Energy Conservation and Demand Side Management in Power Sector Reforms

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Introduction

Since independence, our installed power capacity has increased from 1362 MW to over 140,000 MW and more than 500,000 villages have been electrified. However, it is a matter of concern that the annual per capita power consumption, at about 350 kWh is among the lowest in the world and there are widespread shortages of power in almost all parts of the country. A large number of villages have no access to electricity at all. Households, farmers, commercial establishments, industries etc. are confronted with frequent power cuts, both scheduled and unscheduled. Power cuts, erratic voltage levels and wide fluctuations in the frequency are common. The consumers are resorting to captive power supply arrangements.

To mitigate the acute shortage of power in the country, we are faced with the challenge to enhance end-use efficiency and manage the power demands of the country for sustainable and environment-friendly development. This paper analyses the power scenario of the country and suggests ways to improve the current power situation through sectoral reforms driven by energy efficiency and demand side management.

The present power scenario

The total energy shortage today is roughly 8 per cent of the total demand and the peak shortage is roughly 13 per cent of peak demand. Based on the demand projections made in a survey by the Ministry of Power, over 100,000 MW additional generation capacity needs to be added by 2012 to bridge the gap between demand and supply. The major reasons for inadequate, erratic and unreliable power supply are:

1. Inadequate power generation capacity
2. Lack of optimum utilization of the existing generation capacity
3. Inadequate inter-regional transmission links
4. Inadequate and ageing sub-transmission & distribution network
5. Large scale theft and skewed tariff structure
6. Slow pace of power reforms
7. Inefficient use of electricity by the end consumer

Based on a report of the Ministry of Power, a capacity addition target of 46,500 MW has been fixed for Central Public Sector Undertakings. At the State level, the SEBs/ State utilities and private sector will add another 41,800 MW. An integrated approach, including capacity addition through nuclear and non-conventional energy also has been planned in which 6400 MW would be added through nuclear power and 10,700 MW through non-conventional resources up to 2012.

Opportunities in the Power Sector

The large coal reserves in the country provide a ready and economical resource and ensure energy security. Hence, coal has been identified as the main fuel resource for power generation. Emphasis has been laid on setting up large pit head stations to avoid high costs associated with transportation of coal. Hydroelectricity is clean energy and its generation is not linked to issues concerning fuel supply, especially the price volatility of imported fuels. It enhances our energy security and is ideal for meeting peak demand. However, in this sector, less than one fifth of the vast hydel potential of 150,000 MW has been tapped so far. Compared to the high utilization of hydro potential in countries like Norway (58%), Canada (41%) and Brazil (31%), India utilizes only 17% of its hydel potential which is extremely low. The share of hydro generation in India has gradually declined during the past 25 years. Consequently, thermal generation, which should generally be used for base load operation, is also being used to meet peaking requirements. India has the potential to emerge as a major power producer because of the following:

1. Abundant coal reserves (enough to last at least 200 years)
2. Vast hydroelectric potential (150,000 MW)
3. Large pool of highly skilled technical personnel
4. Expertise in integrated and coordinated planning
5. Emergence of strong and globally comparable central utilities (NTPC, POWERGRID)
6. Wide outreach of state utilities
7. Enabling framework for private investors (Indian Electricity Act, 2003)
8. Political consensus on power reforms
9. One of the largest power markets in the world

The above strengths have to be leveraged and the integrated reforms processes under APDRP have to be pushed through at a determined pace to meet out the following objectives for integrated power sector development in our country:

1. 'Power for all by 2012'
2. Reliable and quality power at an economic price
3. Economically and environmentally sustainable power development
4. Promote general awareness to achieve consensus on power reforms

A comprehensive and integrated strategy is required after realistic assessment of our strengths and challenges facing the power sector. The strategy must integrate the supply side imperatives with demand side management, short and medium term measures with long-term action plans and operational measures with institutional and structural changes.

Capacity creation through Energy Efficiency & Demand Side Management

There is an estimated potential of 20, 000 MW through energy efficiency and Demand Side Management (DSM). Some of the performance improvement initiatives that could be taken in the power sector in this area:

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1. Use of beneficiated coal
2. Use of fluidized bed combustion boilers (super critical boilers)
3. Focus on Fly ash management
4. Predictive maintenance and pro-active maintenance
5. Renovation and Modernization measures using clean technologies
6. Improving transmission system and maintaining grid discipline
7. Implementing unified national grid

In order to minimize the overall requirement and cost of power, energy conservation and DSM have been accorded high priority. Some of the steps that could be taken to implement an effective programme in end-use energy efficiency and DSM are:

1. Installation of energy-efficient bulbs (CFL), tube lights and agricultural pumpsets
2. Installation of shunt capacitors in all DTs for power factor correction
3. Time of the day metering and differential tariff for peak and off peak hours (Introduction of time-of-the day tariff will induce industries to shift production from peak to off peak period)
4. Strengthening of sub-transmission and distribution network through R&M
5. Energy audit, accounting and load flow studies
6. Suitable mass awareness in energy conservation programmes

The benefits to be derived by promoting End-use Energy Efficiency and DSM are:

1. Possibility of availability of nearly 15,000 MW through end-use energy efficiency.
2. Saving potential of 30-35% each in industry and agriculture by retrofitting with efficient equipment / pump-sets.
3. Saving potential of 25-30% in Commercial / Government establishments and residential houses.
4. Energy efficiency/ conservation measures encourage consumers to use energy more efficiently, which will result in reduced energy consumption thereby reducing cost and increasing productivity.
5. Effective load management which will help in shifting electricity load from peak to off peak period.
6. Initiatives taken on the issue of matching time and load profiles will help manage the demand (especially peak demand) across different regions in accordance with the identified timings of high and low demands in different parts of the country

Legislation to promote Energy Efficiency

Enactment of an enabling legislative framework on energy conservation gives the Central and State Governments statutory powers for promoting and enforcing a regime of energy conservation in the country. The Energy Conservation Bill is a step in this direction and includes all forms of energy viz. coal, oil, nuclear, renewable sources etc. The salient features of the Bill are:

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1. Setting up of energy conservation standards for any equipment or appliance consuming, generating, transmitting or supplying energy.
2. Certain industries, establishments and users of energy to be notified as designated consumers keeping in view the intensity and quantity of energy consumed.
3. Mandatory energy audit for all designated consumers, as and when required by the designated authority.
4. Promotion of mass awareness at both the Central and the State levels for energy conservation, consumer education and guidance.
5. Government to take steps to encourage preferential use of energy efficient equipment and appliances.
6. Constitution of an Energy Conservation Fund at the Centre and the States for utilizing any grant or loans made available for promoting energy conservation.

Distribution Reforms and Energy efficiency

Distribution is the weakest link in the power supply chain. Huge T&D losses are a major cause of concern. Distribution reforms and Energy efficiency are inter-linked processes. In order to reduce the T&D losses, and thereby improving energy efficiency, the following measures have to be taken in right earnest:

1. **100% metering and AMR**: Installation of meters at all the transformation stages and in the premises of consumers, with the provision for accurate meter reading, will help to operate on the concept of "cost and profit centre".
2. **Static (electronic) meters:** Installation of static meters on all 11 KV out-going feeders and distribution transformers (DTs)
3. **Effective Management Information System (MIS)**: Both feeder and DT static meters will record active energy, power factor and load information. The data recorded in the static meters can be down loaded to a computer network and software packages will be effectively utilized to process the data for meaningful management of the distribution system. An effective MIS ensures effective flow of information to facilitate quick decision-making and to improve the operation and management of the distribution system.
4. **Total energy accounting**: The energy received in each 11 kV sub-station and 11 kV out-going feeders; energy billed and T&D losses at each of the distribution transformer shall be accurately accounted for. The implementation of energy audit and accounting system, with billing unit at subdivision level as the nodal point, the problem of commercial losses can be solved. This will help fix proper responsibility at the sub-divisional, divisional, circle and zonal levels.
5. **Installation of capacitor banks & network reconfiguration**: Installation of capacitors at all levels; reconfiguration of feeder lines & distribution transformers in such a way as to reduce the length of LT lines (to reduce technical and commercial losses) and make the system less LT oriented
6. High Voltage Distribution System & re-conductoring: Installation of smaller size energy efficient distribution transformers so that each transformer supplies power to 10 to 15 households only; re-conductoring of over loaded sections; development of digital mapping of the entire distribution system and load flow studies for better energy management.

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