CHAPTER - I
INTRODUCTION

Electricity is the prime mover of growth and is vital to the sustenance of modern economy. The projected growth of Indian economy depends heavily on the performance and growth of power sector. It is the endeavor of the Government to ensure that agriculture, industry and commercial establishments and all the households receive uninterrupted supply of electricity at affordable prices. The Ministry of Power envisions reliable, affordable and quality supply for all users by 2012. In the prevailing situation, this might appear to be an ambitious goal. However, we have to achieve this objective if the nation is to attain rapid economic growth and ensure the desired quality of life in keeping with infrastructure attainments worldwide.

1.1 Backdrop of Power Sector Reforms

During the 1990s, electricity sector reforms were part of a seismic shift in India from a closed toward a more open economy. From Indian independence in 1947 until the mid-1980s, the state played a strong role in planning and implementing strategies for economic development. Internal and external pressures to rethink this approach emerged in the 1980s, as the country went through a moderate recession. These views were endorsed primarily by strong statements from development agencies that their borrowers would henceforward have to increasingly look to international capital markets for their financing needs. The immediate impetus for action was a serious balance of payments crisis in 1991. The response was to liberalize investment in key sectors of the economy, including electricity, to reduce licensing restrictions on industry, lift government controls on the financial sector, and partially free currency transactions. Both the intent, and the actual policies, marked a significant departure from the previous 40 years of government policy.

Operating under the Electricity Act of 1910, private companies or local authorities supplied more than 80 percent of the total generation capacity in the country prior to independence in 1947 (World Bank, 1993b). In 1948, the Electricity Supply Act 1948 brought all new generation, transmission, and distribution facilities within the state’s purview. Each state subsequently established its own vertically integrated state
electricity board (SEB). Significantly, SEBs were financed through state government loans and were run as extensions to state energy ministries. As a result, SEBs were “indebted in perpetuity,” and were forced to continue in a relationship of financial dependence and administrative thrall to energy ministries. Nonetheless, SEBs were the backbone of the electricity infrastructure, and by 1991 controlled 70 percent of electricity generation and almost all distribution (World Bank, 1991. Under the Indian constitution, the electricity sector is a “concurrent” subject, allowing both the central and state governments some authority in the sector. SEBs are under the control of state governments, which also controlled the critical tariff-setting function. The central government was responsible for electricity policy, long-term planning, technical analysis, and project approvals through the Power Ministry, Planning Commission, and Central Electricity Authority. Despite the accomplishments, there were reasons for concern about the future of the sector. Well before 1991, the sector had been locked into arrangements with electricity users, and into management practices with negative long-term implications. These arrangements constrained future reform efforts. With the growing consensus favoring a shift in macroeconomic policy, spurred by the balance of payments crisis, India was set to press the accelerator and motor into the next century. The electricity sector was at the forefront of the new liberalizing India.

1.2 Early Development of the Electricity Supply Industry (ESI)

‘As far as domestic applications are concerned, electricity has wrought a revolution that is so complete that it is virtually taken for granted in most homes in the advanced industrial societies’ — Buchanan in ‘the Power of the Machine’.

Electricity providers are commonly grouped in the category of ‘utilities’, along with providers of services such as clean water, waste water removal, gas and telecommunication (Lomas,1999). While electricity provision is commonly regarded as a basic utility that is noticeable in the most developed economies only when it fails, in developing countries electricity provision remains a core aspiration and development indicator. The electricity industry is a young one, post dating the industrial revolution. Whilst electricity was known by the ancient Greeks in the form of static electricity, it was not until the ‘second electrical revolution’ of the 1880’s that power for lighting and motors was used to any degree, while still over a quarter of the world’s population does
not have access to electricity (Strange, 1979). The early days of the Electricity Supply Industry (ESI) were driven by discovery and private enterprise. Whilst experimental usage grew during the 19th century, for example the lighting of an opera in Paris in 1844 with arc lights, it was the growth of public incandescent lighting using power stations as a source that marks the beginning of the ESI (Bower, 1982). Development during the first 15 years was rapid as we can see from the chronology below:

- 1878 Creation of incandescent light bulb by Swan in the UK
- 1878 Street (arc) lighting in Paris
- 1879 Creation of long lasting incandescent light bulb by Edison and Jehl in the USA
- 1881 Opening of Godalming power station in the UK
- 1882 Opening of Pearl Street power station in the USA
- 1882 First transmission lines in Germany (2400v DC, 59km)
- 1883 Holborn viaduct power station in the UK
- 1885 Commercially practical transformer (William Stanley)
- 1885 Hydro power station and 56km transmission in France
- 1885 Public electricity supply in Norway
- 1887 Interior lighting in Lloyds Bank, London UK
- 1887—9 High voltage alternating current transmission in Deptford, UK
- 1887 Public electricity supply in Japan
- 1889 Single -phase alternating current transmission (4kV, 21 km) Portland Oregon, USA
- 1893 Three phase AC transmission (12kv, 179km) Germany
- 1894 generators used to supply motor pumps in mines in Malaysia
- 1895 Public electricity supply in Australia

In Great Britain, for example, by 1909 there were already laws denying new entry without license and by 1914 there were 70 power stations in London. Soon after this
burst of development were attempts to standardize. For example, the first attempt to standardize frequency to 60Hz in the USA was in 1891, although Southern California Edison did not convert from 50Hz to 60Hz until 1949\(^1\).

1.3 **Characteristics of Electricity**

Electricity has several unique characteristics that distinguish it from the other commodities such as oil or natural gas and make marketisation of electricity a different proposition. The following are the unique characteristics of electricity:-

1. For all practical purposes, electricity cannot be stored economically except to a limited extent through pumped storage

2. Hence, continuous supply-demand matching is required. If supply falls short of demand, the frequency falls below the value for which generating and utilization equipment is designed and if supply exceeds demand, frequency rises above the frequency that is healthy for generating and utilization equipment.

3. Demand varies hourly, daily and seasonally with the peaks in demand being well above the ‘average’ demand

4. Electricity has become so essential that demand is relatively price-inelastic.

5. Electricity is very easy to control in the sense that a supplier can easily turn the supply on or off.

1.4 **The Lifecycle of Electric Power**

Central to almost all aspects of electricity is the issue of storage. Whilst most commodities can absorb production and demand variations by delivering to stock and withdrawing from stock, this cannot be done for electricity. While we shall see that there are various methods that amount to storage, for the moment we can assume that electricity must be consumed as it is produced.

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\(^1\) In the history of electricity, no single defining moment exists. The way we produce, distribute, install, and use electricity and the devices it powers is the culmination of nearly 300 years of research and development (Leposky, 2000).
The essential stages in the lifecycle in electric power are:

1. Energy sourcing;
2. Power generation;
3. Network transmission
4. Supply management;
5. Consumption.

There are in addition three essential activities that can be considered as part of the supply chain, since every megawatt (MW) of electricity that passes through the network passes through them.

They are:

6. System operation;
7. Market operation;
8. Metering.

And finally, something that cannot be ignored, which is:

9. Disposal and environmental impact.

**Energy Sourcing** — Starting with the energy source, a natural asset under (initially) common ownership must be exploited to create electricity. This source might be underground e.g. nuclear, hydro, thermal etc. (IEA, 2001c).
**Power generation** — Power generation is the process by which an *in situ* energy supply is converted to electricity and delivered into the electricity transportation infrastructure or directly to a ‘host’ load. To deliver into the infrastructure requires a high degree of control of the electrical product. To generate power, requires not only a source of energy, but fair physical and economic access to the full energy source infrastructure, which may include pipeline or rail, road, and ports. Similarly, the generator requires fair physical and economic access to the consuming customer. This requirement may be limited, in the form of adjacent host load, or extensive in terms of geographical distance, and barriers in the forms of regulation, laws and local factors (Tucker, 1977).

**Transmission** — A process in the delivery of electricity to consumers, is the bulk transfer of electrical power. Typically, power transmission uses an electricity network connecting the power plant to multiple substations to the consumers. Electric power transmission allows distant energy resources (such hydro power plants) to be connected to consumers in population centers. Due to large amount of power involved and to reduce losses; transmission normally takes place at high voltage (Hughes, 1983).

**Supply management** — While consumers require all of the upstream activities, such as generation and transportation, to occur, electricity is delivered to most consumers as a ‘bundled’ retail product. Consumers pay a price to the suppliers for the delivered product, and the suppliers arrange everything else.

**System operation** — System operation is electrical management of the system, particularly in the short term (less than one day). Because of the need for production and demand to match perfectly and continuously (to a resolution of fractions of a second), then in the short term there is no time for multilateral interactions, and a single system operator must coordinate.

**Market trading** — In the more mature markets, electricity is traded several times from the first producer sale to ultimate consumer delivery.

**Market operation** — Market operation involves the commercial arrangements for energy and capacity trading between participants and the system operator, and coordination of such commercial arrangements between participants.
**Metering** — While cost is incurred at all points of the supply chain, there is only one source of revenue — the consumer. To pay for electricity, the consumer must have a definitive price and amount to pay for. The meter is clearly the source of information, but in practice the processes are highly complicated. Hence metering is regarded as an important and distinct part of the supply chain².

**Disposal and environmental impact** — This can variously be regarded as the last stage of the lifecycle of electricity, a by-product of electricity production, or an input factor. Whilst the impact is predominantly incurred in the generation sector, it is rendered inevitable by the act of consumption.

### 1.5 Drivers for Reforms in Electricity Sector

In the last twenty years the electricity power sector in both developed and developing countries has been subject to restructuring. Although the approaches to reform have varied across countries, the main objective has been to improve economic efficiency of the sector by introducing capital, liberalizing markets and introducing new regulatory institutions.

In most countries infrastructure activities such as electricity supply has been viewed as strategic activities with ‘natural monopoly’ characteristics. These monopoly characteristics result from the existence of economies of scale and scope. Hence, the view has been that supply is best provided by vertically integrated monopolies owned by government. However, over the last two decades, the notion of ‘natural monopoly’ has been rejected in electricity generation and supply and these parts if the supply chain have been opened up to competition; though transmission and distribution systems still retain important economies of scale that usually limit the scope of competition.

A number of studies and reports have already described the principal driving forces behind electricity reforms (Bacon, 1995; World Energy Council, 1998; Patterson, 1999; International Energy Agency, 1999). Although they may not be present in every country that is reforming its electricity sector, they can be summarized as:

1. The poor performance of state-run electricity operators in terms of high costs, inadequate expansion of the access to electricity services and unreliable supply.

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² An electric meter or energy meter is a device that measures the amount of electrical energy consumed by a residence, business, or an electrically powered device. Electric meters are typically calibrated in billing units, the most common one being the kilowatt hour. Periodic readings of electric meters establish billing cycles and energy used during a cycle (Wikipedia, 2009).
2. The inability of the state sector to meet the investment and maintenance costs of the electricity industry, in order to keep pace with the increasing demands for power resulting from economic development in other sectors of the economy.

3. Rapid changes in the technology in both the generation of electricity and in the computing systems used to meter and dispatch power, making new industrial structures possible.

4. The need to remove electricity subsidies so as to release resources for other areas of public expenditure

5. The desire to raise immediate revenue for the government through sale of assets

6. The demonstration effects of the pioneering reforms of the power sectors in Chile, England & Wales and Norway in the 1980’s.

7. Pressure for reforms from international financial organizations and donor agencies such as IMF and World Bank through their ‘lending for institutional reform’ programmes.

Figure 1.3: Drivers for reforms

Source: Ministry of Power, Govt. of India
Like other countries India too has responded to changing electricity scenario by undertaking various reforms to bring about efficiencies in the sector. The reform programmes adopted have the following main elements:

1. Introduction of competition to the sector to improve efficiency, customer responsiveness and innovation.

2. Restructuring of the industry in order to enable the introduction of competition. This means breaking up or ‘unbundling’, the incumbent monopoly utilities possibly into separate generation, transmission, distribution and supply providers.

3. Privatization of the unbundled generators and suppliers. It is expected that entities under dispersed ownership will facilitate competition and that private investors and operators will bring in financial resources and managerial expertise into production and supply, previously dominated by sleepy state-owned monopolies.

4. Development of new regulatory framework (Electricity Act 2003) Instead of direct regulation by a government department, the establishment of ‘independent’ regulatory bodies (CEA & CERC) This form of arm’s length regulation is expected to encourage private capital. Privatization requires investors to sink funds into assets in the electricity sector that may have little if any residual value if government reneges on power contracts, say in the form of failing to take supplies or preventing price increases when input cost rise. Energy supply and prices are always interest to politicians because supply failures and sharply increase prices can provoke social unrest. Some form of independent regulation can provide reassurance to investors that prices, outputs and inputs will not be politically manipulated (Jamasb & Pollitt, 2001).

1.6 The Liberalization Paradigm

Whilst ‘deregulation’ has a specific meaning (stepwise opening of the monopoly sectors with regulated prices to competition), liberalization has a more informal use. There are essentially three components to liberalization in the ESI.
1. Reduction of the role of the state, in terms of ownership, command and control, prescriptive solutions and direct cross subsidy.

2. Creation and enhancement of competition by deregulation, vertical de-integration (Unbundling), horizontal de-integration (divestment) and regulated third party access.

3. Increasing choice for consumers and participation in short and long term demand management and responsibility to secure their energy.

1.7 Process of Liberalization ESI

To address the critical challenges facing their power sectors, many developing countries are now reforming the way that electricity services are provided. They are now opening power generation to private investment, further privatizing transmission and distribution, and even restructuring the sector to introduce competition and independent regulation. Governments are reforming the electricity sectors to stimulate private investment and thus free up large amounts of public capital for other uses, to promote managerial accountability and better customer service, and to reduce
government deficits and international debts (World Bank, 1995). Most countries are undertaking liberalization in some form, though the starting point, pace and scope varies in each country. So there is ‘No one size fits all’ and is tailor-made according to the needs, demography, economic, social and political conditions of the country.

The list below is in approximate order, though it may vary from country to country:

1. Corporatisation;
2. Unbundling;
3. Ring fence chosen sectors. For example, nuclear, hydro, grid; privatization;
4. Forced divestment and fragmentation of the incumbent utilities; deregulate;
5. Privatization
6. Deregulate;
7. Further fragmentation;
8. Further unbundling and opening to competition;
9. Re-integration of some sectors and cross-sectorial integration; re-consolidation;
10. Horizontal integration with other industries;
11. Entry of financial institutions into the wholesale markets; pressure on retail deregulation;
12. Further deregulation of networks and metering; revise model.

These changes are described below, ordered by logical sequence of explanation, rather than chronology.

1.7.1 Unbundling (and De-integration)

Unbundling is the process of breaking apart something into smaller parts. In electricity market unbundling is one of the foundations of ESI reform. In broader terms it is de-integrating vertically integrated utility into:

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3 Power sector can learn an important lesson from two comparable sectors — telecom and cable TV. How were these two sectors able to meet the consumer needs in a short time? This happened because both these sectors were liberalised and investors were allowed to make profit with no political interference.)
- Generation
- Transmission
- Distribution
- Retail services

In the extreme, vertically integrated utilities (providing generation, transmission and distribution and retail services) are unbundled into legally and functionally distinct companies.

Variations among countries exist within overall framework of unbundling. (Hunt & Shuttle, 1996) The variety of market structures can be categorized according to increasing competition. In some countries, independent generators sell to a single power procurement business. Such single-buyer model is appropriate for smaller systems, where the political gains from competition are too small to offset transaction costs.

Figure 1.5: Single buyer model

Also, some countries have separated electricity distribution from retail services, while others have kept them within the same company. The main risk with this model is that government can still impose uncommercial practices on the market by
manipulating the single buyer. An additional risk is that government’s commitment to full reform may weaken to avoid politically controversial consequences of introducing more privatization and competition (Lovei, 2001).

While the “wires” portion of the electricity sector (transmission and distribution services) is still considered a natural monopoly, competition may be introduced into the system selling the power to the grid (wholesale competition) and providing electricity to end-users (retail competition). Whole sale competition may take the form of independent power producers (IPP) bidding for long term contracts with power purchasers. Although many styles of bidding exist, commonly the utility solicits bids from projects sponsors and awards the lowest bid supplier, regardless of the type of generation. The selection emphasizes lowest fixed costs and the winning bidder receives the payment sufficient to cover fixed investment and operating costs. Purchasers tend to award contracts on the basis of capacity and energy costs in the first few years of a project’s 30 –year life span. (Cook & Kirkpatrick, 1997).

As an alternative to awarding long term contracts, some countries (such as Chile and Argentina) are creating spot and short-term markets for whole sale power. Under this model, multiple generators bid to be dispatched by an “Independent System Operator”. The ISO purchaser relies on competition to ensure that bids are kept low. (If individual generators constitute too large a share of the market, they can manipulate output or availability to increase profits. Generation projects that depend on spot markets for most of their revenues are called as “merchant plants”4.

In addition to wholesale competition, a few places (California, England, Norway and Wales) are experimenting with retail competition for some or all customer classes. Retail competition is feasible in areas with significant number of industrial and large commercial customers, who are typically more attractive targets for competing firms rather than residential customers. Consequently, governments can open competition for large customers and then phase in smaller customers.

Retail competition can be introduced through different methods. In one, multiple power generator have direct access to transmission and distribution networks

4 A merchant power plant is funded by investors and sells electricity in the competitive wholesale power market. Since a merchant plant is not required to serve any specific retail consumers, consumers are not obligated to pay for the construction, operations or maintenance of the plant (Meel).
(for a charge), allowing then to compete to supply final customers regardless of their location or who owns wires. In another, independent retail service providers (which don’t own any generation facilities) buy power from generators, contract for use of transmission and distribution facilities, and sell the power to final customers. Where distribution and retail function remain within the same entity, the service provider buys from wholesale power producers and contracts transmission access.

Fig 1.6: Multi buyer model

Source: Ministry of Power, Govt. of India

1.7.2 Corporatisation

Corporatisation is the process by which a government owned company with a public service franchise and purpose starts to behave like an investor owned company. This it has many elements:

1. The requirement of each entity not to lose money, with no cross subsidy from one entity to another. (Pareto optimality, applied within the firm).

2. Migration of some long term and high level responsibilities back to governments. For example nuclear decommissioning.

3. Public service becoming a requirement rather than a purpose.

4. Preparation for unbundling by internal transfer pricing and service level agreements.
5. Increased independence from the fiscal and monetary structure of the nation. For example, payment of taxes, payment for fuel.

6. End of requirement to create labour.

1.7.3 Ring fence some activities under state control

Regardless of ownership, the state is the ultimate guarantor of ESI performance. Accordingly, governments have been reluctant to relinquish control in some areas. The main three areas are described below.

- **Nuclear power** — This has commonly remained under national control because it has been considered that governments should be able to determine the amount of nuclear power generation in the future, those nuclear decommissioning funds can only be assured by public sector retention, that consolidation of nuclear power maximizes safety, and that overall public interest with respect to such a long term issue as nuclear power can only be served by having national ownership and accountability through the electorate.

- **Hydropower** — The case for public sector retention for existing large hydro plant for the protection of public ownership of natural resources is not particularly compelling in countries, which have been happy to privatize fuel and mineral extraction. However, the construction of large dams requires such significant tradeoffs between national and local environment that sometimes the public interest can only be best served by public ownership. The control of hydro dispatch is also highly useful for the system operator. In addition, international aid, commercial loans and ‘soft loans’ in relation to large hydro schemes and the sheer size of the schemes often call for a high degree of state involvement.

- **National grids** — National grids are commonly retained because it was felt, with some justification, that the grids form the focal point through which the industry is managed in the short and long term. By maintaining control of the grid, there was de facto control on every other sector, and by maintaining control of the grid, it was possible to form a coordinated view of security of supply, and then facilitation of whatever construction is required to alleviate this.
In each case, there is now an increasing level of private ownership.

1.7.4 Forced divestment and fragmentation of the incumbents

Competition is enhanced by increasing the number of participants. If the number of participants is one or few, then the number of participants can be increased by dividing up the incumbents into approximately equal or unequal sizes, or by forcing the incumbents to sell pieces of their business, such as power stations.

1.7.5 Privatization

When the state monopoly has been corporatised, vertically unbundled and horizontally fragmented, then the component parts can be privatized, one at a time, or all together. While privatization of public enterprises in various economic sectors has been a widespread phenomenon, the electric power sector is typically one of the last enterprises to be affected because its functions are considered to be too vital for the state (Ahluwalia & Sanjeev, 2000.)

The traditional method of assigning new projects for private sector development is for the utility to draw up expansion plans and assign specific projects for private financing. Another approach is to specify capacity requirements and let the private sector identify least-cost sources. Several modes exist for private participation in power generation – for example Build – Own- Operate (BOO), Build-Own-Operate-transfer (BOOT), Build-Maintain-Transfer (BMT), and Build-Lease-Transfer (BLT)

Power- purchase agreements (PPAs) are a key component of schemes in which private developers retain ownership of the generation facility (BOO).

Privatization is commonly associated with politically independent regulation of those power sector components that remain in monopoly control. Full privatization means that the private sector operator takes its revenue from final customers. Regulation is supposed to ensure that the tariffs charged allow a fair return on its investment. Although tariffs may be reformed as a part of commercialization, the utility’s incentive to recover costs become stronger when private owner takes over. Allocating ownership to the private sector and giving regulatory functions to a public agency that is at least partially independent of political pressure increases the prospects

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5 Privatization transfers existing power sector assets to private ownership and allows private development of some or all new power sector infrastructure.
for basing tariffs on actual cost of service. Tariff subsidies are common in developing countries; bit reform does not necessarily mean price increases. Depending on customer class, cost based tariffs may go up or down.

1.7.6 Deregulation

The regulated sector is comprised of privately owned local monopolies, but has prices, revenues and/or profits regulated by government through the regulator. It is seen that the generation sector has generally been open to competition for a long time, and even when the dominant incumbent generator is regulated, generation competition is not usually classed as deregulation (Dixit, Sant & Wagle, 1998). Almost always, deregulation begins by a gradual opening of the supply sector to competition, starting with the very largest consumers, with a phased opening of the market to smaller and smaller consumers, and eventually residential consumers.

1.7.7 Re-regulation

The deregulation process leads to the existence of two distinct sectors — the deregulated sector, which is open to competition, and the regulated sector, which has regulated prices or revenues. Regulation is applied to both sectors, but is more of a monitoring, guiding and policing role in the deregulated sector than a price setting one.

1.7.8 Further fragmentation

The opening of the market and the divestment of incumbents create opportunities for strategic investors. It is commonly considered that access to the market is best found, not by building a company from scratch but by buying a company and using that as a base for expansion. The divestment from incumbents also created the ability (the money from the sales) and the desire (to expand when domestic expansion was not possible) for foreign strategic investments by the incumbents. Historically, this caused the prices of investments to rise so much that many incumbents continued to sell assets voluntarily after the forced divestments were complete.

1.7.9 Cross industry horizontal integration

The opening to competition also facilitates strategic entry into the market from

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6 Deregulation is the process by which parts of the regulated sector are opened to competition.
large companies with relevant skills, such as oil majors, construction companies, banks and supermarkets.

1.7.10 Re-consolidation

In some cases, the fragmentation of generation was so much that market prices fell to marginal costs, leaving many generators to lose money via their fixed costs. This caused a degree of reconsolidation. In addition to this, there has been extensive international consolidation, particularly in Europe. In 2006 Europe has six dominant transnational electricity companies. In the USA, the consolidation has been more a result of the failure of companies or deregulated arms of companies in the wake of the Enron saga,” than of transnational mergers and takeovers that occurred in Europe (Hogan 1998).

1.7.11 Entry of financial institutions

The presence of financial institutions should be regarded as a measure of success, of market reform. Financial institutions can enter the industry in a number of ways including strategic investment, loans, wholesale market trading and electricity supply. There have been several circumstances in which creditors have acquired the assets of power companies as collateral on default.

1.7.12 Pressure on retail deregulation

From a regulatory perspective, the retail sector is the most important sector, since this is the interface between ESI and consumer.

1.7.13 Further deregulation of networks and metering

As known that networks contain many functions thus any function that can be outsourced can be deregulated. So, for example, transmission construction need not be the sole province of transmission network owners or operators. In addition, networks can be deregulated at their boundaries, for example by allowing independent network operators from the end of the network to the consumer, offshore networks and interconnectors. Further deregulation can be in connections, site works, meter ownership, meter management, meter reading and meter data processing.
1.8 Revise model

There are a number of measures of success for ESI reform. In the light of these it must be decided (Hogan, 1998):

1. If there has been sufficient market reform to achieve success.

2. If the market has reformed substantially, then how should we adjust the model to improve ESI performance in delivering welfare.

3. How to deliver further economic and environmental efficiency.

Fig 1.7: Stages of market development from the centrally managed model

The variety of market structures can be categorized according to increasing degree of competition, as follows:

- Model 1 (monopoly) has no competition at all, only monopoly at all levels of the supply chain. A single monopolist produces and delivers electricity to the users.

- Model 2 (purchasing agency) allows a single buyer or purchasing agency to encourage competition between generators by choosing its sources of electricity from a number of different electricity producers. The agency on-sells electricity to distribution companies and large power users without competition from other suppliers.

- Model 3 (wholesale competition) allows distribution companies to purchase electricity directly from generators they choose, transmit this electricity under
open access arrangements over the transmission system to their service area, and deliver it over their local grids to their customers, which brings competition into the wholesale supply market but not the retail power market.

- Model 4 (retail competition) allows all customers to choose their electricity supplier, which implies full retail competition, under open access for suppliers to the transmission and distribution systems.

1.9 The Role of the State after De-regulation

Even in a fully privatized industry, the ESI is a collection of assets, existing property rights, right to build, franchises and obligations that has an inbuilt legacy relationship between private and public sectors that is de facto and informal as much as it is formal. These relationships built up incrementally as the industry developed, with a few step changes such as nationalization and deregulation that in fact made relatively slight differences to this collection (Hawdon, 1998)

1. The state therefore retains an intimate connection with the running of the ESI. The various aspects of state involvement are examined later.

2. The state is the ultimate guarantor even if companies in the industry fail. In developed economies, this is particularly important in the consideration of security of supply. The state has a remit to monitor the current and likely achievement of national and international policy objectives that are affected by the ESI, and to intervene where the delivery falls short or can be enhanced.

3. Electrification (connection of the population to the electrical infrastructure) is seen as an essential development for welfare and economic growth.

4. In the absence of a complete market such as for emissions, the state must manage aggregate welfare by economic or prescriptive instruments.

5. Since the market does recognize fuel poverty, government intervention is required to alleviate it by mechanisms such as subsidy, cross subsidy and discriminatory pricing.

6. The ESI is a significant component of the fiscal macro economy of nations. The state performs numerous roles, for example:

(i) The participation of the ESI in the fiscal structure of the macro economy.
(ii) The setting of policy.
(iii) Primary legislation (Acts of Parliament) to drive and control policy.
(iv) The conversion of direct taxes to indirect taxes
(v) The management of those parts of the ESI that remain under state control.
(vi) Consumer subsidy if the requirement for cross subsidy within the ESI is reduced.
(vii) Corporate cross subsidy by taxation and concessions

1.10 Regulator

There is an essential place for regulators in the full spectrum of ESI structures from fully integrated and centrally managed to fully unbundled and deregulated with mature wholesale markets.

Whilst the varying natures of ESI’s and of political structures and of legacy arrangements in different countries mean that functions of regulators differ, they have the same general purpose which is to monitor competition and market power, to assist in the implementation of national and international energy policy and to assist in the commercial development in the ESI, particularly with regard to deregulation and wholesale markets (Cook & Kirkpatrick, eds., 1997). They can also act as policy implementer, policeman, and watchdog, instrument of industry accountability, communicator and international policy integrator. Power sector regulation in several countries, both developing and developed, has been analyzed by a series of authors (Gilbert & Kahn, 1996).

Jorge Vasconcelos described some characteristics of good regulators. These are:

1 Independence — from industry and party politics.
2 ‘Reasons-giving’ — justification and explanation.
3 Transparency.
4 Stability and predictability.
5 Promotion and facilitation of general interest objectives.
6 Efficient allocation of natural resources and capital.
7 Fairness.
There are a number of different regulatory models:

1.10.1 **Fully independent**

Regulators are civil servants, and independent of any specific ministry. As a result, they can find themselves in conflict with ministries, as indeed the ministries can find themselves in conflict with each other. The independence gives the regulator a substantial de-facto role in policy formulation. Examples are — UK (Ofgem), Italy (autorita energia), Belgium (CREG), Ireland (CER), Austha (e-control), Portugal (ERSE), Turkey (EMRA), Hungary (HEO) and India (CERC)

1.10.2 **Regulator as Ministerial Adviser**

Here the regulator is attached to a ministry, and advises on, rather than formulates policy solutions. Examples are France (CRE), Spain, (CNE), Luxembourg, Greece (RAE), Croatia (CERC), Czech Republic (ERU), Slovakia (URSO), Latvia (PUC), Lithuania (NCC), Malaysia (EC).

1.10.3 **Light handed regulation**

Here the industry substantially self governs, and market intervention tends to be ex post, enquiring after specific events. Examples are Sweden (STEM), Denmark (energitilsynet), and Finland (electricity market authority).

1.10.4 **Competition authority as regulator**

Not being attached to a ministry, the regulator is very similar to an independent regulator, although with a greater emphasis on competition and market development, relative to policy implementation. An example is the Netherlands (DTE).

1.10.5 **Self -regulation**

The presence of a regulator independent of the industry is generally regarded as essential, and hence pure self-regulation is becoming less common. Germany appointed a regulator (BNetzA) as recently as 2004. Regulators can be funded by taxes, or by levies to the ESI, mainly through price-regulated entities such as distribution. Regulators do not have exclusive control over the industry. For example, the competition authority, international competition law, international agreements and directives, ministry for trade and industry, and ministry of the environment all have authority of one form or other. It is natural for there to be some tensions between the
objectives of the regulator and that of the other bodies.

1.11 Regulatory indicators

Due to the wide variation in stages of liberalization development in different countries, and the widely varying functions of regulators, benchmarking is not straightforward. (Kennedy, 1999). Examples of features examined is:

- Resources and autonomy — Budget amount, source, approval and schedule.
- Commissioners — Numbers, term lengths, positions, experience, salaries.
- Scope of authority — Electricity, gas, district heat, other.
- Disputes — Dispute resolution power, scope of power, mechanism for appeal,
- Effectiveness of decision pending panel, scope of review.
- Licensing — Issuance, number, types.
- Monitoring — Information collection, verification of information, audits, enforcement
- Mechanism, violations.
- Transparency — Annual reporting requirements, publications of reports, independent
- Audit, code of ethics, conflict of interest.
- Accountability — Open hearings on tariffs and licenses, publication of decisions,
- Explanation of decision, timeframe, and confidentiality.

1.12 Price regulation

The sector for which the regulator directly sets prices or revenues is commonly termed the regulated sector. The baseline for regulated prices is commonly the same price as the previous year, plus inflation, minus an ‘X’ percentage to drive efficiency improvements, plus an allowance for designated capital expenditure for new or improved provision. It is very common for the regulator to allow companies to increase returns over that implied from the regulatory regime, either by decreasing costs or by a
performance based incentive regime.

1.13 Rate of return regulation

Rate of return regulation specifies an upper limit to the rate of return on capital. This actually creates an incentive to increase capital above the optimum level and therefore causes an upward bias on prices. Price regulation and revenue regulation are very similar to rate of return regulation in practice since both are driven by the fair return on capital.

1.14 Expected Effects of Liberalization

The liberalization journey must be intended to enhance the performance of the ESI. The key performance indicators are listed here (World Energy Council, 1998):

- Electrical — Stability of voltage, frequency, phase, harmonics, etc.
- Interruption — Lost hours per year in fuel, generation, transmission and distribution.
- Sustainable — Medium term economic sustainability, long-term energy source sustainability.
- Environmental — Absolute degree of local, regional and global impact, and local and regional amenity.
- Price — Low prices in the wholesale market and for residential, small and medium enterprise, industrial and commercial sectors.
- Welfare — Degree of fuel poverty, universal service.
- Stability — Legal, regulatory, financial.
- Electrification — Percentage of population supplied.
- Risks — Exposure to single events (e.g. hurricane, cold winter, drought, terrorism, fuel supply interruption) and systemic events (type faults, geopolitics, oil prices, emission permit prices).
- Competition — Not a goal in its own right, but a measure of capability for the other measures.