Developing Energy-Efficient Products in Different Economic Regimes: A Primer For Market Transformation Strategies

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ABSTRACT

The paper broadly compares the market transformation programmes in three different economies with disparate economic traditions: Capitalist America, Communist China and Socialist India. The paper concludes that key to successful programme development is a strong institutional framework (rules and effective organizational coordination and implementation). Programme design in these countries may converge in terms of the mix of different measures and the involvement of different actors. Programmes in China and India may require longer time framework given the energy markets are not yet properly developed. Lastly, in order to sustain market transformation of energy-efficient products and services, developing country governments must in parallel initiate activities to develop energy markets as well as other activities that spur economic growth thereby raising purchasing abilities of the consumers.

Introduction

In the past 20 years, a number of market transformation programmes have been successfully implemented in the US and other developed countries. In the 1990s, several Asian countries including China and India have also developed programmes to introduce and sustain the diffusion of energy-efficient products and services. The potential contribution of these programmes in terms of energy and emissions intensity reduction are significant particularly in Asia where the average efficiencies of domestic appliances are relatively superior to the international average. This is compounded with the rising incomes of the people from higher economic growth experienced in the past years. Sales of domestic appliances in Asia have been projected to grow rapidly in the medium term.

The paper surveys and compares market transformation efforts in China, India and the US: countries with three different economic and political regimes. The paper reviews the energy industry structure, energy efficiency legislation, policies and institutional framework for energy efficiency development. The paper finally analyses the market transformation strategies in these three different countries.

Governance and Energy Industry Structure

The three country studies represent three different economic structures with disparate political traditions. China under communism has a hierarchical and authoritarian form of government. The government has central control of the economy, and state enterprises dominate in almost all industries. The United States of America on the other extreme has a federal form of government with strong democratic traditions. The economy is market driven and the private sector plays an important role in the economy. India is a federal

republic. The Indian National Congress or its dominant faction, which in the past has governed the country for long since its independence, has been committed to democratic socialism with a mixture of private and public enterprises.

The political traditions are reflected in the ownership, organization and management of the energy sector. In China, most of the energy enterprises and corporations are owned by the government. As such, the overall management of the energy sector in China is under the bureaucracy. Developmental and bureaucratic objectives are integrated in the development of the energy sector. Thus economic intervention is in the form of ownership and direct management control. Most of the energy corporations are supervised "nominally" by the Ministry of Energy (MOE) (Yang et al. 1994). The Ministry however receives guidance from the State Development and Planning Commission (SDPC), formerly State Planning Commission (SPC). The SPDC moreover controls the State Energy Investment Corporation (SEIC) – the government's energy project investment arm. Coordination of activities is clearly defined and is undertaken at the MOE and SPDC levels.

The United States of America on one end is characterized with mature institutions and better functioning markets. The energy sector is composed of mostly private companies and utilities. The US government however intervenes in the market by regulating private energy utilities to prevent abuse of market power and to ensure that certain social norms are respected. The Department of Energy (DOE) represent the energy policy making body while the Federal Energy Regulatory Commission (FERC) is responsible for energy regulation.

India, like other developing countries is a mixed economy where both private and public enterprises are important components of the economy. In the energy sector of India however most of the energy companies and utilities are either owned by the national or state governments. Ownership and management control is more common than economic regulation as form of intervention. In fact only in 1998 did the Indian Federal Government establish the Central Electricity Regulatory Commission (CERC) to regulate electricity generation company tariffs. The energy sector of India is composed of the multitude ministries and organizations such as Department of Atomic Energy, Ministries of Coal, Power, Non-conventional Energy Sources, and Oil and Gas. There are no specific forums and structures that coordinate the activities of these authorities but coordination is made possible through the Parliament which allocates the budget, the Cabinet which reviews plans and decisions and the Planning Commission which reviews investment programs (Teri 1999).

Energy Efficiency Legislation

True to its political nature, China's success in promoting energy efficiency and reducing energy intensity in the past decades has been attributed to strong government energy efficiency intervention and effective implementation. While several policy directives issued since the late 1970s until the present promote efficient utilization of energy resources (Liu et al. 1994), perhaps the most important are the energy national efficiency regulations of 1986 (Provisional Regulations on the Administration of Energy Resource Savings) and 1997 (Energy Conservation Law or ECL) (see Table 1). The temporary regulations for energy conservation management in 1986 is more specific for implementation and includes articles on energy conservation management system, basic energy conservation management work, energy supply management, industrial and residential energy use management, encouragement on technological advancement, awards, and propaganda. In contrast, the

ECL is broad in its provisions and formulation of specific rules and methods is left to planning and implementing organs of the central and local government (Sinton et al. 1999). Aside from energy conservation objectives, ECL is also used as an instrument to meet developmental objectives. ECL is aimed to promote energy conservation, improve efficiency in energy use, achieve economic benefits, protect the environment, secure national and social development, and meet the needs of people's livelihood.

It is ironic that the USA promotes economic liberalism yet depends on government intervention in promoting energy efficiency. The market alone was perceived to be insufficient in providing correct signal to both consumers and producers on energy-efficient products (Levine et al. 1995). Several laws and regulations regarding energy policy, energy conservation policy and energy efficiency promotion have been promulgated. These are embodied in the Energy Policy and Conservation Act of 1975 and its subsequent amendments, Motor Vehicle Information and Cost Savings Act of 1982, National Appliance Energy Conservation Act of 1987, and the Energy Policy Act of 1992.

Table 1. Energy Efficiency Law and Regulations

Year	China	India	USA
1975			Energy Policy and Conservation Act (Public Law 94-163)
1982			Motor Vehicle Information and Cost Savings Act
1986	Provisional Regulations on the Administration of Energy Resource Saving		
1987			National Appliance Energy Conservation Act
1992		Order No. 12/92/PD of Power Department*, Government of Kerala	Energy Policy Act
1995		Order No. 70 Power/I Department of Power*, Government of West Bengal	
1997	Energy Conservation Law of China (approved in 1997 but effective in 1998)		
2000		Energy Conservation Bill 2000	

* mandatory audits of electricity consumption in industry
Source: UN-ESCAP 1999; Bulletin on Energy Efficiency 2000.

The apparent lack of coordination of the energy sector at the national level results in the lack of support in developing a national comprehensive and coherent energy conservation legislation in India in the past. A review to explore the desirability of a comprehensive legislation for energy conservation was undertaken after the Indian Institute of Law prepared a draft Energy Conservation Legislation in 1987 (UN-ESCAP 1997). At the state level the governments of Kerala and West Bengal have instituted state legislations to make energy audits of electricity consumption in industry mandatory in 1992 and 1995 respectively. More recently in recognition of the need to have a comprehensive energy efficiency and conservation law, the Energy Conservation Bill 2000 was proposed to be enacted by the

parliament (Bulletin on Energy Efficiency October 2000). The bill is aimed to establish a regime of financial and fiscal incentives and penalties for energy conservation. The main provisions of the bill include minimum energy efficiency standards for equipment/appliances and mandatory labeling program for appliances; development of codes to ensure energy conservation in building design; and formulation of energy consumption norms for large consumers and defining a set of initiatives for regulation of these norms.

Energy Conservation Policies

Aside from energy efficiency regulation, China has developed a multi-faceted energy efficiency policy. This policy addressed several facets that have influence in the diffusion and penetration of more efficient technologies and processes. Key strategies are energy efficiency and energy conservation management; financial incentives; direct investment, and research, development and demonstration; information and technology service; and propaganda, education and training. The major policy measures under each strategy are given in Table 2.

Table 2. Energy Efficiency Policies in China (1980s and early 1990s)

Strategy	Policy Measures
Energy Efficiency and energy conservation management	• Controlled unit energy consumption and energy supply through quotas • Placed control on oil use; substitute coal for oil • Disseminated energy-efficient technologies and products • Retired energy-intensive mechanical and electrical devices; restrict energy-wasting production practices • Created energy efficiency standards for buildings and residential appliances • Monitored enterprise energy conservation
Financial incentives	• Set low interest rates for energy conservation project loans • Tax breaks for energy-efficient products • Provided monetary energy conservation awards to enterprises
Direct investment, and research, development and demonstration	• Established national agency for funding efficiency investments: The China Energy Conservation Investment Corporation • Developed national strategic science and technology plan • Carried out demonstration and dissemination projects • Encouraged enterprise self-development
Information and technology service	• Established national resources and conservation and comprehensive utilization information network database • Established national, local, and sectoral energy conservation technology service centers • Established and maintained an energy statistical reporting system, including capabilities and methods for energy supply and demand forecasting
Propaganda, education and training	• Held activities for an Energy Conservation Awareness Week • Included energy conservation in primary and middle school curricula • Established national, local, and sectoral energy conservation training centers

Source: Yang et al. 1994

It is interesting to note how the policy has evolved in the past. In the mid-80s, the emphasis was given on energy efficiency and conservation management. From the late 80s to early 90s priorities were given to R&D and demonstration projects (Gan 1998). Attempts were also undertaken to reform the prices. It appears that since the mid-90s the policy

orientation has been on strengthening energy efficiency regulation and developing as well as implementing market transformation strategies.

Despite the fact that there was no energy efficiency legislation enacted in India in the past as well as no comprehensive national policy on energy conservation, the government of India has recognized the importance of energy efficiency to its economic development. In the present economic plan (1997-2000) efficient use of energy resources and energy conservation are the core policy objectives pursued by the energy sector (Asian Development Bank 1999). Emphasis is given on institutional mechanisms, demand management, research and development and regulatory mechanisms. The coal sector aims at the penetration of improved coal utilization technologies; the hydrocarbon sector promotes substitution to clean and efficient fuels as well as pricing rationalization; the renewable energy sector aims at commercialization of non-conventional energies and exploitation of cogeneration; and the power sector pursues electricity pricing reform, modernization of generating stations and private sector participation (the power sector restructuring programs in several Indian States also consist of demand-side management programs).

Energy conservation activities implemented in India includes: efficiency standards (voluntary standards for refrigerators and room air-conditioners); research development and dissemination (demonstration projects to promote energy conservation equipment/technologies in pre-commercialization stage as well as R&D grants for development of energy-efficient devices and equipments); awareness (mass-media based awareness campaigns, production of video films, case studies; product consultant directories, award schemes, etc); financial incentives (depreciation policy, tax reductions and exemptions, low interest loans and loan assistance); and training (training programs for energy managers and auditors, supervisors and managers, trainers, agriculture pump auditors, etc) (Center for Energy Environment Research and Development 2000).

Institutional Framework

To facilitate effective policy implementation, the Chinese government established energy conservation apparatus in parallel at the central, ministerial and provincial levels. The institutional framework for energy conservation is shown in Annex 1. The Office of Energy Conservation Work of the State Council is responsible for energy conservation project selection and management. The Resources Department of SPC (recently renamed SDPC) coordinates energy conservation activities among central ministries and local governments. The State Economic and Trade Commission (SETC) is tasked to draw up national energy conservation plan. The MOE has the mandate to pursue energy conservation in energy industries while SEIC has established a subsidiary unit responsible for energy conservation investments. The Central ministries and local administrations are given the task to develop specific regulations to save oil, coal, electricity and water in accordance with state policies and plans. The provincial Electricity Bureaus are responsible to manage rational, safe, and efficient use of electricity. Moreover, energy conservation centers are established at the provincial and municipal levels to monitor as well as provide consulting services to enterprises. With the recently-passed Energy Conservation Law, the SPDC was given the overall policy authority for energy efficiency while the SETC was given the central authority for implementation.

With well-established institutions, the energy efficiency legislations in the United States clearly specify the implementing agencies for each specific regulation. In most cases the DOE is responsible for implementation in consultation with other government agencies, business associations, utilities and manufacturers. There are also cases where the implementing agencies are other government units such as the Department of Housing and Urban Development and the Department of Agriculture for Building Energy Efficiency Standards, and other federal organizations in implementing Federal Agency Energy Management[1].

Due to lack of national legislation on energy conservation, energy ministries (power, petroleum and natural gas, coal, surface transport, non-conventional energy sources, industry, civil supplies for efficiency standards, etc) and the Council for Scientific and Industrial Research implement their own energy conservation programs and activities. In 1989 the Energy Management Center was established under the Ministry of Power to coordinate fragmented efforts and initiatives of various institutions active in energy management such as the National Productivity Council and the Petroleum Conservation Research Association. The Bank of India has instituted investment schemes to promote energy conservation (Energy Audit Scheme and Equipment Finance for Energy Conservation Scheme). More recently IREDA through the support from the World Bank/GEF facilitate a scheme to finance energy efficiency projects. Moreover, Industrial Credit and Investment Corporation of India Ltd. (ICICI) manages the USAID's loan fund to provide financial incentives to support market development activities aimed at implementing ESCO demonstrations and for leveraging private-sector investments for energy efficiency, utility DSM and non-sugar cogeneration projects. The energy promotion institutional framework in India is also shown in Annex 1. The Energy Conservation Bill 2000 seeks for the establishment of a Bureau of Energy Efficiency.

Market Transformation Strategies

Market transformation is broadly defined as market oriented energy-efficiency interventions aimed at changing the structure and function of the market (Geller and Nadel 1994). Measures that encourage market transformation include R & D, demonstrations projects, manufacturing incentives, education and training, consumer incentives; building codes; equipment efficiency standards; etc. In the past energy utilities and government agencies developed programmes, known as market transformation programmes, that involved energy end-users and market actors (e.g. manufacturers, trade allies) to promote the diffusion and production of energy-efficient equipment, processes and services. Depending on the market maturity level, market transformation programmes are designed to introduce, commercialize or even enlarge the market of energy-efficient products and services (Neij 2001). A strategically planned market transformation programme consists of a combination of measures that stimulate the adoption of energy-efficient product and services at different levels of market maturity.

[1] Refer to the Title 1 of the Energy Policy Act of 1992 – Energy Efficiency.

Standards and labeling. Among these measures, minimum efficiency standards and building codes played a critical role in achieving market transformation in the US (Geller and Nadel 1994). The United States through legislations (NAECA and EP Act) imposed mandatory standards for several domestic appliances (There are more than 20 products subject to mandatory standards) (Foley 1997). In China, efficiency standards were among the first measures implemented by the government in promoting energy conservation. In 1989, the government established minimum efficiency standards for 8 household products[2]. These standards were derived through consensus with the manufacturers. More recently however the Chinese State Bureau of Technology Supervision announced more rigorous standards for refrigerators and fluorescent lamp ballasts (Li et al. 2000). Standards for fluorescent lamps, clothes washers and TVs are also being considered. In India on the other hand, the Bureau of Indian Standards (BIS) has developed voluntary standards for refrigerators and room air-conditioners. These standards were determined through recommendations from the manufacturers and have been criticized to be lenient and ineffective in moving the efficient products in the market (Egan and du Pont 1998).

Energy efficiency labeling has also been considered to effectively compensate the lack of concern of the consumers on energy efficiency attributes of different consumer products (Colombier and Menanteau 1997). There are several types of labels used in the US, such as endorsement, comparison and eco-labels. Voluntary eco-labels exist in both China and India (Ecomark) though participation rate from manufacturers is relatively low (Egan and du Pont 1998). In China moreover, efficiency standards for refrigerators and ballasts for fluorescent lamps were announced in 1999 while standards for fluorescent lamps, clothes washers and TVs are being considered. Endorsement label for refrigerators; labeling programs for compact fluorescent lamps and conventional fluorescent lamps are also under development.

Market transformation programmes. In the past 20 years, The US government and electric utilities have implemented market transformation programmes aimed to introduce, commercialize and enlarge the market of different products and services (Geller and Nadel 1994). Core to the success of the programs are the combination of complimentary measures that facilitate the penetration of these technologies in the market. These measures are aimed at the consumers as well as manufacturers of the efficient product. The measures applied include a mix of the following: R & D; demonstrations and field tests; commercialization incentives; marketing and consumer education; grants, loans, and tax incentives; voluntary commitments, bulk purchases; building codes and equipment and efficiency standards.

China and India on the other hand have only started to implement market transformation programs in the 1990s to introduce and commercialize energy-efficient products and services. China implemented the UNDP assisted Green Lights Programme in 1996 aimed at transforming the market for efficient lighting (International Institue for Energy Conservation 1998) and UNDP/GEF supported Green Refrigerator Programme in 1999 to phase out the use of chlorofluorocarbons (http://www.usinfo.state.gov). The UNIDO/UNF Motor System Energy Conservation Programme is currently under review (http://www.unido.org) (see Table 3). There are other upstream activities in coordination with international organizations, manufacturers, government agencies, American Universities

[2] refrigerators, room air-conditioners, washing machines, irons, rice cookers, TVs, radios and recorders, electric fans

and laboratories on district heating, cogeneration, energy-efficient buildings, industrial process controls, transformers, etc that may probably lead to an internationally assisted market transformation programmes (International Institute for Energy Conservation 1999; http://www.oit.doe.gov).

Similarly in India, DSM programmes have been implemented in the States of Orissa, Haryana, Andra Pradesh, Rajasthan, and Uttar Pradesh as part of the World Bank supported project on State Power Sector Restructuring (Bulletin on Energy Efficiency October 2000). Other activities are also undertaken by different local and international organizations to improve the level of awareness of different actors in energy efficiency market (International Institute for Energy Conservation 1999; http://www.oit.doe.gov). These activities may pave the way for future market transformation programmes. In January 2000, the USAID launched a more comprehensive Energy Conservation and Commercialization Project (ECO) (Bulletin on Energy Efficiency August 2000).

Table 3. Market Transformation Programmes in China

Program	Agency	Measures
Green Lights Program (CFL and thin-tube fluorescent lamps) 1996-2000	State Economic and Trade Commission; Beijing Energy Conservation Center; technical experts	• Manufacturers efficiency standards soft loans certification • Consumers public education marketing product labeling demonstrations
Barrier Removal for Efficient Lighting Products (4 years)	Department of Resources Conservation and Comprehensive utilization of the State Economic and Trade Commission;	• Manufacturers standards certification quality & technology • Utilities/EMCs financing • Consumers labeling market aggregation Consumer education

One has to notice however that unlike in the US and China, the ECO project does not only promote commercialization of a specific product or service but addresses the whole array of issues related to policy and institutions. The ECO project consists of 3 main components: energy efficiency policy and institutional reform; state-level energy efficiency and power sector reform; and energy efficiency market development and financing. Under these 3 components are different measures designed to remove barriers in the adoption and commercialization of energy-efficient products. China however addresses the issue of institutional strengthening outside the market transformation programme. For example, in parallel to the implementation of the Green Lights and Green Refrigerator Programmes, it has also developed the Energy Conservation Project which established three pilot Energy Management Centers (EMCs) in Shandong, Beijing and Liaoning, streamlined institutions facilitating financial investments, and strengthened the administrative structure through organizational reforms (Sinton et al. 1999).

The US programmes have been used to support national policies on energy security and environmental protection. The same pattern can also be found in the Chinese and the Indian efforts on energy efficiency. Recent programs are being linked with environmental issues, either local or global. In China, environmental agencies have been involved recently with the market transformation programs.

In terms of programme design, the transformation programmes in China and India which are similar to the US and other developed countries integrate several measures that involve appropriate government agencies, utilities/companies, trade allies, manufacturers and consumers. The absence of a lead agency in promoting national energy conservation as well as lack of coordination among sectoral, national and state organizations in India has sacrificed transformation programmes in the past. Institutional rivalries may have caused the rejection of the Belle Project in the USAID assisted Program for Acceleration of Commercial Energy Research (PACER) in 1989 (International Institute for Energy Conservation 1998). Institutional issues are being recognized as an important factor and currently being addressed in the recent ECO project (Hagler Bailly 1998).

Measures implemented in these countries to mitigate market barriers are also aimed at the supply side (manufacturers) and the demand side (consumers). These include measures to improve information, finance energy efficiency investments, financial incentives to investments, efficiency standards, and technology procurement. Moreover, these programmes include upstream activities that support capacity building for utilities/companies and manufacturers.

The timeframe of these programmes are relatively long. The Chinese programmes on lighting and refrigerators are for 5 years. Similarly, the Indian ECO programme is for 5 years. Moreover, with lessons learned and market barriers identified in the Green Lights Program in China, a follow-up 4 year programme, Barrier Removal for Efficient Lighting Products and Systems, to be funded by GEF has been developed to address these barriers.

The two major barriers in China's Green Lights Programme are high initial cost of more efficient technologies and poor quality of some efficient products (Sinton et al. 1999). While the latter could be addressed by designing a programme measure to improve the quality of the product, the former requires government action beyond market transformation programme. The high initial cost of the efficient products can be justified if the monetary amount of saved energy would be significant. This would happen in regimes where energy prices reflect real production costs. In economies where prices are subsidized or cross subsidies exist, a meaningful programme may not be sustained by the market once the project is completed. Energy pricing reform is one of the baseline conditions in order to have a successful market transformation programme.

Another important aspect is that the perception of high initial cost is relative to the purchasing capacity of the household. In countries where per capita GDP is below $1000 per year the market for relatively expensive energy-efficient product would be shallow given the fact that only a very small percentage of the population has the purchasing ability. Financial assistance to consumers could be a good measure though this implies that financial resources must be taken from somewhere else. Developmental measures that support the growth of consumers' income could be a good companion to market transformation programmes.

Conclusion

China, India and the US are characterized by disparate political traditions and institutional arrangements. These traditions have been reflected in the organization of the energy sector and in the promotion of energy conservation and diffusion of energy products.

The US is a free market economy with strong democratic traditions, mature institutions and better functioning markets. The private sector is the backbone of the energy industry. The government intervenes in the market through economic and social regulation. In promoting energy conservation, the US relies more on energy efficiency intervention through energy policy legislations. To transform the market of energy-efficient products and services, the government has also intervened through market transformation programs. With effective institutions and coordination between utilities, manufacturers, trade allies, etc, the US has been successful in moving energy efficiency markets.

China, a communist nation is characterized with an authoritarian form of government and dominance of the public sector in the economy. The government is actively involved in the energy sector with effective organizational control. To promote energy conservation the government has effectively promulgated energy efficiency legislations. China has formulated multi-faceted energy efficiency policies. Key strategies are energy efficiency and energy conservation management; financial incentives; direct investment, and research, development and demonstration; information and technology service; and propaganda, education and training. China has also established an institutional framework to effectively coordinate and implement the defined policies. As a result, the government has significantly reduced the country's energy intensity in the past decades.

India, a federal government has strong socialist traditions. Both the private and the public sector have played an important role in the economy. Public enterprises however dominate the energy sector. The energy sector is characterized by lack of coordination among government agencies. Though the government has recognized the importance of energy conservation and promotion of energy efficiency it has failed to develop a comprehensive national energy conservation policy. Moreover, the government was slow in recognizing the importance of energy efficiency legislation. As such, energy ministries and other organizations implement their own energy conservation activities.

The key to effective program development and implementation therefore is a strong institutional framework. By institution, we mean well-defined rules in the form of regulation and legislations as well as effective implementation through coordination with organizations involved with the programme.

India and China have implemented market transformation programmes to introduce and commercialize efficient products and services in the recent past. China's programmes have been focused on specific product market transformation such as the Green Lights Programme and Green Refrigerator Program. India on the other hand through its ECO project does not only look on specific energy-efficient product and service but also addresses policy and institutional deficiencies.

The programmes implemented in these countries are carefully and strategically designed to consist of a series of measures aimed at different market actors such as utilities/companies, manufacturers, consumers and supporting organizations. These measures are a mix of regulatory and market-based instruments. This converges with the market transformation programmes developed in the US and other developed countries.

At the current level of economic development with the existing state of affairs of the energy and manufacturing sectors in India and China, it is not yet clear if market transformation programmes would be sufficient enough to kick-off a sustainable energy efficiency market. The China's Green Lights Programme shows that a market transformation programme must have a very long time framework. As presented earlier, a GEF support was sought to extend the Green Lights Programme to another 4 years to address barriers encountered in the past 5 years of the programme's existence.

Finally, as manifested in China's Green Lights Programme, there are barriers that must or could be addressed beyond the market transformation programme in order to sustain market transformation of energy-efficient products and services. These include developing a better functioning energy markets through energy pricing reforms as well as catalyzing activities that may spur economic growth to increase the purchasing abilities of the consumers.

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Annex

Figure 1.1 Energy Conservation Institutional Framework in China in the 1990s

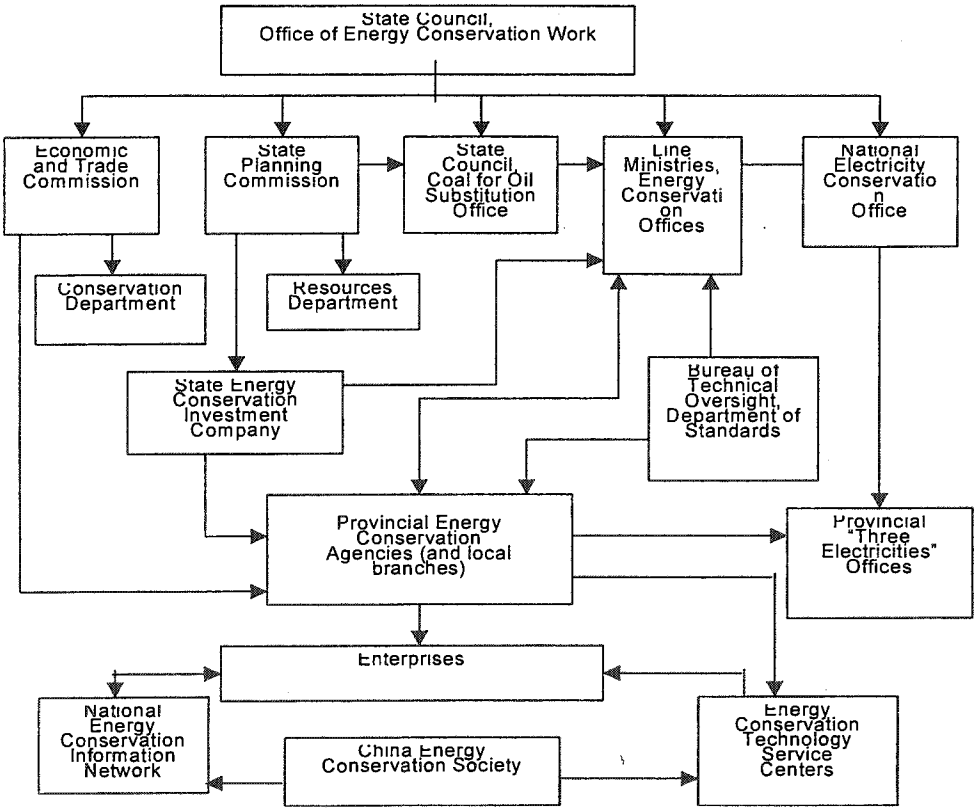

Figure 1.2 Energy Efficiency Promotion Institutional Framework in India in the 1990s

Institutional structure for energy efficiency promotion in India