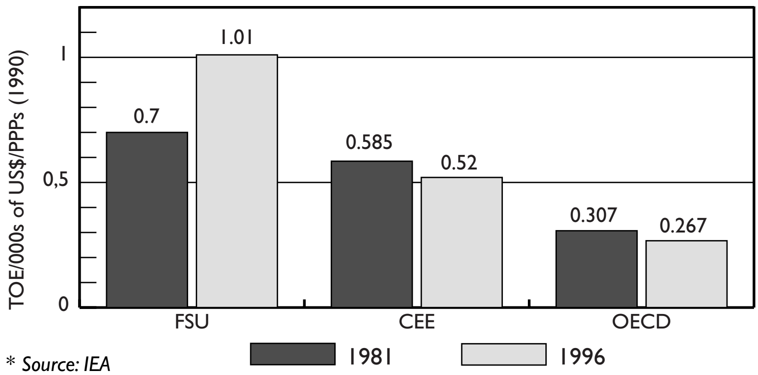
Energy intensity levels in transition economies are much above the OECD's, even those of 25 years ago

Energy intensity levels in transition economies are much above OECD levels, even those of 25 years ago. IEA indicators show Russian space heating requirements 50% greater than in Nordic countries (adjusted for climate and house size). Manufacturing energy use per tonne of output is up to twice the level in western European countries. Energy intensity has actually increased in the FSU since 1990. This underlines the urgency of increased investments in energy efficiency in these countries.

The energy efficiency potential in transition economies is higher than in OECD countries

There is evidence that energy could be more efficiently used in all economies. Estimates suggest a potential for cost-effective energy savings in the range of 10%-30% over the next two to three decades. The energy efficiency potential in transition economies is higher, given that these countries were shielded from the energy price shocks of the 1970s that triggered much of the energy savings in OECD countries. At current domestic energy prices the potential for energy savings in Russia is probably in the range of 40-45%.

Comparative Energy Intensity Levels



* *Source: IEA*

Potential energy efficiency investment in the CIS and Central and Eastern Europe is estimated at $40 billion with a pay-back of less than three years

Energy efficiency investments can be profitable, as witnessed by increasing Energy Service Company (ESCO) activity in some countries. They are imperative if industry is to remain competitive and provide gains in personal comfort and standards of living. The European Commission, EBRD and others have estimated the market for energy efficiency projects in the CIS and Central and Eastern Europe at $40 billion with a pay-back of less than three years. To date the level of investment is less than a tenth of needs.

Major investment barriers exist related to demand-side energy projects

Major investment barriers exist, not the least of them being the focus of multilateral development banks, commercial banks, and large investors in transition economies on supply-side investments. In part this is due to the small size of energy efficiency projects (making the fixed costs of arranging loans prohibitive) and to the lack of trained and skilled experts to develop bankable project proposals. On a macro-economic level barriers to investment include subsidised energy and heating prices, lack of enforceability of contracts, unstable investment environments and non-payment of energy bills. Barriers of a more structural/ technological nature compound the problem. These include lack of metering, the very structure of building and district heat supply systems and the uncertain future of many energy-intensive industries. The social changes in transition economies are also making implementation of energy efficiency projects at the residential level difficult, due to a lack of homeowner responsibility or housing associations.

Activities under the UNFCCC could create additional investment opportunities

Considerations of health, safety and environment will increasingly become a high priority for governments, private investors and the public at large. This will impose an even greater financial burden on transition economies, where past energy-related investments were undertaken without due consideration of the environment. Polluted areas posing serious human health risks will increasingly be made priorities for remediation. But lack of market-based mechanisms remains a key problem in accurately addressing environmental problems. Projects and activities under the UNFCCC have the potential for introducing an extensive amount of foreign direct investment.

■ Benefits from Investments in the Energy Sector

General benefits of investments in energy

Several studies show how energy investments provide a range of socio-economic benefits from improvements in infrastructure to transfer of technology, job creation, increased tax revenues and industrial and labour competitiveness. In general private investment allows the government to redirect its funds to other uses and public needs; i.e., into areas which will not attract private investment. By creating more private-sector employment, the tax base is widened and there is a reduction in the dependency and demands on the state (either in the form of state jobs or unemployment payments). Foreign direct investment in the energy sector compensates for deficiencies in local capital markets. At the same time it provides access to advanced technology, know-how and production techniques, as well as advanced management techniques.

Benefits in the UK and Norway

In the United Kingdom, studies of the impact of the oil industry on employment levels estimate some 28,000 employed in the offshore petroleum sector. Ten times more work in onshore jobs spread throughout the country, involved to varying extents in supporting and servicing the needs of the offshore industry. In a 1993 study, Statistics Norway assessed the impact, both direct and indirect, of the oil industry on its economy. The oil industry and its multiplier effect was credited with halving unemployment from almost 11% to about 6%. The Study estimated that GNP growth rates between 1972 and 1993 which averaged 3% would have been only 1% without energy investment.

The Alaskan experience

In the United States, the development of the Prudhoe Bay petroleum reserves has had a tremendous impact on Alaska, with over 47% of the state economy tied to oil production and oil investments accounting for almost 40% of total investment. About 30% of all Alaskans are employed in oil-related activities with 10,200 direct jobs created for each $1 billion invested and an estimated 50,800 total jobs if the multiplier effect is considered. Revenues from the development of energy resources can provide long term security as well. Since the 1970's, Alaska has saved a large share of its oil receipts and reinvested them into a diversified portfolio of assets outside Alaska. The Fund now totals some $24 billion with $750 million disbursed in 1997 or $1,300 to every Alaskan. In 1996 the total income from the Fund equalled total oil revenues. Other funds in oil producing countries and regions have not been as successful, due to lack of public scrutiny and oversight, poor investment choices or the use of the funds for short-term budget needs.

Conditions for Investment in the Energy Sector

■ Risk – Distribution and Reduction

Perceived risk affects investors' decisions

Perceived risk affects decisions on whether to invest and, if so, how much. The higher the risk, the higher the return demanded and, in most cases, the fewer the investors prepared to participate.

One of the most important considerations for potential investors will always be a country's level of political and economic stability. This is of course an issue which goes far beyond the energy field.

Commercial risk should stay with the companies

Private investors are better able than public bodies to judge and minimise commercial risks such as disappointing geology, project delays and cost overruns, or a failure of anticipated demand. If governments assume those risks (and private companies have been known to ask them to do so) the purpose of private investment is defeated. But Governments can act to reduce changes in legislation and policy which make the investment environment unpredictable and unfair.

International investors can be given additional assurance

A key element in risk reduction is predictability. Given the flight of capital from some countries, it is just as important to decrease political risk for nationals as for foreign private investors. Foreign investors are at a disadvantage because of remoteness and unfamiliarity with the local context. They can, however, be given additional assurance against political risk by international or bilateral treaties. The more unstable a country's perceived environment, the more benefit it will obtain from being party to an international agreement which enhances investment conditions.

In considering a potential investment, investors will evaluate other financial, regulatory, contractual and operational risks. Those for which governments are responsible are access to investment opportunities and operation once the investment is made.

■ Access to Investment Opportunities

Access to invest in the energy sector is normally regulated through licences, permits, concessions, contracts, etc. This section concentrates on bureaucratic difficulties and possible discrimination in obtaining such permits. In the energy sector, monopolistic structures are possibly the largest constraint on private investment. The existence and behaviour of monopolies and especially natural monopolies are analysed. New investment opportunities have and will be created through privatisation and reductions in monopoly power.

Difficulties experienced by one energy company in making an investment in a particular country will affect the willingness of other private investors to consider making investments there. In any case, the original company will have had plans to expand on its initial investment, either by developing other oil fields or by constructing petrol stations to sell the output of his refinery. Those investments too will be lost.

Bureaucracy/Administration

Especially small companies hampered by excessive bureaucracy

One of the most pervasive deterrents to private investment is the amount of bureaucracy and elaborate negotiations required at many different levels of administration, with many possible points for reopening matters. This is especially daunting to small and medium size companies.

Major investments in natural resources almost always require negotiations between the owner of those resources (often the State) and the investor. Moreover, in all countries major projects need to obtain a variety of planning and other consents from national, regional and local authorities. Again, the conditions under which investors may proceed while minimizing environmental damage are likely to require detailed negotiations between planning authority and enterprise.

Potential damage caused by excessive bureaucracy can be limited

The potential for damage caused by excessive administrative procedures can and should be restricted by:

- a close review of the requirements for permissions, licenses, etc. to see if all are strictly needed;
- covering as many of the requirements as possible by generally applicable rules that minimize the scope for administrative discretion and provide for appeals against refusals of permissions or unjustified conditions;
- minimizing the number of stages through which an application has to go and setting time limits for each stage;
- clear division of responsibility between different authorities;
- ensuring that consent once granted is irrevocable except on payment of compensation;
- training programmes for administrators in transition economies.

Discrimination

Ill-considered administrative requirements deter all private investors, both domestic and foreign, but they bear more heavily on the latter because of their unfamiliarity with local conditions. Some measures deliberately discriminate against foreigners wishing to make investments.

Coverage of investment admission in international treaties

The subject of investment admission is a relatively new issue in international agreements. Most bilateral treaties do not define obligations relating to the admission of foreign investments. The North American Free Trade Agreement (NAFTA) and the Supplementary Treaty to the ECT, on which general agreement on the text has been reached, do address this issue. In general, they contain an obligation to refrain from introducing new measures which discriminate on grounds of nationality, together with voluntary undertakings to reduce existing discriminations.

Examination of existing discriminatory measures

NAFTA has an annex enumerating all exceptions to non-discrimination. Exceptions in the energy sector have to be notified under the ECT. During the negotiation of the Supplementary Treaty to the ECT there was an extensive survey of exceptions. (These did not of course include exceptions in OECD-countries not taking part in the negotiations such as Korea, Mexico, New Zealand Canada and the United States). The main findings were:

- of the 50 ECT countries, 12 reported no exceptions. These included, among the G8 countries, Germany and the United Kingdom;
- slightly over 100 exceptions existed in matters such as land ownership, privatization, registration or screening, and reciprocity.

It was noted that many of these exceptions are not applied in practice and there is in any case a general commitment to remove all such exceptions over time.

Effect of discriminatory measures

It is doubtful whether the exceptions relating to registration and reciprocity have any substantial effect on admission to invest in the ECT-countries. Powers to screen and refuse foreign investments have been used very sparingly. Limiting foreign participation in privatisation can be very costly to the country concerned but it is less damaging to foreign investors, since there have been no restrictions on subsequent resale of privatized assets. Discrimination in land purchase, which existed generally in the transition economies could have a double effect on foreign investment, since it deprives them of a main source of collateral for loans and may raise siting problems. Lack of clear title to land may also affect domestic investors in transition economies. At the least, those countries which wish to attract foreign investment should ensure that there is an alternative to ownership in the form of secure, very long-term transferable leases.

Market Structure

High degree of liberalisation attracts investments

Private investors will equally examine the structure of energy markets in the host country. In general they will direct investments to markets where there is a high degree of liberalisation and no unnecessary restrictions on access, competition or trade. Minimisation of direct or indirect government interference is important in ensuring that markets operate effectively as is control of monopoly behaviour. Economies in transition are committed to energy market reform as part of their transition away from planned economy systems.

Steps towards a competitive market

There are a number of possible steps on the way to a competitive market:

- contracting some functions out to the private sector;
- abolishing legal monopolies;
- encouraging joint ventures between state and private companies;
- adopting new legal provisions while encouraging the entry of private companies into a monopoly company's field of activity;
- limiting vertical and horizontal integration;
- privatisation.

Essential reforms prior to privatisation

Studies covering the 55 OECD and ECT countries show that the prevalence of energy monopolies varies from nil in some countries to almost 100% sectoral coverage in others. Monopolies vary significantly between and within countries in terms of coverage, responsibilities, organisation, independence of government and how they are regulated.

Legal monopolies tend to be sectors with inherent monopoly features

For oil, only two out of the 55 countries maintain a legally protected monopoly on production, and there are virtually no monopolies downstream. In a handful of countries there are de-facto monopolies with only one state-owned company which has no legal protection of its monopoly position. Gas has historically had a high degree of monopoly. While no country has a monopoly on gas production, approximately 20% of them have a legal monopoly for gas transport, and authorisation to export is often limited. Effective monopsonies for the purchase of gas production also exist. On the gas distribution side, the prevalent model is a network of regional monopolies. More than half the countries maintain legal monopolies encompassing the electricity sector (production, transmission and distribution). Reforms in the gas and electricity sectors are, however, going ahead in a number of these countries, reducing monopoly structures.

Where competition exists there are benefits from privatisation

In the past two decades, there has been growing attention throughout the world to the behaviour of monopolies and state companies, and a general move towards liberalisation and reduction of government intervention. Studies so far support the conclusion that where it is possible to establish competition in the energy product market, demonopolisation gives clear and measurable benefits. When competition is limited or absent, there is no clear evidence that private firms are more efficient than publicly owned companies. In the absence of competition private firms have to be regulated, which can also significantly reduce efficiency gains.

Separation of monopoly activities from potential competitive activities

There may be arguments for maintaining a state enterprise to operate a justifiable monopoly activity. If, however, that enterprise engages in competitive as well as monopoly activity, the economic distortions resulting from cross-subsidies and the deterrent effects on other potential investors may be very damaging, and they should therefore be strictly controlled. Accordingly, competition policy must give a high priority to separating justifiable monopoly activities from those activities where competition can be introduced.

Competition has been tested out in a few countries

Several approaches have been introduced to minimise the functional extent of the monopoly or dominant positions and to reduce their ill effects. The two main approaches are to separate production or generation from other functions (which may in turn be further separated) or to promote periodic competition for the ownership of systems. In Norway, all customers of electricity, including individual households, can choose a new supplier for a fee of $30. The local distributor is subject to regulated third party access, while the main transmission lines are owned by one company providing open access. In England and Wales, a similar system exists for gas and electricity in the commercial and industrial markets, and residential markets are being liberalised.

The existence of state industries may discourage private investment

In some countries state industries have been seen as a better option than that of maintaining detailed regulation in sectors with strong monopoly characteristics. State companies can also be a means of securing such benefits as the performance of public service obligations or regional equality of tariffs. The maintenance and establishment of state industries may, however, tend to discourage private investment, even if they are not accorded monopoly rights or dominant positions. They pose two inherent risks:

- while steps can and should be taken to avoid Government interference in day-to-day operations, it is difficult to avoid distortion of commercial objectives by political considerations. Even in the absence of government intervention, state enterprises could give priority to their own political agenda by over-investing in security, expanding their systems beyond the point of cost effectiveness, taking on new functions or seeking autarchic solutions when normal market solutions would be less wasteful;
- state industries can and should have financial objectives set for them both in aggregate and for individual activities. But the state companies are likely to be involved in the shaping of those objectives and will be capable of hiding or excusing any failures in achieving them. Financial objectives are no substitute for the disciplines of the market.

Monopolies may successfully balance supply and demand, particularly if, as in the gas industry, they control both sides of the equation. They may also, by shadow pricing, achieve a good allocation of resources which maximises the sum of consumer and producer surplus. But, whether in state or private hands, they will lack the dynamic advantages of private entrepreneurs in competitive markets. If they are also state entities, their net investment requirements will be borne by the state and may therefore reduce the scope for other public expenditure.

Companies often want to reduce competition

It is of paramount importance that once direct regulation has been abandoned or a monopoly has been broken up, competition laws (in particular with regard to mergers and acquisitions) should be put in place and fully applied. A concern in all countries, but particularly in many transition economies is that there might be no practice or policy to control mergers. Potentially, some of the advantageous competitive structures may be lost if merger activity is not vigorously controlled. The public authorities need adequate powers to monitor markets and prevent the subversion of competition. The UK power market is a case in point, where reintegration via ownership links became an issue in 1995 as soon as the initial restriction on mergers and takeovers was lifted.

No provisions against monopolies or state companies in treaties

International standards do not exclude monopoly situations, but there is an emerging consensus that the move to a market based economy should take place in the context of respect for basic principles such as non-discrimination. The IEA countries have a long experience with strengthening market policies in the energy sector. All the G8 countries together with the other Energy Charter signatories have taken on a political commitment to strongly promote access to local and international markets taking account of the need to facilitate the operation of market forces and promote competition.

The fewer the restrictions – the larger the benefits

Under certain conditions, privatisation is a valuable option for liberalising markets. The main objective is to obtain the efficiencies of a competitive market system. The fewer the restrictions on eligibility to buy shareholdings, the more money is likely to be obtained for the privatised asset and the more efficiently it is likely to be run in the future.

There are particular reforms which are essential or highly desirable before privatisation:

- restructuring of the enterprise to be privatised so that it does not have a monopoly or dominant position;

- elimination of any remaining problems of non-payment or payment in kind, and introduction of effective bankruptcy procedures;
- introduction of proper company law and rules of corporate governance so that minority shareholders cannot be cheated or managers protected from commercial disciplines.

There are other problems in achieving competitive markets, particularly in the energy sector. The most difficult derive from the monopoly characteristics of the fixed transport systems needed to move electricity and gas, and to a lesser extent other fuels, to their consumers. The monopoly character depends on the cost of entry for a competitor. The cost of having parallel distribution systems for gas and electricity competing in the same area is very large. These costs are however changing with technological and administrative developments (telecommunication is a good example).

Access to grids important for investors

Access to systems for transporting energy to consumers is vital to the viability of investments in crude oil and natural gas production, and in electricity generation. Depending on geographical location it may also be important for investments in the downstream oil sector. Before committing themselves to a long-term investment, companies will want to be sure that they can move their product to domestic and/or foreign markets on economically viable terms.

But the behaviour of monopoly transport network owners may jeopardise investment decisions. A monopoly or dominant network owner may be motivated to make excess profits and/or to create for itself a competitive advantage in product markets. The establishment of regulated, separate network companies will remove the cross-subsidies to other sectors and control profits.

Independent regulation of integrated transportation systems

Governments will need to clear the way for new private investments in energy production and generation by providing a legal framework ensuring access to energy transportation systems. The extent and manner of safeguarding access, including tariffs and other conditions, depends on particular circumstances. Strong competition rules may be sufficient in some cases to prompt a satisfactory deal between the network owner and producer or customer. Regulation is not always easy; if private risk investment is to be attracted to transportation systems as well as to production, then a balance has to be found between producers, transporters and consumers; and among the original users of the system, who will have borne the main risks, and newcomers.

Increasingly, direct government influence is transferred to independent regulators

Different approaches will apply in dealing with the monopoly characteristics of electricity and gas industries depending on whether the industries are in the public or private sectors. In recent years, there has been a clear trend away from strong direct influence by government on state-owned companies to a more arms length relationship and creating greater commercial orientation in state company management. Increasingly electricity and gas industries are subject to control by regulators who are independent of both government and the regulated sector.

Independent regulation of energy industries is established practice in the United Kingdom, United States and Canada. For countries with economies in transition, for example, in Russia, the establishment of the Federal Energy Commission with responsibilities in the area of access to the oil export system, and oil and gas pipeline and electricity tariffs, is a valuable step in this direction. Its independent status will be vital to its ability to achieve its goals.

Co-ordinated approach reduces investment needs

Particular problems may arise in relation to integrated network systems connecting a number of points of origin and points of destination in more than one country. The most beneficial arrangement overall may not be the optimum for each of the individual countries, and arrangements for ensuring that benefits are fairly shared will not be easy to establish. The multinational oil product system of the Rhine appears to have worked efficiently on the basis of a treaty. But some of the logistical systems for oil, gas and electricity in and between the Newly Independent States have broken down or are in danger. Formerly those systems were national and have become international through the breakup of the Soviet Union. The Newly Independent States may be tempted to create their own self-contained systems. This would result in allocation of more investment in infrastructure than a co-ordinated approach.

The Energy Charter Treaty establishes rights and obligations for importers and exporters wishing to transit another ECT country. It is the only multilateral agreement on grid-bound transit. It does not, however, guarantee mandatory third party access, interfere with purely commercial transactions or define appropriate tariffs. Transit is discussed in detail in a separate paper.

High cost energy resources have been and are developed world wide, while cheaper resources are left in the ground. This is an unfortunate consequence of the geographical concentration of resources and monopolistic behaviour coupled with large political uncertainties. This waste of resources can be reduced through closer economic and political co-operation, underpinned by international treaties.

■ Operation Once the Investment is Made

Once investments are made, companies will need to have the right to enjoy their investments without unreasonable interventions from governments or regulators, or discrimination in favour of their competitors. It will be essential for potential investors to know that their activities can be conducted under a coherent framework of law guaranteeing their rights and ensuring performance of contracts and other agreements. The rate and certainty of return from any given energy investment will depend crucially on the relevant tax system. Other important financial considerations will include access to investment capital and freedom from restrictions on international transfers. Access to markets and internal transport systems will be essential. Nor should companies suffer from restrictions on international trade in energy products, equipment or services.

Legal environment

Legislation governing energy investment needs to be transparent, stable, predictable and co-ordinated with other laws to make clear the overall legal regime. Otherwise it will leave scope for arbitrary decisions and be a serious disincentive to investors. If regulatory and fiscal power is shared between different levels of government, the demarcation of responsibility between these authorities should be clearly defined. This is a problem in many federal systems with large energy sectors, as each level of government tends to see the energy sector as a lucrative source of tax revenue for itself. In OECD countries, the various levels of governments have sought ways to co-operate in order to avoid deterring investors by excessive levels of combined taxation and overlapping or conflicting regulations.

Legislation governing energy investment needs to be transparent, stable, predictable and co-ordinated with other laws

Concerns about possibility of fundamental changes to the legal regime governing an investment

One of the worst fears for investors is the possibility of fundamental changes to the legal regime governing an investment which would undermine the fiscal or contractual undertakings that formed the basis of original investment decision. Delay in developing an adequate legal regime or reliance on piece-meal regulation also heighten investor uncertainty.This is a significant issue for transition economies These economies need to move more quickly to put in place comprehensive systems of legal regulation which will provide strong assurances to investors making large-scale long-term energy investments.

Pattern of stability needed through strong legal guarantees

There is consensus in the investment community about the level of guarantees necessary to offset political risk. Investors will base their investment decisions on an assessment of the soundness of the local legal regime in that respect. In OECD countries, it has taken decades to develop effective legal and tax regimes which balance public and private needs. Governments which cannot rely on an historical pattern of relative stability or long experience in a market economy must take positive actions to engender investment confidence and establish stability through strong legal guarantees. Participation in investment treaties, such as bilateral investment agreements and the Energy Charter Treaty, will do much to provide investors with the degree of assurance they need.

Certain absolute legal requirements in bilateral and multilateral treaties

Most bilateral investment protection treaties and multilateral treaties such as NAFTA, and specifically for energy, the Energy Charter Treaty (ECT) lay down certain absolute legal requirements. There are differences of detail but the more advanced provisions include:

- requiring a Contracting Party to fulfil obligations which it has entered into with an investor of another Contracting Party so that a breach of an investor's agreement with a host country will become a treaty violation;

- permitting investors to employ key personnel of their choice, regardless of nationality, so long as such personnel have work and residence permits;
- allowing a foreign investor freely to transfer out of the country, in fully convertible currency, the capital it has invested and any associated earnings;
- compensating foreign investors for losses resulting from civil emergency at least to the degree to which national investors are compensated and providing for full, adequate and prompt compensation if the loss results unnecessarily from the country's own actions;
- submitting expropriation to the tests of due process of law and national interest and providing for full, adequate and prompt compensation for assets expropriated;
- giving the investor a right to pursue binding international arbitration under the treaties' dispute resolution provisions.

Same treatment as national investor provides a general guarantee

Many actions by governments, e.g. to control the macro-economy or introduce environmental and safety legislation, can affect investment earnings. The best assurance here for the foreign investor is a guarantee that it will receive the same treatment as the domestic investor. International investment treaties provide for this guarantee.

Besides generally accepted standards for investment, investors and major lending and financing institutions have a need for a national legal regime that meets basic criteria for reduced political risk. In this context they have raised questions as to whether legislation in the transition economies does in fact provide appropriate assurances. In the case of Russia, major studies have noted that the existing Joint Venture licensing arrangements are based on an administrative system that views the Subsoil License as the supreme document, while the agreement among parties to the Joint Venture is only secondary. This exposes the investor to several significant risks. The terms of the license to use the subsoil are subject to unilateral change by new legislation and are terminable by the government on various grounds. It is subject to all applicable taxes at all levels of government, and no protection is provided against adverse changes in tax laws or other laws. There is no clear right to export, and disputes are not subject to impartial adjudication because there is no contractual relationship between the Joint Venture partners and the government.

Experience with PSAs

Experience in many countries has shown that investors regard Production Sharing Agreements (PSAs) as an alternative mechanism on which to base major investments especially while an overall tax regime is being drafted and put into place. The recent boom in investment in Azerbaijan shows how legal and fiscal arrangement for PSAs can attract investment, especially when it is underpinned by strong treaty obligations. Azerbaijan was among the first countries to ratify the ECT. It has signed PSAs involving total investment of over $30 billion since September 1994. In Russia, the Sakhalin I and Sakhalin II PSA projects are already underway. They are expected to bring the Sakhalin region more than $40 billion in investments over the next 10 to 15 years.

There are immediate and relatively low-cost measures to promote investor confidence

There are immediate and relatively low-cost measures that governments can take to promote investor confidence, such as becoming party to international treaties, bilateral and multilateral, which provide for basic guarantees for investors, including access to international arbitration. The Washington Convention on the Settlement of Investment Disputes and the Energy Charter Treaty are obvious examples.

Crime and corruption form a particular risk in the energy sector because of the large sums involved in any investment. Inadequate and vague laws, which provide scope for arbitrary decisions, wide discretion in their application or differential price controls provide opportunities for corruption and crime. Governments must balance the need to minimise the risk that mistakes may be made or delegated authorities may be abused in concluding agreements against the need to encourage private investment. If the approval requirements become too onerous or restrictive or the process too complex and lengthy, investors are likely to be deterred especially if there are other less risky opportunities to invest elsewhere.

If approval requirements become too complex and onerous, investors are likely to be deterred

Financial environment

The principles which form the basis of effective fiscal regimes have not fundamentally changed over the centuries. Adam Smith, in his "Wealth of Nations" published in 1776, described these principles as: Equality of treatment of taxpayers, Certainty for taxpayers as to the impact of the tax, Convenience of payment for taxpayers and Cost effective collection for the government. Today a multiplicity of approaches, levels of taxation and royalty regimes and differing levels of risk or attractiveness as perceived by the investor need to be taken into account. In a competitive world, governments have to match the need for revenue with the investor's perception of the opportunity cost of investing elsewhere.

Governments must match needs for revenue with investor perception of country and project risk

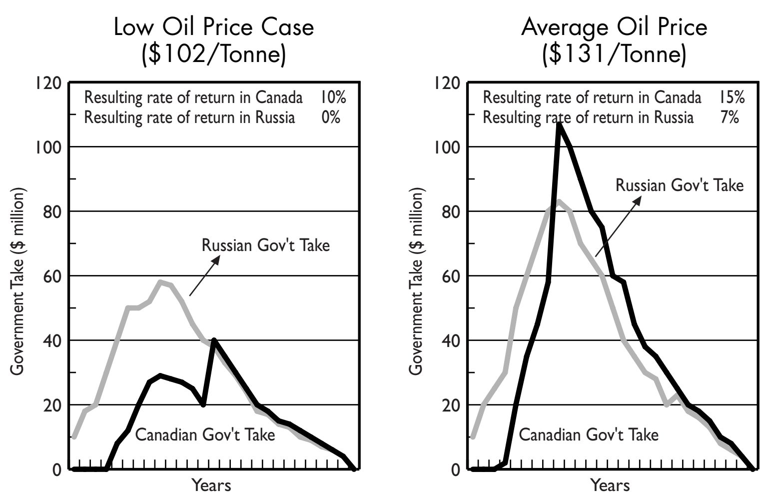
Risk of fiscal change is a major concern to investors making large upfront investments, especially in regions with little or no history of fiscal stability. Frequent tax changes are due in part to the nature of gross-revenue based regimes where governments need to make

Risk of fiscal change is a major concern to investors

adjustments to benefit from changes in prices or costs. Profit-based systems are more self-adjusting and give a better basis for investors to assess the fiscal impact over the life of their investment project. Such systems do not impose a heavy tax burden in the early years of production which would negatively affect projected rate of return. This can be seen in the chart below, which compares the impact on project rate of return and the tax revenues over the life of the same oil project under the Canadian tax system (a representative of profit-sensitive tax regimes) and under the current Russian tax system, which is essentially based on gross revenues. Taxation which aims to maximise short-term government revenue may jeopardise the long-term economic goals of attracting investments, providing long-term employment, income and a widening of the tax base. Finding the right tax structure is of particular importance to Russia where the oil & gas industry accounted for over 50% of federal government revenues in 1997.

Taxation that aims to maximise short-term government revenue may jeopardise long-term economic goals

Comparison of Government Take and Impact of Fiscal Systems on Project Rate of Return



A profit based tax system should be combined with an audit system based on accepted accounting principles

Conformity with OECD countries in the area of taxation will need to be combined with a sound and professionally run public and private audit system. That system should be based on generally accepted accounting principles, for purposes of checking and monitoring tax compliance under a much more complex tax system. This should in turn reduce the perceived need to set norms to control maximum allowable business costs, thereby reducing still further the differences between countries formerly run under central planning and OECD systems of taxation. This could lessen or remove altogether investor concerns about double taxation or problems with tax credit in home countries. Implementation of an effective Tax Code will be a key component to build and strengthen the ongoing process of reform to a market economy.

There should be no restrictions on international monetary transfers at the investment or operational stages, as investors will need access to capital from national or international lending institutions, consistent with normal commercial criteria.

Market operation

Free markets reduce costs

For most goods free markets have proved historically to be the most efficient means of matching bids and offers and reducing costs. Lack of correct feedback from the market can lead to serious distortions. Historically in the energy industry lack of proper market signals has more often led to too much investment and misplaced investment, rather than too little investment. But in some countries and some energy sub-sectors, the combination of a lack of market reform and inability to raise revenue for public sector investment threatens to result in too little investment, failures in supply and lost opportunities for export earnings.

Risks are not eliminated in markets

Markets do not eliminate risk. Expected demand may not emerge, competitors may obtain access to cheaper raw materials, new technologies may make a process or product obsolete, transport to customers may not be available on terms which allow profit, or may be interrupted. But, to the extent that risk can be reduced, investment becomes more attractive. Private investors may seek to transfer some of these risks to the public sector, particularly where an investment depends on negotiation. But Governments and other public sector organisations are less adapted to adjusting to risks and tend to fail on a grander scale when the risk has been miscalculated.

Non-payments seriously hampers the effective workings of the market

In transition economies the issue of non-payments is a major problem in making markets work, especially in the energy sector. Non-payment for energy and other goods continues to be a vicious circle. Large state-owned industrial and commercial companies are major "non-payers" both for services received and in wages. In Russia, inter-company non-payment is estimated at over $85 billion; non-payment to the United Energy Systems is estimated at over $16 billion and UES in turn owes huge amounts to Gazprom and other suppliers. This massive gridlock of debt makes investment difficult or impossible and paralyses much of the industrial sector. A number of transition economies have passed laws enabling utilities to cut off non-paying customers, but most such laws have been watered down by exceptions and are difficult to implement in practice. International non-payment among transition economies is also a major problem (especially for gas). Russia has concluded debt-for-equity swaps with a number of countries; problems remain, however, with some of them.

Doubtful benefits of interventions in market mechanisms

Government interventions in market mechanisms may be designed to attract private investment (e.g. protective tariffs, subsidies) or undertaken for political reasons. The beneficial effects of interventions to attract private investment are likely to be of limited long-term value because investors have no assurance that what Governments did, they will not undo. Examples in the energy sector of such interventions are:

- price controls in the absence of a monopoly situation;
- subsidies;
- tariff structures distorted by regulation;
- local purchasing requirements;
- import tariffs;
- export tariffs and quotas;
- requirements to supply equipment from the home market;
- pressures to construct or use domestic refineries.

The World Trade Organization has rules that ban or control many such measures. The Energy Charter Treaty applies most of those rules in the energy sector to the non-World Trade Organization parties (with the exception of tariffs for which there is a separate regime).

Other Government interventions may be made for non-economic reasons, to protect the environment, enhance safety and health, protect poor consumers etc. These may in fact have the incidental effect of increasing investment.

Recommendations to Governments on Energy Investment

Governments should address the need for attracting higher levels of private sector investment by liberalising energy markets and ensuring fair competition, including control of monopoly behaviour.

Procedures for granting investment rights should be reasonable, practical, transparent and based on published criteria.

Where investment opportunities are generally available, the scope for private sector investment should be maximised by giving companies equal access to those opportunities without discrimination by nationality or on other subjective grounds. The national economic benefits arising from a particular investment will not be determined by the nationality of the investing company.

Privatisation opportunities should, except in very limited cases of clearly defined national interest, be open to companies without discrimination on grounds of nationality. There should be no constraints on subsequent resale and purchase of shareholdings or other assets after privatisation.

Investment prospects should be enhanced by a stable and comprehensive framework of national law, properly implemented at all levels of administration, including enforceability of contracts, debt recovery mechanisms and recourse to effective national and international dispute settlement procedures. The respective responsibilities of national, regional and local authorities should be clearly defined. Investors should receive effective protection from crime and corruption.

In countries where the legal framework for upstream oil and gas investments and the relevant taxation rules do not yet provide sufficient confidence to investors, Governments should include effective alternative options such as Production Sharing Agreements into their policies.

Taxation systems should be clear, stable, non-discriminatory and based mainly on profits rather than on gross revenues or production.

No constraints should be placed on international financial transfers relating to energy activities, or on access to capital funding.

To enable resources to be allocated efficiently, Governments should allow energy prices to reflect market conditions.

In accordance with international standards, there should be no discrimination in the operation of national energy markets.

Governments should have legal regimes ensuring access to energy transport systems on fair terms, under rules applied by operationally independent regulatory authorities.

Companies should be free to sell their production in foreign markets through the full application by governments of World Trade Organization Rules. Consistent with World Trade Organization Rules, there should be no barriers to purchases of energy equipment, services or technology from the most economic source, whether that source is within the country concerned or abroad. Government policies in this area should acknowledge the benefits of transfers of modern technologies.

As well as energy supply projects, investments in energy efficiency and environmental quality should be given high attention in energy investment policies.

The governments concerned should continue to pursue, as a matter of priority, ratification of the 1994 Energy Charter Treaty. The Treaty remains open for accession by other countries.

REFERENCES

ARMSTRONG, Mark, COWAN, Simon, and VICKERS, John, 1994. *Regulatory Reform - Economic Analysis and British Experience*. MIT Press: London, UK.

BONBRIGHT, James C., DANIELSEN, Albert L., and KAMERSCHEN, David R, 1988. *Principles of Public Utility Rates*. Arlington.

BREALEY, Richard and MYERS, Steward, 1984. *Principles of Corporate Finance*, McGraw-Hill Book Co. (New York, USA), pp. 172-173.

CAMBRIDGE ENERGY RESEARCH ASSOCIATES, 1997. *Electric Power Watch North America*, Summer.

CULY, J.G., READ, E.G. and WRIGHT, B.D., 1996. "The Evolution of New Zealand's Electricity Supply Structure", in Richard J. Gilbert and Edward P. Kahn (eds.), *International Comparisons of Electricity Regulation*, Cambridge University Press (Cambridge, UK), Chapter 8, pp. 312-365.

DEMPSEY, Paul, 1992. "Lost in the Bermuda Triangle". In *The American Prospect*, Winter 1992.

DILLON, Graeme, 1996. Presentation to the *First Meeting of the Association of Power Exchanges*, The Association of Power Exchanges (London, United Kingdom), September 1996.

DILNOT, Andrew; and HELM, Dieter, 1989. "Energy Policy, Merit Goods, and Social Security". In Helm, Dieter; Kay, John; and Thompson, David (eds.), *The Market for Energy*. Oxford.

ECONOMIST, 1996. "Short Circuit." The Economist, 13 April 1996, pp. 31-33.

ENERGY INFORMATION ADMINISTRATION, 1996. *The Changing Structure of the Electric Power Industry: An Update*, DOE/EIA-0562(96), United States Department of Energy, Energy Information Administration (Washington, DC).

ENERGY INFORMATION ADMINISTRATION, 1997. *Electricity Prices in a Competitive Environment: Marginal Cost Pricing of Generation Services and Financial Status of Electric Utilities*, DOE/EIA-0614, United States Department of Energy, Energy Information Administration (Washington, DC), August 1997.

FEHR, N. Von der and HARBORD, D., 1997. *Competition in Electricity Spot Markets. Economic Theory and International Experience*. Mimeo.

FORRESTER, Paul, 1997. "Wanted: a New Financing Model (and Acronym?) For Merchant Power Projects". *Power Economics*, Vol. 1, Issue 1, February 1997.

GHOSAL, Vivek, and LOUNGANI, Prakash, 1996. "Product Market Competition and the Impact of Price Uncertainty on Investment: Some Evidence from US Manufacturing Industries". *Journal of Industrial Economics*, Vol. XLIV, No. 2, June.

GUNDERSON, James, 1994. "Derivative Instruments for Energy Industries". *Energy Financing*, 1994.

HAERI, Hossein, KHAWAJA, Sami and PERUSSI, Matei, 1997. "Competitive Efficiency: A Ranking of US Utilities". *Public Utilities Fortnightly*, 15 June 1997, pp. 26-33.

HANSEN, Teresa, and SMOCK, Robert, 1996. "Gas Turbines Aim at World Power Market Dominance." *Power Engineering*, June 1996, pp. 23-32.

HELM, Dieter; KAY, John; and THOMPSON, David (ed.), 1989. *The Market for Energy*. Oxford, 1989.

HILL, Lawrence J., 1996. *Economic Efficiency Considerations in Restructuring Electricity Markets*, ORNL/CON-436, Oak Ridge National Laboratory (Oak Ridge,TN, USA), pp. 37 ff.

HUNT, S. and SHUTTLEWORTH, G., 1996. *Competition and Choice in Electricity*. J.Wiley & Sons Ltd.West Sussex, England.

IEA, 1997. *Electricity Information 1996*, International Energy Agency (Paris, France).

IEA, 1999. *Electricity Market Reform - An IEA Handbook*, International Energy Agency (Paris, France).

JONES, Ian, 1989. "Risk Analysis and Optional Investment in the Electricity Supply Industry". In Helm, Dieter; Kay, John; and Thompson, David (ed.), *The Market for Energy*. Oxford, 1989.

JOSKOW, P., 1997. "Restructuring, Competition and Regulatory Reform in the US Electricity Sector". *Journal of Economic Perspectives*, Vol. 11, No. 3, pp. 119-138.

KAHAN, Mark S., 1992. "Confessions of an Airline Deregulator". In *The American Prospect*, Winter 1992.

LONDON ECONOMICS, 1997. *Setting Prices for short and Long Term Reliability*. Mimeo. December.

NATIONAL POWER, 1995. *The First Five Years*. Brochure by National Power (Swindon, UK).

NUCLEAR ENERGY INSTITUTE, 1999. *US Nuclear Power Plant Average Capacity Factors, 1980-1998*. Information sheet on internet web site www.nei.com. Nuclear Energy Institute (Washington, DC, US), September.

NUCLEAR NEWS, 1997. "Performance Indicators - Continued Progress for the US Nuclear Industry", *Nuclear News*, May 1997, pp. 40-43.

NUCLEONICS WEEK, 1994. "NE Says Nuclear kWh Costs Cut by 40% in Five Year's Operation," Nucleonics Week, 1 December 1994, p. 3.

OECD, 1997. *Communications Outlook*, Vol. 1 and 2. Organisation for Economic Co-operation and Development (Paris, France).

OECD, 1997. "Regulatory Reform in the Electricity Sector," in *Regulatory Reform*. Organisation for Economic Co-operation and Development (Paris, France).

OECD, 1998. *Projected Costs of Generating Electricity - Update 1998*. Organisation for Economic Co-operation and Development (Paris, France).

OLARREAGA, Francisco, 1993. *Analysis of Electricity System Costs*. UNIPEDE Document 60.01.TARCOST, International Union of Producers and Distributors of Electricity (Paris, France).

PAFFENBARGER, John, 1997a. "Electricity Sector Financing". In *Asia Electricity Study*, International Energy Agency (Paris, France),

PAFFENBARGER, John, 1997b. *Oil in Power Generation*, International Energy Agency (Paris, France).

POWER IN EUROPE, 1996. "Italy's Anti-Trust Barks Again," *Power in Europe*, 8 March 1996, p. 219/2.

RYAN, 1997. "Many Nuclear Units Competitive if Corporate Costs Can Be Limited," *Nucleonics Week*, Vol. 38, No. 22, May 29, 1997, p. 1.

SCOTTISH NUCLEAR/ERM ENERGY, 1994. *Diversity in UK Electricity Generation: A Portfolio Analysis of the Contribution of Nuclear*. London, September.

SHMUEL, Samuel S., and OREN, P., 1996. *Service Opportunities for Utility Managers*. Cambridge, Mass.

TONN, Bruce, HIRST, Eric and BAUER, Douglas, 1995. *Public Policy Responsibilities in a Restructured Electricity Industry*, ORNL/CON-420, Oak Ridge National Laboratory (Oak Ridge, TN, USA).

UNIPEDE, 1998. *Programmes and Prospects for the European Electricity Sector*, Europrog 1998, International Union of Producers and Distributors of Electricity (Brussels, Belgium).

VIETOR, Richard H. K., 1990. "Airline Regulation and Deregulation, 1925-1988". *Business History Review*, 64, Spring 1990.

WAGSTYL, Stefan, 1997. "Power Equipment Hunt Heats Up," *Financial Times*, 15 July 1997, p. 5.

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Photo PIX - Printed in France by Louis Jean
(61 99 10 1 P) ISBN 92-64-16961-X 1999