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Demand Side Management

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1. Changing Electricity Supply Structure in India

In India power development program implementation was opened to private sector participation in the earlier Nineties. Existing power supply utilities had to be restructured. By now most of monolithic public sector utilities (State Electricity Boards/Corporations) have been unbundled. Non Government electricity supply utilities are now in the field contributing to power generation programs and distribution companies have

- Higher responsibilities-service parameters include customer satisfaction and ensure cash flows
- Evolving competitive environment in distribution leading to service beyond tariff collection
- Legal foundation for emergence of competitive or multi-buyer structure in the Indian Power Sector was laid by the Indian Electricity Act 2003 mandating certain restructuring needed for the purpose. The Act also brought in certain legislation empowering the consumers to have a choice to decide a supplier to take power from with multi-user. This is the basic ingredient of competition.

The unbundled single buyer model is essentially a chain of connected monopolies. All generating stations who supply electricity in the state sell to the Transco. The Transco in turn procures all electricity that needs to be supplied to end consumers. The discoms can purchase their requirements only from the Transco and consumers in each of the discoms have no choice but to buy their electricity supply from the local distribution company, which has the monopoly to serve in that area.

Although the single buyer model could have at best been a transitory model, it was never clear what the eventual structure the electricity supply industry should aim at. However, what it did achieve was ensure that each function of generation, transmission and distribution received the focus of management as it was a separate entity. And along with regulatory oversight, each of the companies, particularly the distribution companies had to focus on revenue collection and efficiency improvement.

2. Power Trading in India

In India, while there is a huge section of consumers, who are power deprived, there are a lot of Captive Power Plants (CPPs) that are under utilized and a lot of merchant capacity also expected to be added in the near future, there is a need to encourage the peaking power plants and bring the surplus captive generation in the grid.

The Electricity Act, 2003, mandated development of power markets by appropriate commissions through enabling regulations. This paved the way for the new trends to emerge like Open Access and the one in February, 2007, when the Central Electricity Regulatory Commission (CERC) issued guidelines for grant of permission for setting up operation of power exchanges within an overall regulatory framework. The emerging trends will help in proper flow of power from surplus regions to deficit regions and thus try to bring about a balance in the power sector.

The National Electricity Policy, pronounced in February 2005, stipulated that enabling regulations for inter-and-intra-state trading, and also regulations on power exchange, shall be notified by the appropriate Commissions within six months.

On 6th February 2007, the Central electricity Regulatory Commission (CERC) issued guidelines for grant of permission for setting up and operation of power exchanges within an overall regulatory framework. Private entrepreneurship is allowed to play its role. Promoters are required to develop their model power exchange and seek permission from CERC before start of operation.

3. Inter State Trading of Electricity

The Central Electricity Regulatory Commission (CERC) has issued final Regulations for Inter-State Trading of Electricity after taking into account the suggestions and comments received from the stakeholders. The Electricity Act, 2003, recognises trading as an independent activity and accordingly prescribes issue of trading licences by the CERC for inter-state trading. The Commission earlier received applications from various companies for issue of trading licences immediately after the enactment of the Electricity Act, 2003 and the Commission had permitted all of them to continue trading till 31.3.2004 or till the issue of Regulations by the Commission whichever was earlier. After Notification of Trading Regulations, the interested parties could file fresh applications before CERC, seeking inter-state trading licences, in accordance with these Regulations.

The Commission is also initiating actions for preparation of Regulations for establishment of a market mechanism for electricity. The Regulations for market mechanism will be done after following a transparent process as is the normal practice of the Commission.

The highlights of the final Regulations for inter-state trading are as follows:

1. The Regulations provide for trading carried out bilaterally between the generating company including captive generating plant, distribution licensee and electricity trader on the one hand and the electricity trader and the distribution licensee on the other.
2. The Inter-State Trading Licence shall be granted for 25 years.
3. The Regulation prescribes the application form for trading licence. The application fee is Rs.1.00 lakh which is subject to adjustment after the same is prescribed by the Central Government. A model licence document is also appended to the Regulations.
4. The Regulations also specify the methodology for publication of the licence application. The application shall be published in at least two national English daily newspapers including one economic newspaper and two local newspapers falling within the areas of trading, one of which shall be in vernacular. The entire application shall also be posted on the website.

5. The applicant for the licence shall file his comments on the objections or suggestions received in response to the public notice.
6. The technical requirements for being an electricity trader stipulates having at least one full time professional each with experience in

i) Power System Operations and commercial aspects of Power Transfers and

ii) Finance, Commerce and Accounts.

7. Capital adequacy requirement for various categories has been stipulated.

4. REGULATORY ROLE

Central and State regulatory Commissions have been formed with a view to placing greater emphasis on meeting future electric needs at least cost. The Commissions would become involved in conservation also if International experience was any guide. They might reflect preference for renewable energy and emphasize 'integrated' or non-traditional supply options like conservation and other Demand side management (DSM), the development of technology like 'waste to watt' electricity generation.

Under the Electricity Act-03 Regulators have been mandated to develop energy markets. Energy efficiency initiative is the proactive approach to Market Transformation Program (MTP). The MTP focuses on longer-term strategies for delivering more resource-efficient goods and services, primarily through policy measures that drive innovation and competition. For example, policies such as energy labelling, product standards development and voluntary agreements with industry are especially powerful in influencing manufacture, design, market and produce in volume the more efficient products where needed. Indeed, with increasing globalisation, our ability to deliver more and more efficient products to the global market will depend on the ability to meet global expectations. It is necessary to initiate energy conservation measure subject to regulators oversight.

Regulatory policies determine the level of investment in energy efficiency. The policies are pushed through regulation, incentives and specific programs. Such policies are pursued for societal benefits, minimization of power shortage, reduce environment degradation and over all economic efficiency. Governments set the standards for building codes, appliances.

Under Integrated Resource Planning (IRP) the utility will have many options for meeting future needs. The latest idea of conservation is an additional option. The idea is that instead of meeting future demands through building more generation –transmission-distribution, facilities can be dampened making new facilities unnecessary. One of the primary means of dampening the future demand is through energy conservation that would include better energy information dissemination on consuming equipment like energy labelling.

The strategies emerging are combination of financing energy efficient technologies and financing market development policy initiatives and detailed disclosures about energy. The regulatory strategies can be designed to increase the participation of various stakeholders, notably credit providers, equipment vendors, utilities and technological service providers etc.

5. Demand Side Management (DSM)

Demand Side Management (DSM) programs are promoted and implemented under Govt. policies and regulations, Programs of Power Supply Utilities and by consumer participation. DSM programs refer to programs of Electricity Supply Utilities implemented by them to modify customer load profiles. Such programs have multitude of objectives. Some important of them are:

(i) "Peak lopping" to reduce energy consumption during daily system peak. This is done by using technologically more advanced and efficient consumer end equipment on services like heating cooling etc.

(ii) "Valley filling" to build up off peak loads to flatten load curves improve system load factor and consequently more revenue.

(iii) "Load Shifting" which can be alone by Thermal Storage

(iv) Energy conservation at the consumer end by use of energy efficient equipment. Energy efficiency programs are to be considered along with the cost of achieving the energy conserved in comparison with the cost of procuring the quantum of energy that may have to be purchased i.e. cost in Rs. per KWh of conserved/ saved with that of energy procured/purchased.

Electricity Utility DSM Program:

There are 3 main categories of utility DSM programs viz (i) Energy Conservation (ii) Load Management and (iii) Strategic Load Growth.

(i) Energy Conservation Program:- This is intended to be achieved by using equipment with improved efficiency, building and industrial processes.

(ii) Load management Programs:- This is achieved by redistributing energy demand to spread it more evenly i.e. load shifting program offering time of use tariff and interruptible power tariff rates etc.

(iii) Strategic Load growth program:- Programs that uncover cost effective electrical technologies that operate primarily during periods of low electricity demand.

Recommendation of Integrated Energy Policy for DSM

The following recommendations have been made in the integrated Energy Policy Report of the Planning Commission Government of India

1. The importance of energy efficiency and DSM has clearly emerged from the various supply scenarios and is underlined by the rising oil prices. Efficiency can be increased in energy extraction, energy conversion, energy transportation, as well as in energy consumption. Further, the same level of service can be provided by alternate means requiring less energy. The major areas where efficiency in energy use can make a substantial impact are mining, electricity generation, electricity transmission, electricity distribution, pumping water, industrial production, transport equipment, mass transport, building design, construction, heating ventilation & air conditioning, lighting and household appliances. Thus a "Negawatt" (a negative Megawatt), produced by reducing energy need saves more than a Megawatt generated.

2. The 10th Five Year Plan proposed benchmarking of the hydrocarbon sector against the rest in the world. It also suggested demand side management specifically in the transport sector. The target for energy savings in the 10th Plan 95,000 Million Units (Planning Commission of India) (13% of the estimated demand) in the projected terminal year of 7,19,000 Million Units.

3. A study for the Asian Development Bank (ADB, 2003) estimated an immediate market potential of energy savings of 54,500 Million Units and peak saving of 9240 MW. This has an investment potential of Rs.14,000 crores (3500 Million US Dollars). Though there is some uncertainty in any aggregate estimates, it is clear that the cost-effective saving potential is at least 10% of the total generation through Demand Side Management. Additional savings are possible by auxiliary reduction in generation plants. At present an estimate of the total volume of the energy efficiency consulting business (Audit, performance contract, engineering and technical assistance consultancy) is less than 1% of this potential (DSCL,2004).

4. Since most Energy Efficiency/DSM schemes are often cost effective is it necessary to have policy interventions? In actual practice there are several barriers that constrain the adoption of EE/DSM. These relate to high transaction cost, lack of incentives to utilities who perceive DSM as loss of market, inadequate awareness, lack of access to capital, perceived uncertainty concerning savings, high private discount rate and limited testing infrastructure for ascertaining savings. Policy interventions are required to address these barriers.

5. BEE (Bureau of Energy Efficiency) should be made autonomous and independent of the Ministry of Power. It should be funded by contribution from all energy Ministries or a cess on fuels and electricity adjusted for cess on fuels used for generating electricity. BEE staffing should be substantially strengthened.

6. **Increasing Efficiency of Coal-Based Power Plants:-** Require NTPC and SEBs to acquire technology to enhance the fuel conversion efficiency of the existing population of thermal power stations from an average of 30% to 35%. No new thermal power plant to be allowed without a certified fuel conversion efficiency of at least 38%.

7. **Implementing Time of Day (TOD) Tariffs:** All utilities should introduce TOD tariffs for arge industrial and commercial consumers to flatten the load curve. Utilities should support load research to understand the nature of different sectoral load profiles and the price elasticities of these loads between different time periods to correctly assess the impact of differential tariffs during the day. The utility should have focus group meetings of industrial or large commercial consumers, document a few potential case studies illustrating the potential for shifting loads and provide information and analytical support along with implementation of the TOD tariff.

8. **Facilitating grid interconnection for Cogenerators:** Enforce mandatory purchase of electricity at fixed prices from cogenerators (at declared avoided costs of the utility) by the grid to encourage cogeneration. The buying/selling price should be time-differentiated and declared by the state regulatory commissions at the time of each tariff notification.

9. **Improving efficiency of Municipal Water pumping**:- Institute measures that encourage adoption of efficient pumping systems and shifting of pumping load to off-peak hours. The public sector should be mandated to do so. Private sector could be encouraged to do so through time of day pricing. This will help reduce peak demand and energy demand.

10. **Promoting Variable Speed Drives:-** All large industries should be required to assess suitability of variable speed drives for their major pumping and fan loads.

11. **Undertaking efficient Lighting Initiative:-** Utilities should launch pilot efficient lighting initiatives in towns/cities (similar to the BESCOM programme in Bangalore). Features should include warranties by manufacturers, deferred payment through utility bill savings. (International examples are available at www.efficientlighting.net)

12. **Making Energy Audits Compulsory For all Loads Above 1 MW:-** Energy audit should be done periodically and be made mandatory for public buildings, large establishments (connected load> 1 MW or equivalent energy use > 1MVA) and energy intensive industries.

13. **Reaping Daylight Savings:-** Finally saving daylight by introducing two time zones in the country can save a lot of energy.

14. Adoption of a least cost planning and policy approach that ensures that energy efficiency and Demand Side Management (DSM) have a level playing field with supply options. The regulatory commissions should invite bids for DSM while approving new capacity additions. Thus, if a state requires an additional peak demand of 1000 MW in the next five years, the utility can ask for bids from Independent Power Producers (IPPs) as well as Energy Service Companies (ESCOs). For example, an efficient lighting programme may offer to save 150 MW at a cost of Rs.5000/peak kW saved. This would then become part of the cost of Rs.5000/peak kW saved. This would then become part of the least cost plan before putting in new power plants that may cost Rs.40,000-50,000/peak kW generated. Similar exercise should be adopted for the oil sector.

15. Regulatory commissions can allow utilities to factor EE/DSM expenditure into the tariff.

16. Each energy supply company/utility should set-up a DSM/energy efficiency cell. BEE can facilitate this process by providing guidelines and necessary training inputs. A large number of pilot programmes that target the barriers involved and have low transaction costs need to be designed need to be tried with different institutions, incentives, and implementation strategies. Innovative programme designs can be rewarded.

17. Create competition among manufacturers to e the first to achieve the target through a "golden carrot" which is a large monetary reward to the first one to commercialise products which provide, say a minimum saving of 20% over the best existing design within a given time frame.

18. Mandate clear and informative labelling in well-designed standardised form for equipment and appliances. Combine this with consumer awareness programmes that illustrate the savings & gains that can be made.

19. To strengthen the labelling initiative create regional testing facilities for testing and certification. The labelling/standards initiative should be supported by analytical studies to establish equipment consumption benchmarks (minimum achievable energy consumption targets).

20. Industries may need technical support to identify and execute energy saving options. Energy Service Companies (ESCOs) can provide such support. We need to promote and facilitate ESCOs. Some possibilities include-

- Financing Support- The support for ESCOs could be in the form of payment security mechanism (this may be required for projects in municipalities, government buildings), partial credit guarantee, venture capital.
- Encouraging different business models- For ESCOs to be successful in India a variety of alternative business models need to be attempted to determine the appropriate ones in the Indian context. BEE could facilitate 15-20 demonstration ESCO projects in different sectors. These should be well-documented, independently monitored and made available to the public. This will encourage more entrepreneurs to invest in ESCOs.
- ESCOs as producers of "Negawatts" may be given the same tax breaks that are available for renewable energy programmes or other energy investments.
- Providing an institutional framework for independent monitoring & evaluation of projects delivered by ESCOs.

DSM in Indian Power Systems

Historically, energy efficiency in India has gradually emerged from being a subject of advocacy and awareness building to that of a key frontrunner among the strategic options that are available to narrow the widening supply-demand gap facing the nation today. As a potent tool to advance sustainable development, energy efficiency has come into its own.

Power Ministry has developed initiative to make power available to all by 2012 includes promotion of energy efficiency and its conservation in the country, which is found to be the least cost option to augment the gap between demand and supply. Energy conservation potential for the economy as a whole has been assessed as 23% with maximum potential in industrial and agricultural sectors.

LONG TERM MEASURES

The Thrust Areas:

1. Industry specific Task Forces.
2. Notifying more industries as designated consumers.
3. Conduct of energy audit amongst notified designated consumers.
4. Recording and publication of best practices (sector wise).
5. Development of energy consumption norms.

6. Monitoring of compliance with mandated provision by designated consumers.

THE BROAD OBJECTIVES OF BEE (Bureau of Energy Efficiency) ARE TO:

(a) Provide leadership and a policy framework and direction to national energy conservation activities and efficiency programs.

(b) Co-ordinate policies and programs on efficient use of energy with stakeholders.

(c) Establish systems and procedures to measure, monitor and verify energy efficiency results in individual sectors as well as at a macro level.

(d) Leverage multilateral bilateral and private sector support in implementation of the Act.

(e) Demonstrate delivery of energy efficiency services as mandated in Act through private public partnership and

(f) Interpret, plan and manage energy conservation programs as envisaged in the Act.

BEE'S STANDARDS & LABELING PROGRAM

BEE's power and functions regarding Standards & Labeling are specified in the Act as follows:

(i) Notifying specified equipment and appliances:

(ii) Directing mandatory display of label on notified equipment and appliances;

(iii) Specifying energy consumption standards for notified equipment and appliances not confirming to standards;

(iv) Prohibiting manufacture, sale, purchase and import of notified equipment and equipment and appliances; and

(v) Developing testing and certification procedures and promote testing facilities for certification and testing of energy consumption of equipment and appliances.

Utility DSM affected by Restructuring:

The restructuring of the electric power industry may change electric utility DSM. Utilities that anticipate little growth in the use of DSM resources attribute this to increasing competition in the electric power industry. The fundamental characteristics of a restructured industry are:

- Generation revenues will be based on market prices for generation services, instead of through cost-of –service regulation.
- Customers increasingly will have access to flexible prices that reflect fluctuations in spot-market prices for generation.

These are characteristics of most models of a restructured electric power industry. The economic forces released by such changes could have significant impacts on 3 types of electric utility DSM energy efficiency, load building, and real-time pricing and other flexible load-shape programs.

Energy Efficiency in a Competitive Electric Power Market

As per study carried out for US Electric Utility Demand Side Management: Trends and Analysis

Energy-efficiency programs were designed in an IRP framework in which regulators required utilities to consider the benefits and costs of substituting such programs for the acquisition of new generation resources. In a deregulated competitive market, generating capacity will likely be added or retired based upon its marketability. Resource planning will become a competitive business function. This change is leading some commentators to question the continuing role of energy-efficiency programs. The resulting debate focuses on three issues:

- The ability of markets to capture cost-effective energy-efficiency opportunities.
- The costs of energy-efficiency programs in a competitive electric power market and the benefits of the programs to consumers and society.
- The rate impacts of energy-efficiency programs.

The Ability of Markets to Capture Cost-Effective Energy-Efficiency Opportunities

Technology-based evaluations suggest that many cost-effective energy-efficiency improvements are not rapidly adopted in the marketplace. For example, in 1990, the Electric Power Research Institute estimated that 20 percent of total U.S. electricity consumption could be saved with energy-efficiency measures costing less than 3.5 cents per kWh saved.[29] Others suggest much higher potential savings. Given the measures considered in such studies, it appears that consumers acting on their own do not adopt many commercially available and cost-effective efficiency measures. This finding is consistent with a second group of studies of actual consumer purchasing practices indicating that residential consumers act as if they severely discount the value of future energy savings when making energy-efficiency investments. A third group of studies examining commercial and industrial customer behavior found that such customers seldom undertake major energy-efficiency investments with more than a 2-year simple payback. For many measures, a 2-year payback implies that energy-efficiency investments have to produce an after tax return on investment of 30 percent or higher.

Economists, technologists, and social science researchers are engaged in a debate concerning the source of this non-cost-effective consumer behavior. Such behavior may be the result of barriers to the adoption of efficiency measures which represent real costs of efficiency improvements or failures of markets to operate efficiently. Energy-efficiency programs that remedy or offset genuine market failures could increase overall economic efficiency in comparison to competitive market outcomes. Three primary perspectives are being advanced in this debate.

First, some economists argue that there must be “hidden costs” associated with the adoption of efficiency measures. In some cases, this argument is offered as a simple tautology: markets are presumed to operate efficiently; therefore, the failure of markets to adopt efficiency measures must be attributable to some cost not considered in conventional benefit/cost analysis. At this level, the hidden cost position adds little to the debate since the answer is assumed in the premise of the argument. There may be hidden costs such as minor inconveniences or differences in performance associated with the adoption of some efficiency measures. There may also be hidden benefits such as small improvements in performance or conveniences that are not considered in conventional benefit /cost studies. The hidden cost hypothesis is at best incomplete in that there are cases, such as efficient lighting ballasts, refrigerators, personal computers, and televisions, in which there is little or no possibility of hidden costs, yet cost-effective efficiency measures are not widely adopted.

Second, some commentators relate the efficiency gap to uncertainty about future energy prices or other market conditions. In the face of uncertainty, an efficient consumer may put off making deferrable investments. Most energy-efficiency improvements are made as part of a decision to invest in new equipment or a new building. If decisions to adopt efficiency measures are not made at the time a building is designed or equipment purchased, the opportunity is effectively lost. For example, it is not practical to change the orientation of a building to reduce summer heat gains after it is built. Nor can the consumer obtain a more efficient refrigerator without purchasing a new one. The opportunity to make energy-efficiency improvements exists when a building or appliance is acquired. Such efficiency investments are not deferrable. In these circumstances, efficient consumers must make decisions at the time of purchase based on the expected outcome of their choices regardless of the extent of uncertainty about market conditions.

A third view advanced by other economists, supported by social science researchers, and implicit in the positions of many technologists is that part of the efficiency gap may result from market failures related to the nature of the information involved in evaluating energy-efficiency investments. Economists identify two types of market failures in consumer evaluations of energy-efficiency investments:

- Information on the energy use of many products and services is not readily available or evident to many consumers when making energy efficient investments. This also contributes to the difficulty of communicating the benefits of energy-efficient investments. Energy use can be a low priority for some commercial and industrial establishments where energy costs represent approximately 3 percent of their total costs.

- Consumers may lack the expertise necessary to gather, process, and apply information to make optimal energy-efficient choices. Additionally, recent experiments in economics show that consumers tend to repeat prior decisions when faced with unfamiliar choices and to avoid cost minimizing choices that have higher first costs.[40] In the market, such behaviour impedes the commercialisation of new energy-efficient technologies.

Such market failures may disproportionately impact the acceptance of new technology, limiting the ability of suppliers to achieve economies of scale, reduce product prices, and make energy-efficient technologies more competitive and widely available. They also may contribute to a more general market failure-new technology frequently has spillover benefits, making it difficult for the original developer to capture the full value of development and commercialization.

To the extent that market failures retard the commercialization of energy-efficient technologies, utility or government energy-efficiency programs can play an essential role in pulling new technologies into the market place.

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Material available on the subject in Draft Report of the Experts Committee on Integrated Energy Policy of Planning Commission, Govt. of India, All India Seminar on "Power Distribution Sector- Managerial issues Challenges & Solutions" held on 28-29 August 2005 at Hyderabad, Deliberation in the International Conference on Power Exchange held on 20.2.2008 at New Delhi, CERC Press release, Feb 4,2004, www.ficci.com, www.eia.doe.gov have been freely used in the preparation of this paper.